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Pairing Fruit and Vegetables to Promote Consumption in Elementary School Cafeterias

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ABSTRACT

Purpose/Objectives
This study evaluated a behavioral economic strategy which paired a fresh cold fruit and cold vegetable to increase consumption of vegetables among elementary school children.

Methods
The 14-day study was conducted in 12 public elementary schools in a suburban school district, which follows the offer model allowing students to select either a fruit or vegetable. The percent of students who consumed the target vegetable was measured and compared between 6 experimental and 6 control schools using a logistic regression framework. Odds ratio tests were used to determine how much more likely a student at an experimental school was to consume the cold vegetable in comparison to a student at a control school.

Results
For all visits, the ratio was significantly larger than one. The probability of consuming the cold vegetable was 1.4 to 2.9 times greater at the experimental schools.

Applications to Child Nutrition Professionals
When a fresh cold fruit was paired with a cold vegetable as one unit, students in elementary schools significantly increased their consumption of vegetables. Strategies for encouraging students to take healthy options is an effective first step in increasing consumption of these items.

Keywords: childhood obesity; behavioral economics; school food policy; fruit and vegetables

INTRODUCTION

With the rise in childhood obesity over the past two decades, public health advocates and nutrition experts have focused on the school environment (Ogden, Carroll, Kit & Flegal, 2014; National Center for Health Statistics, 2011). Schools have a powerful influence on students' eating behaviors (Story, Nanney, & Schwartz, 2009), and by changing the school menu and food offerings, there is an opportunity to create a culture of healthful eating practices where children may receive up to three meals daily (Story, Kaphingst, Robinson-O'Brien, & Glanz, 2008). Clearly, since school cafeterias serve an estimated 95% of children and adolescents nationwide, they are regarded as an optimum setting for improving children's health.

The school food environment is considered a partner in the national efforts to decrease childhood obesity rates (Jaime & Lock, 2009). School nutrition policies may address school meals that meet U.S. Department of Agriculture (USDA) standards and that encourage students to make healthful choices (Briggs, Mueller & Fleischhacker, 2010). At the policy level, the federal government has taken strong steps toward improving childhood nutrition in schools. As required by the Healthy, Hunger-Free Kids Act of 2010 (HHFKA), USDA updated school nutrition standards to align with the 2010 Dietary Guidelines for Americans (USDA, & U. S. Department of Health and Human Services, 2010). The new standards, which were first implemented in the 2012-2013 school year, focus on increased fruit, vegetable, and whole grain menu offerings, along with a decrease in sodium, high-fat, and sugar-sweetened foods (USDA, 2017).

There are different ways to combat obesity. Higher fruit and vegetable consumption has been linked to lower incidences of obesity (Rolls, Ello-Martin, & Tohill, 2004). Fruit and vegetable consumption leads to overall improved child development, weight management, and higher academic scores (Mikkelsen, Chehimi, & Cohen 2007; Florence, Asbridge, & Veugelers, 2008; Basch, 2011). Unfortunately, children's consumption of fruits and vegetables is much lower than recommended guidelines (Hockesin, 2010), and furthermore, studies have shown that children from lower socioeconomic status families consume significantly less fruits and vegetables than their counterparts (Rasmussen et al., 2006, Epstein et al., 2001).

Now that healthier options are being offered to children within the school environment, it is critical for health professionals to nudge or influence students to make healthier lunch choices. The field of behavioral economics combines psychology and economics and assesses strategies that can help shape one's behavior while being economically efficient.

With healthier options replacing some of the more familiar, typically unhealthy choices to which students may be more accustomed, many school nutrition personnel and school districts are concerned about plate waste. Plate waste is costly to school districts and the environment, as well as the students, who are missing the opportunity to consume nutrient-rich foods (Cohen et al., 2013). However, one study determined that the new standards do not lead to more plate waste and students are consuming more fruits than before (Schwartz, Henderson, Read, Danna, & Ickovics, 2015).

Within the school lunch setting, previous behavioral economic strategies that have had success increasing fruit and vegetable consumption include the following: 1) rearranging the food items to make the healthier options more accessible and convenient (Just & Wansink, 2010); 2) attaching stickers of cartoon characters to the fruits/vegetables (Brunt, Bezbaruah, & Stastny, 2012; Belot, Jonathan, & Nolen, 2014); 3) verbal encouragement from cafeteria staff (Schwartz, 2007); and 4) pre-slicing the fruit (Wansink, Just, Hanks, & Smith, 2013). Furthermore, exposure is a critical component to increasing vegetable consumption among children. The more a child tastes a novel food, the more he/she will tend to develop a liking for that food. Studies have shown that children may need 6-10 exposures to a certain food before they start enjoying it (Anzman-Frasca, Savage, Marini, Fisher, & Birch,2012; Lakkakula, Geaghan, Zanovec, Pierce, & Tuuri, 2010; Williams, Paul, Pizzo, & Riegel, 2008; Wardle et al., 2003). Other studies have shown that the use of small, repeated taste tests could increase vegetable consumption among children (Lakkakula, et al., 2010; Cooke, 2007).

Behavioral economics suggests that the appearance of choice in making decisions about a certain behavior can lead to a positive association with the outcome (Hakim & Meissen, 2013; Wansink,

2013). Choosing among a variety of healthful foods in the cafeteria setting can teach students how to make healthy decisions outside of school as well. Hakim et al. (2013) determined that when students are served a meal with a fruit and then given the choice of selecting between multiple vegetables, or vice versa, students will consume significantly higher amounts of both fruits and vegetables.

In 1981, the policy of "offer versus serve" was created under the National School Lunch Program to promote a well-balanced diet while reducing plate waste and improving efficiency for the cafeteria operations. The traditional "serve" policy required students to take all of the served meal components. Due to concerns over plate waste, schools were allowed to follow an offer vs. serve model which allowed students to choose three out of five meal components: grain, protein, fruit, vegetable, and milk (HHFKA, 2010). More recently, that policy was updated so that students are required to take three components including ½ cup of a fruit or vegetable to qualify for a reimbursable meal (USDA-FNS, 2015).

Past research indicates that student consumption of fruit is consistently higher than vegetables. Fox, Clark, Condon, and Wilson (2009) used the Healthy Eating Index 2005 to assess diet quality of elementary school children compared to the 2005 U.S. Dietary Guidelines. They reported that fruit intake was 82% of the maximum possible score compared to vegetable intake at 38%. Further, dark green and orange vegetables had a very low score of 10%. This indicates that students tend to select a fruit over a vegetable in the cafeteria line and are not likely to consume dark green and orange vegetables that provide different nutrients compared to fruit.

In addressing the childhood obesity epidemic, the new school lunch program standards and behavioral economic research are creating cafeteria environments that influence children to select and consume healthier foods. Yet, vegetable consumption is very low among elementary school children and a higher intake of fruit and vegetable is inversely related to obesity. Novel approaches to introducing students to dark green and orange vegetables are needed in the school cafeteria. One novel approach is to pair fruits and cold vegetables as one unit. Placing both the fruit and vegetable on the students' trays may encourage consumption of both items.

This current study evaluated a hybrid version of the "offer versus serve" model in a school district that normally uses the offer model. The goal was to increase vegetable consumption without displacing fruit consumption. Generally, students would have a choice of selecting the fruit, cold vegetable, or hot vegetable. In this case, students had the choice of selecting the hot vegetable and/or a fruit/vegetable combination that included a serving of fresh fruit and a cold vegetable packaged together in a clear, pint-sized bag with a sticker on the front. The hypothesis was that the pairing technique would increase the percent of students who take and consume a cold vegetable while not decreasing consumption of the fruit.

METHODOLOGY

Participants

The study was conducted in grades Pre-K-5 in 12 public elementary schools in a suburban school district during Spring 2015. Data collectors tracked fruit and vegetable consumption over 14 days, on Tuesdays and Wednesdays, for seven non-consecutive weeks, compiling a total of 33,781 student-meal observations. Baseline data were collected for two days in all schools, and consumption was measured for each cold vegetable, hot vegetable, and fruit. The 12 public elementary schools followed the standards issued by USDA that require all schools offer a fruit and vegetable daily for lunch. The school district utilizes an offer model; therefore, students are

required to take either a fruit or a vegetable in order to qualify for a reimbursable meal. Students who pay full price for meals are not bound by this provision.

Study Design

The technique of pairing a fresh cold fruit with a cold vegetable was used in six experimental schools. The fruit and cold vegetable were packaged together in pint-sized, clear, plastic bags. Examples of a paired fruit and vegetable include an apple with baby carrots or an orange with pepper strips. Attractive, age-appropriate stickers were placed on each bag to entice students to take the bags. Students were allowed to make the choice of selecting the packaged bag and/or the hot vegetable; however, individual servings of fruit or cold vegetables were not available at the experimental schools. Schools were assigned to be control or experimental at random and remained under this classification for the entirety of the study. The schools were comparable in a number of ways: student enrollment, demographics, geographic location, percent free and reduced-price lunch eligibility, academic proficiency scores, and National School Lunch Program participation rates (Table 1).

Consumption data were collected using a smartphone application called "V-Project," developed by Dr. Joseph Price at Brigham Young University (Brigham Young University, 2015). The application allows the data collector to input school information, and non-identifying student information such as grade and gender and the entrée for the day, as well as individual items served. Consumption of these items is measured on a sliding scale from 0-100 %. For the current study, data collectors recorded each student's fruit and vegetable consumption.

Study Procedures

Data collectors were stationed in the cafeteria during the entire lunch period. Once a student finished his or her lunch and approached the waste bin, the data collectors recorded: 1) whether the student took the packaged cold fruit and vegetable, and 2) the amounts consumed of both the fruit and vegetable. Data was collected on consumption of each individual fruit and vegetable. If the student selected the fruit or vegetable, but did not eat the fruit and/or vegetable, it was recorded as "0 %." Any consumption greater than zero (i.e. one bite) but less than the entirety of the portion was marked as "50 %," and full completion of the serving was marked as "100 %." Therefore, consumption was defined as consuming 50-100 % of the food item. In previous research, this half-waste method yielded the best inter-method reliability for visual measurement with a proven .83 reliability measure of vegetables based on three vegetable food items (Hanks, Wansink, & Just, 2014). Using the app, data collectors noted students who did not take a fruit or vegetable, and these students were recorded as zero consumption. Data collectors were trained on the V-project application prior to the study including verbal instructions and hands-on practice with the application for visually measuring consumption. Two data collectors were assigned to each school.

Following baseline collection, the fruit and cold vegetable were bagged together in a clear, plastic bag with an attractive sticker by the school nutrition staff at the experimental schools. The bags were presented in the same location where the fruits and vegetables would normally be served in the lunch line. This pairing occurred twice per week (on Tuesday and Wednesday) for four consecutive weeks, followed by a week break for spring break, and then again for two consecutive weeks. On average, approximately 300 bags were used at each experimental school during each intervention visit. In the control schools, fruits and vegetables were offered as usual.

Table 1. ***Description of All Experimental and Control Schools***

School Name	Total Students	Average Student Meal Observations	Total School Meal Observations	Demographics	Free/Reduced Rate (%)	Breakfast Participation (%)	Lunch Participation (%)
Experimental							
School E-1	570	242	3,389	Hispanic (42.9%); White (29.8%); Black (13.1%)	50.7	18.4	54.0
School E-2	549	252	3,524	Hispanic (44.9%); White (36.0%); Black (8.9%)	55.6	19.3	59.2
School E-3	729	193	2,706	Hispanic (52.3%); White (36.2%); Black (5.0%)	35.0	11.3	52.8
School E-4	406	170	2,380	Black (39.8%); Hispanic (30.3%); Asian (16.2%);	65.0	21.8	60.9
School E-5	678	205	2,867	Hispanic (52.2%); White (33.3%); Black (5.6%)	41.9	15.2	58.0
School E-6	700	211	2,954	White (43.8%); Black (18.8%; Hispanic (16.4%)	29.6	11.4	49.2
Control							
School C-1	568	181	2,353	White (61.4%); Hispanic (13.8%); Asian (11.3%)	20.8	8.6	37.9
School C-2	498	228	3,192	Hispanic (48.8%); White (25.7%); Asian (10.8%)	59.6	25.8	61.7
School C-3	424	151	2,110	Hispanic (39.3%); White (30.6%); Asian (14.3%)	56.6	34.8	65.2
School C-4	638	185	2,586	Hispanic (35.1%); Black (31.9%); White (20.6%)	58.0.	19.8	66.3
School C-5	565	184	2,580	White (64.4%); Hispanic (15.0%); Asian (8.4%)	17.9	6.4	41.5
School C-6	429	224	3,140	Hispanic (55.6%); Black (21.1%); Asian (11.9%)	77.2	19.5	74.2

Data collection methods at all twelve follow-up visits were identical to baseline measurement. Consumption data were aggregated in the same manner and compared to baseline to assess the effect of the intervention. Odds ratios comparing the odds of vegetable consumption (50% or 100% versus none) in the experimental group to the control group were estimated at each baseline and follow-up time using the logistic regression formulation of the two-way contingency table. With large sample sizes and independent assignment of treatment groups, researchers used the asymptotic normal distribution of the coefficient estimate for hypothesis tests and confidence intervals. The university's Institutional Review Board approved this study.

RESULTS AND DISCUSSION

Estimates of the odds ratio for the baseline visits provided evidence that the students were less likely to consume the cold vegetable at the experimental schools (Table 2; odds ratio < 1). For all follow-up visits, the tests showed evidence that the ratio is significantly larger than one, supporting the effect of the experiment and specifically estimating that the probability of consuming the cold vegetable when packaged with a cold fruit was 1.4 to 2.9 times greater at the experimental schools. Individual model fit assessments using the Hosmer-Lemeshow goodness of fit test gave no evidence of model deficiencies.

Table 2. ***Estimated Odds Ratios of Vegetable Consumption Comparing Experimental to Control Schools from Separate Logistic Regression Models***

Visit	Odds Ratio	95% Confidence Interval	*p*-values
Baseline 1	0.67	(0.51, 0.95)	.011
Baseline 2	0.50	(0.39, 0.65)	<.001
Follow-up 1	2.44	(1.91, 3.14)	<.001
Follow-up 2	1.78	(1.42, 2.23)	<.001
Follow-up 3	1.37	(1.06, 1.79)	.010
Follow-up 4	1.52	(1.19, 1.95)	.001
Follow-up 5	1.41	(1.04, 1.93)	.015
Follow-up 6	1.59	(1.29, 1.97)	<.001
Follow-up 7	1.69	(1.32, 2.17)	.001
Follow-up 8	1.47	(1.16, 1.86)	.001
Follow-up 9	2.88	(2.23, 3.75)	<.001
Follow-up 10	1.78	(1.37, 2.30)	<.001
Follow-up 11	2.35	(1.73, 3.20)	<.001
Follow-up 12	1.41	(1.10, 1.81)	.001

*Odds ratio = the estimated odds of vegetable consumption at visit time for experimental group divided by the odds of vegetable consumption at visit time for control group.
+ The *p*-value tests for differences in the odds of vegetable consumption between the experimental and control groups.

Additionally, for each school, average cold vegetable consumption was calculated for comparison between baseline and follow-up visits. This process was also repeated for fruit consumption. Tables 3 and 4 display the average consumption of cold vegetables and fruits at each of the schools for baseline and follow-up visits. When baseline and follow-up percentages were compared at control schools, cold vegetable consumption did not tend to increase and stayed fairly consistent for five of the six schools. At the experimental schools, cold vegetable consumption increased substantially at four of the six schools. For the two other schools, cold vegetable consumption slightly increased at one and slightly decreased at the other (5-E). The slight decrease at this school may be attributed to the fact that additional fruit was available in a fruit bowl on the line in addition to the pairing technique.

Table 3. ***Percent of Students Consuming Vegetables and Fruit at the Control Schools***

	Cold Vegetable		**Fruit**	
School	**Average Baseline** (%)	**Average Follow-Up** (%)	**Average Baseline** (%)	**Average Follow-Up** (%)
C-1	11.85	11.81	32.22	37.06
C-2	6.72	6.32	31.38	43.22
C-3	23.68	9.39	30.41	39.20
C-4	14.48	16.23	35.52	46.78
C-5	12.63	12.83	36.29	34.38
C-6	10.44	9.25	67.36	61.08

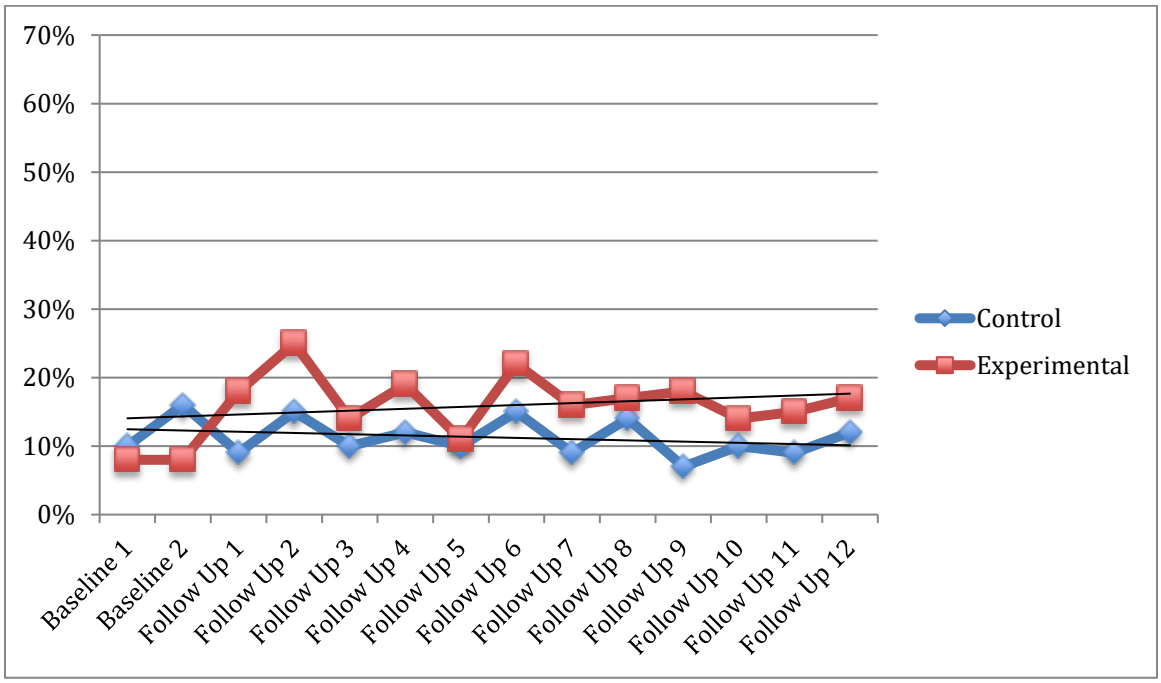
Table 4. ***Percent of Students Consuming Vegetable and Fruit Consumed at the Experimental Schools***

	Cold Vegetable		**Fruit**	
School	**Average Baseline** (%)	**Average Follow-Up** (%)	**Average Baseline** (%)	**Average Follow-Up** (%)
E-1	4.30	18.51	54.12	42.85
E-2	13.54	20.14	54.75	55.66
E-3	5.76	20.14	45.68	48.11
E-4	6.44	16.27	53.66	48.50
E-5	13.03	11.76	29.91	36.95
E-6	9.09	11.41	40.26	32.15

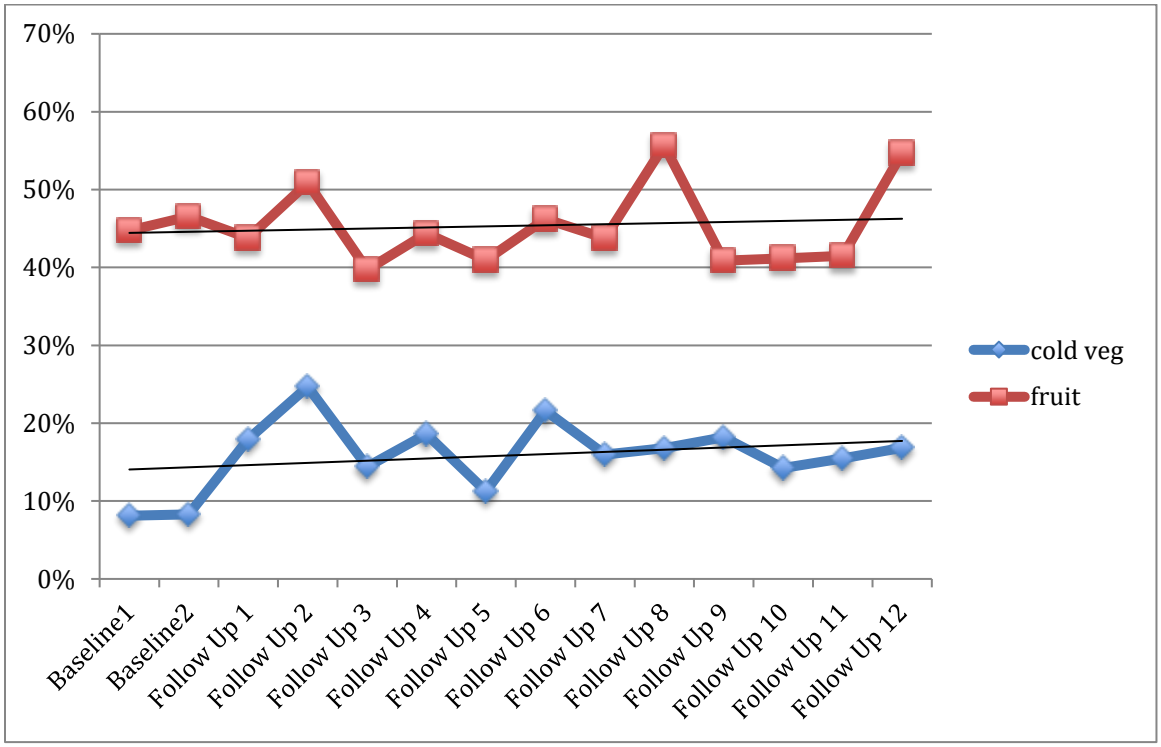
Graph 1 displays the percentage of students from all experimental schools and control schools who tasted or ate all of the cold vegetable by the week of the intervention. Cold vegetable consumption spiked at experimental schools during the first week of intervention and then declined; however, vegetable consumption still remained higher throughout the entirety of the study at experimental schools in comparison to the control schools.

Graph 2 displays cold vegetable and fruit consumption at experimental schools for all 14 days of the study. While cold vegetable consumption had an upward trend from baseline to follow-up, fruit consumption did not decrease; therefore, higher consumption of the cold vegetables did not

necessarily lead to a reduced consumption of the fruit. Aside from the fifth follow-up visit, cold vegetable consumption for all other follow-up visits is clearly higher than either of the two baseline visits, when lunch was offered as normal.



Graph 1. ***Percent of Students Consuming Cold Vegetable at Control & Experimental Schools***



Graph 2. ***Percent of Students Consuming Cold Vegetable and Fruit at Experimental Schools***

Results indicate that the packaging technique significantly increased cold vegetable consumption at the experimental schools compared to the control schools while not changing the consumption of fruit. The spike in cold vegetable consumption at experimental schools during the first week could be expected; the bags with stickers were new to the students and possibly influenced their desire to take the package. However, it is noteworthy that the cold vegetable consumption was nearly twice as high in each of the follow-up weeks at the experimental schools compared to the baseline week. Additionally, the increased consumption of the cold vegetable at the experimental schools did not replace or reduce the fruit consumption significantly.

At one of the experimental schools (E-5) a "fruit bowl" was an option in addition to the bagged fruit and vegetable pair for 6 of the 12 days of the intervention. The fruit bowl contained different fruits from which students could select a fruit choice. Data for the 6 days from this school were discarded as a result.

During the follow-up periods, there were some limitations on a visit-by-visit basis. For Follow-up 5, there was no cold vegetable served at two of the control schools (C-5 and C-6), and at one of the experimental schools (E-3) the fruit and cold vegetable were not bagged. On Follow up 6, no hot vegetable was served in 11 of the 12 schools. Follow-up 10 was an early-release day for all schools in the district, which made for a shorter lunch period.

CONCLUSIONS AND APPLICATION

This approach of pairing a fruit and vegetable in the school cafeteria line showed a significant increase in cold vegetable consumption. Previous research has shown fruit consumption to be higher than vegetable consumption for elementary school children (Fox, et al., 2009); therefore, pairing a food that students regularly select with a food that they rarely select may be an effective strategy for increasing consumption of dark green and orange vegetables. The concept behind behavioral economics is to nudge or influence students to select healthful foods. When a fruit was paired with a cold vegetable in this study, students were not forced to select between the items, and with both items on their tray, consumption of vegetables significantly increased.

While the packaging technique significantly increased cold vegetable consumption, this method requires more time and labor from the cafeteria manager and staff; however, the results of this study can pave the way for more practical opportunities. Changes can be made at the policy level, where students are required to take a fruit and a vegetable. In that case, they are still empowered to make a choice between the hot and cold vegetables. Another possibility is requiring the school meal vendor to pre-package the fruit and vegetable together, although this could increase costs.

In a review of potential determinants of fruit and vegetable intake, Blanchette and Brug (2006) stated that a multi-level approach is the best way to increase fruit and vegetable consumption. In addition to changes made within the cafeteria setting, incorporating nutrition education, a parent-home element, and computer programs, can have a positive impact (Blanchette & Brug, 2006). This approach is costly and not practical to incorporate into a majority of schools in our country; therefore, according to French and Stables (2006), the most cost-effective component, which can have a bigger impact on a larger population, is making small changes to the cafeteria environment to nudge children towards healthier choices.

A child's dietary habits are complex in nature; there are many factors that can influence a child's food choice. Having recess before lunch has been found to significantly increase fruit and vegetable consumption (Price & Just, 2015). Time is another factor that can have an effect on fruit and vegetable consumption. A recent study determined that students who had more time to eat had significantly increased consumption of the milk, entrée, and vegetable (Cohen et al., 2015). Additionally, a school's health culture, which can consist of nutrition and physical activity posters, lunch monitor and teacher encouragement, and quality of food, can strongly influence a student's lifestyle. In this study, the large sample size and significant increases in vegetable consumption are important outcomes. Evaluating various behavioral economic strategies within an elementary school cafeteria, such as this packaging technique, can help inform future interventions in combatting the childhood obesity epidemic.

There are limitations to the data included in this study. The V-project app experienced technical difficulties; some data collectors recorded data manually for one day and entered it into the app at a later date. Additionally, much variation existed among the fruit and vegetable items served from school to school. While a district-wide menu is available, the cafeteria manager may serve different or additional items depending on foods available in the kitchen.

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