Volume 44, Issue 2, Fall 2020

Journal of Child Nutrition & Management

Published by School Nutrition Association

FUN FACTS ABOUT FRUITS AND VEGETABLES CAN IMPROVE CONSUMPTION

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ABSTRACT

PURPOSE/OBJECTIVES

Fruit and vegetable (F/V) consumption among children continues to be lower than recommended. This study tested the effectiveness of nudges using fun facts about F/V on F/V consumption by elementary school students in grades 1 through 5. The study hypothesis is higher F/V consumption with nudges.

METHODS

The design was a randomized comparison of F/V consumption with use of nudges to that without the nudges. Unlike previous studies, the intervention effectiveness was tested in two adjacent school districts in Georgia that differed in terms of socio-economic status (SES) of the students served. Four schools were selected from each school district to participate in the study. Two schools in each district were assigned to the control arm and two to the intervention arm. Fun facts about a select list of F/V were developed and communicated to intervention arm students using table tents. F/V selection and consumption were observed in both arms.

RESULTS

A total of 7,112 trays was observed across all eight schools. Consumption of F/V after nudges increased by 0.14 servings (p <0.001) in the two intervention schools of the district with higher SES. The intervention impact was significant when fewer F/V choices were offered in participating school lunchrooms. Increase in consumption of F/V after nudges was not significant in the district with low SES.

APPLICATION TO CHILD NUTRITION PROFESSIONALS

Our study concludes that using fun facts about F/V can increase their consumption, yet impact is not consistent among schools districts that serve students in different SES. Findings in this study showed students in districts with higher SES reacted positively to fun fact nudges with increased consumption of F/V.

KEYWORDS: elementary school lunchroom, nudges and choice architecture, fruit and vegetable consumption, socio-economic status of the students served, school nutrition

INTRODUCTION

Children's fruit and vegetable intake in the United States (US) is low, as only close to 9% and 2% of high school students meet the recommended consumption of fruits and vegetables (F/V), respectively (Moore, Thompson, & Demissie, 2017). The low rate of F/V consumption is alarming because these foods are increasingly identified as protective against multiple chronic disease conditions (Boeing et al., 2012; Wang et al., 2014). Furthermore, food preferences take shape early in life and continue into adulthood (Devine, Connors, Bisogni, & Sobal, 1998; Vetura & Worobey, 2013). School lunchrooms are a prime location for establishing healthy eating habits and promote consumption of F/V. Federal policy related to school lunch programs regulates the *availability* of F/V; however, availability does not ensure *consumption*. Some studies found no increase in plate waste after the most recent changes in the federal policy pertaining to F/V availability in school lunchrooms, with some reported increases in fruit consumption after the Healthy Hunger Free Kids Act of 2010 (Schwartz, Henderson, Read, Danna, & Ickovics, 2015). Yet other research shows F/V may not be chosen and consumed by children with resultant food waste with one study estimating 26% of the total school food budget lost to food-waste annually (Cohen, Richardson, Austin, Economos, & Rimm, 2013).

Although children's diets are affected by a multitude of factors, familiarity and fondness for F/V play a key role in F/V consumption (Aldridge, Dovey, & Halford, 2009; Appleton et al., 2016). Children often will demonstrate an attentional bias, which in the case of unfamiliar F/V stimuli leads to an unwillingness to try new foods (Maratos & Staples, 2015). Conversely, when food is associated with positively viewed objects and ideas, children may become more interested in the food. The appearance of popular cartoon characters on packaging has been found to increase children's taste evaluations, no matter the health content of the food (Roberto, Baik, Harris, & Brownell, 2010). Likewise, small toys or other rewards were found to increase uptake of healthy snacks by children in a variety of school settings (List & Samek, 2015; Thapa & Lyford, 2018).

Using positive messages and avoiding conflict or pressure to eat F/V are important considerations when developing approaches to encourage consumption of these foods. Past work has shown parental and societal pressure to consume F/V often lead to decreased consumption of F/V (Galloway, Fiorito, Lee, & Birch, 2005; Stok, De Ridder, De Vet, & De Wit, 2014; Vereecken, Rovner, & Maes, 2010), yet when consumers feel they make their own decisions, satisfaction with the decisions made is higher (Botti & McGill, 2006). In studies using a randomized control design, children who were subtly encouraged (although not coerced) to try an unfamiliar vegetable consumed more of it (Finkelstein & Fishbach, 2010; Guerrero, Olsen, & Wistoft, 2018; Maimaran & Fishbach, 2014; Raghunathan, Naylor, & Hoyer, 2006; Thapa & Lyford, 2018; Wardle, Herrera, Cooke, & Gibson, 2003). As such, nudging approaches that preserve choice and highlight favorability of the food without emphasizing health could be used to increase F/V consumption by children (Kraak & Story, 2015; McKinley et al., 2005; C. A. Roberto, Pomeranz, & Fisher, 2014), primarily those between the ages of 2-12 (Kraak & Story, 2015). In the present study, we developed and tested the impacts of subtle, nudge-providing, non-nutrition related fun facts about F/V on the selection and consumption by elementary school children of fresh F/V already available and served in the school lunchroom as part of the National School Lunch Program (NSLP) reimbursable meal. The fun facts were intended to increase children's familiarity with, and positivity toward the F/V rather than communicate their nutritional value (McKinley et al., 2005). The study hypothesis is higher F/V consumption will occur with nudges.

METHODOLOGY

PARTICIPANTS

This study targeted students participating in the NSLP at eight elementary schools, four schools each from two adjacent school districts located in Northwest Georgia. The school districts were purposively selected based on the differences in the socio-economic status (SES) of the enrolled students. One of the two school districts was community eligible, i.e., all students in schools throughout the district received a free NSLP lunch. See Table 1 for details on participating schools. Schools that participated in the study were selected in collaboration with each district's School Nutrition Director (SND). The SNDs confirmed that the schools selected were not currently participating in any other federal, state, or local program that could influence F/V consumption, such as the Fresh Fruits and Vegetables Program. Four schools in each district were randomized into an intervention or control group with two schools in each arm. The control schools received a delayed intervention following data collection. Neither research staff members nor the school partners were blinded to the intervention condition. All procedures involving human subjects were approved by the Human Research Protection Program at the University of Georgia and the district administration--more specifically the data and research office at participating schools. The study received a waiver of written consent, meaning a signed approval from the parent for the child to participate in the research was not collected. Although kindergarten students in the participating elementary schools were exposed to the intervention, data collection and analysis were conducted only for students in Grades 1 through 5.

Table 1: *School characteristics (2015/2016) by treatment group in study school districts (two districts with four schools in each district and two schools in each arm).*

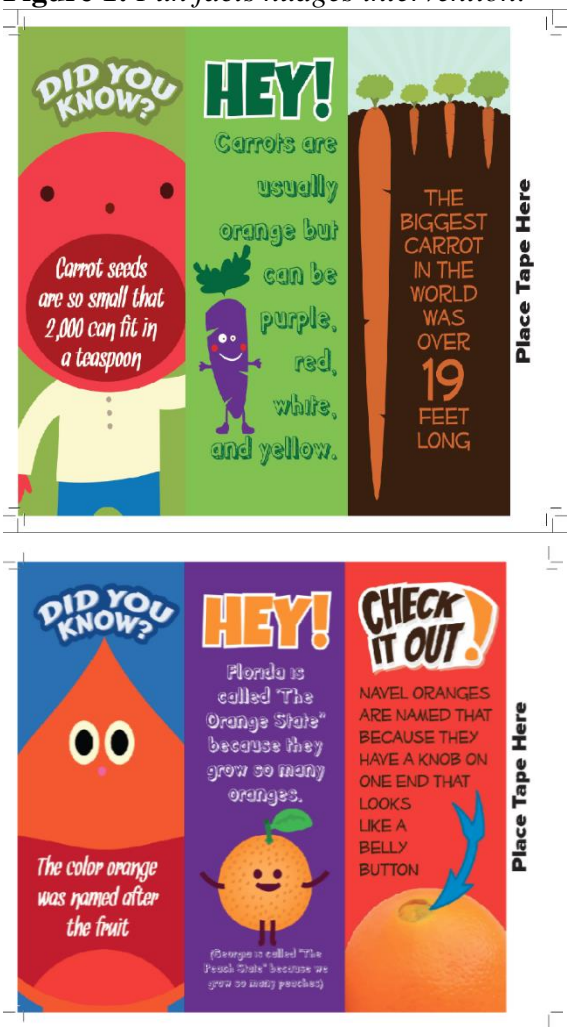
	Community Eligible District				**Non-Community Eligible District**			
	Control schools n=2		Intervened schools n=2		Control Schools n=2		Intervened schools n=2	
Total number of students (N)	557	387	519	575	497	350	338	349
Reduced or free lunch participation (%)*	Free lunch to all students due to Community Eligible Provision				66	78	76	68
Gender (%)								
Male	53	53	51	54	52	53	49	48
Female	47	47	49	46	48	47	51	52
Race (%)								
Asian	6	0	2	3	2	1	2	1
African American	43	80	42	49	8	4	5	1
Hispanic	4	14	12	8	13	10	23	23
White	43	3	40	35	74	81	67	71
Two or more	4	4	5	5	3	4	2	3

Source: http://nces.ed.gov/ccd/schoolsearch/ and * 2015 data received from School Nutrition Director.

INTERVENTION

The intervention involved nudging F/V consumption by using fun facts about the F/V options commonly served in the schools' lunchrooms. First, a list of fresh F/V served in both participating school districts was compiled in consultation with the SNDs. The fresh F/V list did not include F/V from the school gardens. Four fruits and four vegetables were then randomly selected from the list of F/V commonly served in both school districts and fun facts about these were developed. The selected F/V items were apples, bananas, oranges, watermelon, broccoli, carrots, string beans, and tomatoes. The psychologist on the team developed a list of fun facts for each F/V, taking care that the facts did not emphasize nutrition. The final set of three facts per F/V item was selected by the research team after pre-testing with four elementary school students from a different school district. Selection of the fun facts was based on criterion children in the pre-test reported as being the most fun. The fun facts were reviewed and approved by the SNDs, and met reading level appropriate for the third grade. Table tents were used as the medium to communicate the fun facts about each F/V. Table tents were three-sided communicators similar to those frequently used by private industry to promote products. Graphics for the table tents used in this study were developed by a professional graphic designer.

Figure 1: *Fun facts nudges intervention:*



(a) sample table tents used to communicate the fun facts

(b) table tents on display in a school lunchroom.

A total of eight, three-sided table-tents were developed, one for each F/V, with one fun fact per side. During the intervention, two table tents, each representing a different F/V were placed in the center of each lunch table in the four schools assigned to intervention group (Figure 1). Following each meal, the table-tents were collected and shuffled. The table tents were on display for ten school days in each district: February 3rd to 16th, 2016 in the community eligible district and from September 28th to October 9th, 2015 in the other district.

DATA COLLECTION

An experimental design was used in this study. A pre-post randomized study with control and intervention groups was used. Per the design, data were collected pre- and post-intervention of exposure to fun facts messaging about F/V from each group. Each school was visited 2 to 4 times for an hour during lunchtime before and after the intervention period for plate waste data collection. Student confidentiality was maintained as the data recording did not involve the collection of student-level demographics that required surveying the student, such as race and age.

Under the NSLP, schools must either offer two options each of F/V, or serve at least one F/V with a goal of increasing offerings. This is a requirement for reimbursement from NSLP. In the participating schools, F/V were served in pre-portioned 4-ounce containers or as whole or cut fresh fruit items. This allowed observation of the number of servings selected and consumed through observing the empty containers or remains of fresh fruits (such as banana peels or orange rinds). All schools used offer versus serve. Data collection involved observations of servings of F/V selected, and identifying amounts consumed (whether selected and not eaten, selected and half-eaten, or completely eaten) from individual plates or trays of students during lunchtime. Data collection instruments and procedures were validated in previous work (Strohbehn et al. 2016; Thapa & Lyford, 2018). Research assistants that were trained in observing plate waste collected the data and were randomly scheduled at locations to limit researcher bias. Observation of plate waste occurred right before the end of each grade level's lunch period before students were excused from the table to take the trays or plates to the dish room or waste station. Researchers had received lunch schedules and table seating plans by grade level from schools' administration prior to data collection. Plate waste was observed from students in grades 1 through 5. Student characteristics of grade and gender were captured during plate waste observation.

MEASURES

The primary measures were servings of F/V selection and consumption. Servings in this study refer to either the pre-portioned quantity of F/V in school lunchrooms or whole fruit item serving, such as half a banana or apple. The measure of F/V selection was in increments of one serving as per NSLP guidance. The consumption measure was based on half-serving increments, with observations of plate waste noting whether selected and not eaten, selected and half-eaten, or completely eaten. Consumption was estimated visually, with rounding down and up where appropriate.

STATISTICAL ANALYSIS

Descriptive analyses were performed using parametric tests for independent samples to determine the differences between mean servings of F/V items selected and consumed by students across control and intervention schools. Paired tests by schools were used to examine mean differences from baseline to post-intervention. Difference-in-difference regression analysis was used to estimate the intervention impacts on F/V selection and consumption. Data from the control and intervention schools were pooled, and a multi-level generalized linear modeling regression was run by regressing each measure (separately) on the post-intervention period and intervention site interaction term. The interaction coefficient provided a difference-in-difference

estimate of relative change between the control and intervention schools. Similar methods have been outlined and applied in impact evaluation research in school settings (Kristal & Ollberding, 2012; Price & Just, 2015; Thapa & Lyford, 2018). This method allowed for the determination of whether the changes in the selection and consumption of F/V in the intervention schools were statistically different from those in the control schools. We used schools as the random effect, as the measures are nested at the school level. The difference-in-difference analysis assumes that the pattern observed in the control schools provides an accurate estimation of what would have happened in the intervention schools without intervention. We accounted for differences in the control and intervention schools in the baseline and post display period by including a binary variable, 1 for the post-intervention period, 0 if otherwise. The model also includes grade (1st through 5th grade), gender (male and female), and day of the week (Monday through Friday) fixed effects to account for differences in the study measures due to day of the week, gender, and grade level. The standard errors were clustered at the school level. All the models were run separately for the two school districts. Significance was reported at a p-value of 0.05. We used Stata SE 15 for all statistical analyses.

RESULTS

The total number of trays observed during pre- and post-intervention periods was 1,716 and 1,764, respectively, in the district with community eligible schools, and 1,436 and 2,196 trays in the other district. Mean servings of F/V selected during pre-intervention were significantly different across control and intervention schools in both the districts with mean servings of F/V selected higher in the intervention schools compared to control schools (1.8 vs. 1.5, p value <0.001) in the community eligible district while mean servings of F/V selected in the intervention schools was lower compared to control schools (1.5 vs. 1.4, p value = 0.024) in the non-community eligible district. The mean F/V consumed (0.6 F/V servings) in the post-intervention period was lower than that during the pre-intervention period (0.8 F/V servings, p value <0.001) in the control schools but pre-post intervention consumption of F/V was not significantly different in the intervention schools of the non-community eligible district (Table 2).

Table 2: *Pre- and post-intervention mean servings of fruits and vegetables (F/V) selected and consumed in control and intervention schools within study districts.*

		Control Schools			**Intervention Schools**			
	Intervention period	Trays observed	Mean	95%CI	Trays observed	Mean	95%CI	*p*
				Community Eligible District				
Servings of F/V selected	Pre-	812	1.5	1.4,1.5	904	1.8	1.6,1.9	<0.001
	Post-	776	1.6	1.6,1.7	988	1.7	1.6,1.7	0.399
	p		<0.001			<0.001		
Servings of F/V consumed	Pre-	812	0.7	0.7,0.8	904	0.8	0.7,0.8	0.225
	Post-	776	0.7	0.7.0.8	988	0.8	0.7,0.8	0.827
	p		0.979			0.306		
				Non-Community Eligible District				
Servings of F/V selected	Pre-	827	1.5	1.5,1.6	609	1.4	1.5,1.6	0.024
	Post-	1073	1.5	1.4,1.5	1123	1.5	1.4,1.5	0.949
	p		0.342			0.139		
Servings of F/V consumed	Pre-	827	0.8	0.7,0.8	609	0.6	0.5,0.6	<0.001
	Post-	1073	0.6	0.5,0.6	1123	0.5	0.5,0.6	0.743
	p		<0.001			0.557		

The p values in the last column reflect comparison of measures across control and intervention schools and the p values in the rows reflect comparison of repeated measures-paired t tests of F/V selection and consumption pre- and post-intervention. The reported are mean measures across the two schools in intervention and control arms within each district. We report 95% CI to provide range of the mean measures. All of the mean measures have been rounded to one decimal point.

The intervention impact was significant in the non-community eligible district and higher than in the community eligible district. There was an increase in the servings of F/V selected (0.17 servings per student with p value<0.001), and servings of F/V consumed (0.14 servings per student with p value<0.001) post-intervention, as shown in Table 3.

Table 3: *Difference-in-difference estimate of the intervention effect on servings of fruits and vegetables (F/V) selected and consumed from random effects model, including all covariates.*

	Community Eligible District		Non-Community Eligible District	
Dependent variable	Servings of F/V		Servings of F/V	
	selected	consumed	selected	consumed
Difference-in-difference estimate: Interaction of post-intervention period with intervention site	*-0.506*** (0.074)*	*-0.091 (0.059)*	*0.172*** (0.056)*	*0.140*** (0.044)*
Intervention period				
Post-intervention compared to Pre-	0.168*** (0.048)	-0.046 (0.039)	-0.115*** (0.038)	-0.199*** (0.029)
Grade (compared to 1st grade)				
2nd grade	0.005 (0.040)	-0.031 (0.032)	0.024 (0.039)	-0.045 (0.030)
3rd grade	0.027 (0.047)	-0.032 (0.038)	-0.042 (0.041)	0.019 (0.031)
4th grade	-0.007 (0.041)	-0.056 (0.034)	-0.026 (0.040)	-0.030 (0.031)
5th grade	0.038 (0.053)	0.038 (0.043)	-0.076 (0.041)	-0.057 (0.032)
Gender (compared to male)				
Female	0.118*** (0.029)	0.047** (0.023)	0.123*** (0.026)	0.065*** (0.020)
Day of the week (compared to Monday)				
Tuesday	-0.188*** (0.048)	-0.125*** (0.039)	0.347*** (0.048)	0.176*** (0.037)
Wednesday	0.262*** (0.041)	0.082** (0.033)	0.309*** (0.041)	0.237*** (0.031)
Thursday	-0.092 (0.060)	-0.150*** (0.049)	0.213*** (0.043)	0.200*** (0.033)
Friday	0.107** (0.054)	-0.008 (0.044)	0.620*** (0.044)	0.203*** (0.034)
Constant	1.551*** (0.124)	0.796*** (0.079)	1.220*** (0.075)	0.525*** (0.070)
Observations	3,480	3,480	3,632	3,632
Number of random effect groups	4	4	4	4

Standard errors are in parentheses. *** represent p value <0.01 and ** represent p value<0.05

The impact on F/V consumption is an increase of 19% from the mean baseline consumption of 0.75 servings for students in the non-community eligible district. Findings also showed higher F/V selection and consumption among female elementary school students. F/V selection and consumption was also different by day of the week.

DISCUSSION

Findings from a randomized control trial conducted to study the impact of a nudging intervention on F/V selection and consumption by elementary students in two school districts, community eligible and non-community eligible, are presented. First, this study found that the average servings of F/V selected per student at lunch was less than two servings, which means students did not select one serving of fruit and one serving of vegetable as required for a NSLP reimbursable meal. The intervention increased servings of F/V selection and consumption by 0.17 and 0.14 servings, respectively, in the non-community eligible district. Considering a 4-ounce serving of F/V was the typical portion in the participating schools, an increase in consumption of 0.14 servings is 19% more than previously consumed, which contributes to a greater cumulative increase in F/V consumption. While this is a small change, there is potential for greater cumulative change toward increased F/V consumption. For example, cancer risk has been found to be reduced by 2% for each 100 g/day increase in vegetables consumption (Boffetta et al., 2010).

The intervention did not increase F/V consumption in the community eligible district with students receiving free lunch. The results of our study point to potential issues in mechanism of our nudge intervention. Based on district demographics, students in the community eligible schools were less likely to be exposed to F/V at home, especially fresh F/V, relative to students in the non-community eligible district (Walker, Keane, & Burke, 2010; Wang, Kim, Gonzalez, MacLeod, & Winkleby, 2007). Thus, although we designed our intervention to increase both familiarity and fondness of F/V, it is possible that the effects of our intervention were the result of food preferences among individuals who already had a baseline level of familiarity with the presented F/V. Although data was collected in the community eligible district in winter and spring seasons, where students likely had had some exposure to the F/V items on the menus, familiarity with the foods might have been lacking. This possibility is one reason why we may have observed different effects across districts.

The NSLP requirement to select one serving each of F/V was not uniformly enforced in the school lunchrooms with offer versus serve. Further, two options each of F/V were not available for the students during all data collection days. Hence, the difference-in-difference analysis was repeated with an inclusion of a binary variable 1 if less than two choices each of F/V was offered, 0 if otherwise in order to account for the impact of available choices on servings of F/V selected and consumed. The results found that F/V selection and consumption were affected by the number of F/V choices offered. When less than two servings each of F/V was offered, significantly fewer F/V were selected (-0.49 and -0.40 F/V servings, p value <0.001, respectively in community eligible and non-community eligible districts) and consumed (-0.18 and -0.07 F/V servings, p value <0.001, respectively in community eligible and non-community eligible district). Overall, the impact of the nudging intervention on F/V consumption in the non-community eligible district remained significant (with an increase of 0.12 F/V servings per student post-intervention, p value <0.001).

Wastage of F/V in the school lunchroom is well known. One study in Los Angeles found that approximately a quarter of students threw away untouched F/V from their school lunch (Gase, McCarthy, Robles, & Kuo, 2014). Another study found 50% of fresh fruit and 37% of canned fruit were unconsumed in middle and elementary school children (Smith & Cunningham-Sabo,

2014) while other observational studies have also found similar levels of F/V waste, with only potato products items frequently selected and highly consumed (Handforth, Gilboy, Harris, & Melia, 2016). Similar F/V wastage was not observed in the current study.

Nudging and choice architecture changes (Johnson et al., 2012) have been found to be effective in affecting decisions of children through two routes (Nørnberg, Houlby, Skov, & Peréz-Cueto, 2016). Firstly, through structural mechanisms or how the choice is set up. For instance, sliced oranges were more likely to be selected than whole oranges (16% vs. 6%), perhaps due to the added convenience (Swanson, Branscum, & Nakayima, 2009). The second route parallels findings that social factors predict F/V consumption in children in that perceptions of norms and peer consumption behaviors predict F/V consumption in the same direction (Lally, Bartle, & Wardle, 2011; Lien, Lytle, & Komro, 2002; Pelletier, Graham, & Laska, 2014). For example, in one study it was found that daily exposure to branded vegetable characters increased consumption of that vegetable (Hanks, Just, & Brumberg, 2016). Other studies have found negative impacts of messages highlighting nutritional benefits on children's consumption (Maimaran & Fishbach, 2014) with food items portrayed as less healthy associated with increased consumption and preference (Raghunathan et al., 2006).

Our study adds to the literature on the effectiveness of providing nudges to promote F/V consumption. Previous research on changing school lunchroom choice architecture has also found similar results (Hanks et al., 2016; List & Samek, 2015; Price & Just, 2015; Thapa & Lyford, 2018) but did not compare across school districts serving students that differed in terms of SES. One methodological limitation of past research has been the failure of a single study to use large and generalizable samples (Rasmussen et al., 2006). Although our study was restricted geographically to one state (Georgia), our utilization of two very different school districts represents strength and innovation in this domain of research. A systematic review suggests there is a need for rigorous research on choice architecture of F/V nudging interventions (Nørnberg et al., 2016; Skov, Lourenço, Hansen, Mikkelsen, & Schofield, 2013). The current study filled this gap by testing the effectiveness of a nudging intervention across schools districts with diverse SES of the students served.

CONCLUSIONS AND APPLICATION

In this study, non-nutrition focused fun facts about F/V served as part of the NSLP in schools were tested to determine if they nudged students to increase selection and consumption of these items using a rigorous experimental design. This study was unique in that the field experiment was conducted in two school districts serving socio-economically diverse counties. The study found that fun facts about available F/V can increase F/V consumption; however, the impact was different across socioeconomically diverse schools. Timing of data collection, with some occurring at the end of the school year versus the beginning of the year may have played a role in our study. Results also showed differences in F/V consumption by grade level, gender, and day of the week. The intervention impact existed even with limited F/V choices available for selection in the school reimbursable lunch.

APPLICATION TO SCHOOL NUTRITION PROFESSIONALS

The findings of this study showed nudges in the form of fun facts impacted consumption with no effect on selection of F/V, which means less plate waste was present as more of what was selected was consumed. Further, findings showed consumption was higher with the intervention, even when fewer than two choices of F/V were offered for selection. Less plate waste means overall improved efficacy of the school lunch program as money spent on foods is used. Nudges used in this study are straightforward and easy to replicate. The developed nudges are available

to download from the https://healthy-food-choices-in-schools.extension.org/wp-content/uploads/2020/09/Fruits-and-Veggies-table-tents.pdf. The per-unit cost of nudging is low. The lower cost also allows for easy replacement of table tents when they become soiled, as likely to occur in school lunchrooms. The table tents can be utilized by school nutrition directors in their school lunchrooms to promote consumption of F/V. In research with adults, table tents exerted more influence over food choice than point-of-purchase markers (Thayer et al., 2017). They have also been used previously in nutrition education research (Payne, Capra, & Hickman, 2002).

Findings from this study are in line with helping children form healthy food habits at an young age within the current school lunchroom infrastructure (Kessler, 2016). The current study is in line with prior research (Aldridge, Dovey, & Halford, 2009) that has shown increasing familiarity is effective as a precursor to increased consumption of a new food. Findings from this study provide a foundation for future research in using social marketing methods to promote healthy food consumption in public institutions, such as school cafeterias. There were 29.6 million children participating in the NSLP each day in 2019, with a total of approximately 4.86 billion lunches served in 2018 (FNS, 2020). Due to the significant reach of NSLP, any action to increase F/V consumption in school lunchrooms could be an important mechanism to improve current low rates of F/V consumption among children. Further, the school recruitment involved active participation of SNDs. This study engaged the SNDs during development of the nudges. Future choice architecture interventions can potentially engage parents and children with their inputs in development of additional nudges (Sunstein, Reisch, & Kaiser, 2019) .

IMPLICATIONS FOR FUTURE RESEARCH

Nudging and choice architecture school lunchroom intervention effectiveness in past studies have not compared schools or school districts serving socio-economically diverse students. Our study conducted the intervention in two distinct school districts using an experimental design. The results demonstrated that nudging intervention effectiveness differed based on the socio-economic diversity of the school districts. The nudging intervention was effective in a community ineligible district with high SES, whereas it was not effective in a community eligible-low SES district. As such, a blanket statewide nudging promotion may be less effective compared to a focused intervention planned at the school district level. For example, children from low socioeconomic backgrounds may have lower F/V preferences, perhaps in part due to lower exposure to fresh F/V in the home (Dong & Lin, 2009), and this exposure needs to be considered in intervention development. The current study findings suggest a need to replicate nudging interventions across demographically heterogeneous groups before such policies are recommended for wide-scale adoption. The most recent framework for childhood obesity prevention suggests consideration of the health equity issue for lower income children (Kumanyika, 2019).

In our intervention, we aimed to shape the choice structure by creating positive associations of F/V commonly known and frequently served in school lunches. The findings of our study is consistent with extant research findings on positive associations showing increase in F/V consumption in and outside the school lunchroom (List & Samek, 2015; Thapa & Lyford, 2018; Roberto, Baik, Harris, & Brownell, 2010). They may also impact consumption in other contexts, such as home, summer camps, and restaurants. Although we were unable to test the intervention impact outside the school lunchroom, future studies can examine the impact of nudges on F/V consumption outside lunchroom setting.

LIMITATIONS

Further limitations to this study were that exact exposure per student was not assessed, the length of time between exposures to different table tents was not recorded, and availability of F/V was not tracked. This study also did not track impact of F/V presentation on its consumption, such as sliced vs. whole apple. However, because our control and intervention schools were within the same districts, we expected the same presentation within each nutrition program. This study did not report findings for fruits and vegetables separately. However, detailed attention in the study design with random assignment of schools, shuffling of the table tents in the intervention schools, and a rigorous analysis method make findings of this study robust. We used difference-in-difference approach which helped isolate the impact of the intervention for a causal interpretation. To conclude, our research show that using non-nutrition related fun facts about F/V communicated through the use of table tents can promote F/V selection and consumption among elementary school children - primarily among children who may be familiar to the taste of fresh F/V. School nutrition directors can use this approach to promote F/V consumption and reduce F/V waste in the school lunchroom.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Jackson County and Clarke County School Nutrition Directors and the participating schools for their support and provision of the infrastructure to conduct this research. The funding was provided through a USDA sub-award from the Cornell Center for Behavioral Economics in Child Nutrition Programs. The center had no role in the design and analysis of this study.

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