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THE IMPACT OF A SMARTER LUNCHROOM PROGRAM ON SELECTION OF FRUITS AND VEGETABLES BY CHILDREN IN SCHOOL CAFETERIAS

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ABSTRACT

PURPOSE/OBJECTIVES: This paper describes the results from a Smarter Lunchroom program designed to evaluate if bundling fruit or vegetable strategies listed on the Smarter Lunchroom Scorecard increased selection of fruits and vegetables by students in school cafeterias from 2015 to 2017.

METHODS: Twenty-one Michigan State University (MSU) Extension Community Nutrition Instructors (CNIs) were trained to coach Michigan school child nutrition professionals to undertake Smarter Lunchroom programming from 2015 to 2017. Sixty-seven schools completed Smarter Lunchrooms Scorecards (Scorecard) before and after making changes to their cafeterias using either 12 fruit or 15 vegetable strategies listed on the Scorecard. Thirty schools submitted five days of pre- and post- food production records. Mean values of Scorecard totals and five-day average cups of fruits and vegetables selected per student as measured by schools' production records were calculated for pre- and post-cafeteria changes. Changes were assessed using t-tests. A regression analysis was conducted to determine if schools demonstrating greater improvement in their overall Scorecard also demonstrated increased selection of cups of fruits and vegetables per student.

RESULTS: Schools completing pre- and post-cafeteria changes Scorecards saw significant increases in Scorecard scores, regardless of school grade, percentage of students participating in the school meal program, and whether or not the school formed a student team. There were no statistically significant improvements in the cups of fruits or vegetables selected by students after the cafeteria changes, and selection of fruits and vegetables was not associated with Scorecard improvements.

APPLICATIONS TO CHILD NUTRITION PROFESSIONALS: Child nutrition professionals should be cautious in using Smarter Lunchrooms Scorecard strategies to improve and/or monitor student eating behaviors. The link between increases in the Smarter Lunchrooms Scorecard scores and changes in student fruit and vegetable selection should be investigated further.

KEYWORDS: Behavioral Economics, Smarter Lunchrooms, Child Nutrition, School Meals, Fruit and Vegetable Intervention.

INTRODUCTION

All children benefit from healthy eating. Consuming a diet rich in nutrient-dense whole foods is protective against diet related chronic diseases later in life (Fardet & Boirie, 2014). Conversely, it is recognized that consuming a diet rich in refined energy-dense foods is associated with development of chronic diseases such as cardiovascular disease, Type 2 diabetes, and cancers (Fardet & Boirie, 2014). In the United States, children are not meeting federal dietary guidelines (Banfield, Liu, Davis, Chang, & Frazier-Wood, 2016). For example, children 4 to 18 years of age do not consume adequate amounts of dark green leafy vegetables, beans, whole grains, and whole fruit (Banfield et al., 2016). However, younger children, 4 to 8 year-olds, do consume appropriate amounts of whole fruit.

Schools make an ideal environment to reach youth and encourage selection and consumption of healthier foods and beverages. In the U.S., over 50 million students attend public schools annually, and approximately 30 million students participate in the National School Lunch Program (US Department of Agriculture, Economic Research Service, 2020). With the passage of the Healthy Hunger Free Kids Act (HHFKA) of 2010, higher standards for school meal programs and strategies to alleviate childhood hunger were introduced. One component of the HHFKA requires schools to serve more vegetables within dark green, red/orange, and legume subgroup classifications, and more whole fruit. Schools may offer flavored and unflavored milk. One-half of weekly grains must be whole-grain rich. However, getting the 30.4 million students participating in the program each year to select and consume these healthier items is a challenge.

Schools can also provide an important venue to engage students and generate peer-to-peer strategies to increase student acceptance of healthier foods (Jomaa et al., 2010). It is theorized that schools can promote greater student health by finding ways to involve and build stronger connections with students (Jamal et al., 2013). For example, school staff can engage students by sharing decision-making, as well as collecting and incorporating student feedback. Findings from a qualitative investigation of factors influencing children and adolescent food consumption reported that programs attempting to improve nutrition among children and adolescents should make a point of gathering student input (Fitzgerald et al., 2008).

Behavioral economics is a field of study that uses strategies gleaned from the fields of economics, psychology, and marketing to change behaviors such as increasing healthy food and beverage selection (Guthrie, 2016), increasing patient adherence to medication regimens (Chang et al., 2017), and increasing levels of physical activity (Shuval et al., 2017). Cornell University's Center for Behavioral Economics in Child Nutrition Programs has grouped 100 approaches for use within the school cafeteria setting in a document titled "Smarter Lunchroom Self-Assessment 2016 Scorecard" (Scorecard). The most recent iteration of the Scorecard released in 2018 contains 60 strategies (https://www.smarterlunchrooms.org/scorecard). The Cornell Smarter Lunchroom website reports that "awareness [of Smarter Lunchrooms] almost doubled from 2014 to 2015 (22% to 42%)," and that "over 29,000 schools are using Smarter Lunchroom strategies" (https://www.smarterlunchrooms.org/about/research). These strategies can be attractive to school foodservice providers because they are low to no-cost, and relatively simple to implement within the school lunchroom. Strategies include offering at least two types of vegetables daily, moving fruit to all points of sale, serving sliced fruit, and moving the salad bar to a highly visible high-traffic area.

Table 1 presents the current literature associated with the fruit and vegetable strategies listed on the Scorecard and used in our research project. Table 1 also includes citations for research

studies related to each strategy and conducted in a school setting with students from kindergarten to twelfth grade. Given the Scorecard and Smarter Lunchrooms popularity, there is limited evidence supporting the efficacy and effectiveness of many of these strategies. For example, less than half of the 27 fruit and vegetable strategies (12) used in this study were found to have research evidence of their effectiveness. Among these 12 fruit Scorecard strategies, 10 studies were found to have investigated six of these strategies. Among the 15 vegetable strategies listed on the Scorecard, 11 studies were found to provide evidence for effectiveness of six of these strategies.

With awareness of Smarter Lunchrooms, it is important to better understand if these strategies can lead to an increase in student selection of healthier choices. This paper describes the results from a Smarter Lunchroom Scorecard program designed to increase selection of fruits and vegetables by students in Michigan school cafeterias from 2015 to 2017. We investigated whether coaching child nutrition professionals to implement Smarter Lunchroom strategies in their cafeterias resulted in improvements in Scorecard scores, if school characteristics were associated with Scorecard improvements, and whether improved Scorecard scores were associated with increased student selection of fruits and vegetables.

Table 1. *A Summary of The Reviewed Literature On Fruit and Vegetable Strategies Listed On The Smarter Lunchrooms Self-Assessment 100 Point Scorecard**

Strategies	Research Studies Addressing Strategy
Fruit Strategies (n = 12)	
At least two types of fruit are available daily	Adams, Bruening, Ohri-Vachaspati, & Hurley, 2016; Adams, Pelletier, Zive, & Sallis, 2005; Bean et al., 2018; Hakim & Meissen, 2013; Johnson et al., 2017
Sliced or cut fruit is available daily	Ang et al., 2019; Swanson, Branscum, & Nakayima, 2009; Wansink, Just, Hanks, & Smith, 2013
Fruit options are not browning, bruised or otherwise damaged	Gosliner, 2014
Fruit is available at all points of sale service line, snack windows, a la carte lines etc.	Terry-McElrath, O'Malley, & Johnston, 2014
Daily fruit options are available in at least two different locations on each service line	Terry-McElrath et al., 2014
At least one daily fruit option is available near all registers	Terry-McElrath et al., 2014
Daily fruit options are easily seen by students of average height for your school	No studies found in peer-reviewed publications
Daily fruit options are given creative, age appropriate names	No studies found in peer-reviewed publications
Whole fruit options are displayed in attractive bowls or baskets instead of chaffing/hotel pans	No studies found in peer-reviewed publications
A mixed variety of whole fruits are displayed together	No studies found in peer-reviewed publications
Daily fruit options are bundled into all grab and go meals available to students	No studies found in peer-reviewed publications
Daily fruit options are written legibly on menu boards in all service and dining areas	No studies found in peer-reviewed publications
Vegetable Strategies (n = 15)	
At least two types of vegetable are available daily	Adams et al., 2005; Ang et al., 2019; Bucher, Siegrist, & van der Horst, 2014; Hakim & Meissen, 2013
Vegetables are not wilted, browning, or otherwise damaged	Gosliner, 2014
At least one vegetable option is available in all foodservice areas	Terry-McElrath et al., 2014
Individual salads or a salad bar is available to all students	Adams et al., 2005; Adams et al., 2016; Bean et al., 2018; Gosliner, 2014; Johnson et al., 2017; Slusser, Cumberland, Browdy, Lange, & Neumann, 2007; Terry-McElrath et al., 2014;

Strategies	Research Studies Addressing Strategy
The salad bar is highly visible and located in a high traffic area	Adams et al., 2016; Adams, Ohri-Vachaspati, Richards, Todd, & Bruening, 2019; Bucher et al., 2014;
Self-serve salad bar utensils are at the appropriate portion size or larger for all fruits and vegetable offered	No studies found in peer-reviewed publications
Self-serve salad bar utensils are smaller for croutons, dressing and other non-produce items	No studies found in peer-reviewed publications
Daily vegetable options are available in at least two different locations on each service line	Terry-McElrath et al., 2014
Daily vegetable options are easily seen by students of average height for your school	No studies found in peer-reviewed publications
A daily vegetable option is bundled into grab and go meals available to students	No studies found in peer-reviewed publications
A default vegetable choice is established by pre-plating a vegetable on some of the trays.	No studies found in peer-reviewed publications
Available vegetable options have been given creative or descriptive names	No studies found in peer-reviewed publications
All vegetable names are printed/written on name-cards or product IDs and displayed next to each vegetable option daily	No studies found in peer-reviewed publications
All vegetable names are written and legible on menu boards	No studies found in peer-reviewed publications
All vegetable names are included on the published monthly school lunch menu	No studies found in peer-reviewed publications

*"The Cornell Center for Behavioral Economics in Child Nutrition Smarter Lunchroom Self-Assessment 2016 Scorecard"

METHODOLOGY

The Michigan State University's Human Subjects Institutional Review Board granted permission for this study and classified it as exempt.

PARTICIPANTS

Child Nutrition Directors across Michigan were invited to participate in a smarter lunchroom mini-grant program. Thirty-eight Child Nutrition Directors representing 81 school buildings applied to the program, and were selected on a first come first serve basis. Child Nutrition Directors either assigned building managers, lead cafeteria workers, or worked directly themselves with a Michigan State University (MSU) Extension Community Nutrition Instructor (CNI) trained in using the Smarter Lunchroom Scorecard coaching strategies. The Director and the MSU Extension CNI signed an agreement to complete the following grant requirements between November 2015 and June 2017: 1) Form a student team (of at least two students) to assist with completion of the Scorecard and making cafeteria changes; 2) Complete an online

Smarter Lunchrooms training module; 3) Complete a Smarter Lunchrooms Scorecard and provide five days of production records before and after changes to the cafeteria were made; 4) Review the results of the Smarter Lunchrooms Scorecard and with input from at least two students, select either all of the "Focusing on Fruit" strategies (12) or all of the "Promoting Vegetables and Salad" strategies (15) listed on the Scorecard to implement in their cafeterias; 5) Spend $250 on Smarter Lunchroom related activities; and 6) Submit a success story highlighting student accomplishments and changes made to the cafeteria. The MSU Extension CNIs were trained and certified as Smarter Lunchroom Technical Assistance Providers by Cornell University's Food and Brand Lab Smarter Lunchroom Regional Coordinators. Coaching for the Child Nutrition Director, building manager, or lead cafeteria worker by the CNI included: assisting with completing the Scorecard (pre- and post-changes), determining what changes would be made to the cafeteria, using mini-grant funds to support strategies chosen, providing location based oversight, and working alongside student teams.

INSTRUMENTS AND DATA COLLECTION

Smarter Lunchrooms Scorecard: The 100 strategy Smarter Lunchroom Scorecard (Scorecard) developed by Cornell's Food and Brand Lab in 2016 was used in this study. It contained one hundred strategies grouped in the following sections: Focusing on Fruit (12 strategies), Promoting Vegetables and Salad (15 strategies), Moving More White Milk (9 strategies), Entrée of the Day (8 strategies), Increasing Sales Reimbursable Meals (16 strategies), Creating School Synergies (11 strategies), Lunchroom Atmosphere (18 strategies), Student Involvement (5 strategies), Recognition & Support of School Food (3 strategies), and Ala Carte (3 strategies). If a strategy is practiced, the child nutrition professional checks a box next to the strategy. The total number of strategies checked are counted to generate to total score. Total scores between 71-100 are categorized as "Gold," between 51-70 as "Silver," and those between 30-50 as "Bronze." MSU Extension CNIs worked with the Child Nutrition Professional at each school to complete the Scorecard prior to, and after making cafeteria changes. The Child Nutrition Professionals were asked to check off the statements that were true for their school cafeterias. Boxes that were not checked off during the pre-assessment were considered as areas for improvement. Scorecards were reviewed for completeness and accuracy, and entered into a web-based data entry form using SurveyMonkey Inc., by trained research assistants at Michigan State University (MSU). Seventy-four schools completed the pre-Scorecard with 71 schools completing the post-Scorecard. Sixty-seven schools completed both pre- and post-Scorecards. Total Scorecard scores and total scores for each Scorecard section were determined for each school by summing the number of boxes checked in each section of the Scorecard.

Food Production Records: All public schools are required to complete daily lunch food production records, which include a detailed accounting of what foods and beverages were served that day and in what quantities. Child Nutrition Directors from districts with participating schools were asked to submit five days of production records prior to and after changes were made in the cafeteria. One set of production records (pre- and post-cafeteria changes) was submitted for each participating school. Although the format of the production record varied among the participating districts, each record contains similar information and can be used to determine which foods, and how much of each food was selected by students, and how much remained after lunch service finished. Food items reported in the production records may have been different pre- versus post-changes made to the cafeteria. For example, a school may have reported serving oranges before changes were made, and sliced apples after changes made as the fruit menu items. Most schools reported serving sizes in cups, but if pounds or cans were used as a measuring unit, number of grams per pound and cup per gram conversions were determined

using the USDA Food Composition Database to generate total cups, and cups per student values (US Department of Agriculture, Agriculture Research Service, 2016). Five-day average cups of fruit and vegetables served per student was determined for each school pre- and post-intervention. Production records were reviewed for completeness and accuracy by trained MSU research assistants and entered into a standardized form using Excel. If discrepancies or questions about the production record arose, the Child Nutrition Director was contacted and interviewed using a standardize list of questions to improve data quality. Thirty schools submitted production record data pre- and post-cafeteria changes.

DATA ANALYSIS

Data were analyzed using StataCorp Statistical Software: Release 10 (a statistical software package for researchers). Mean Scorecard values were compared to post values using a two-sided paired t-test, with significance testing at $p<0.05$. Regression analyses were conducted to determine whether percent of children eligible for free or reduced priced meals, school grades, student teams, community eligibility provision, or participation in outside healthy schools programming were significantly associated with improvements in Scorecard scores. Mean values of five-day average cups of fruits and vegetables selected per student were calculated for pre- and post-intervention and compared using a two-sided paired t-test. A regression analysis was conducted to determine if schools improvement in overall Scorecard Scores was associated with greater increases in cups of fruits and vegetables selected.

RESULTS

Of the 67 schools that completed both pre- and post-Scorecard data, 40 (59.7%) included grades kindergarten through fifth grades; six (9.0%) enrolled students in grades six, seven, or eight; ten schools (14.9%) included grades nine through twelve; five (7.5%) included grades kindergarten through eight, and six buildings (9.0%) included sixth through twelfth grades. The total number of students attending the 67 schools was 30,348 students. Forty of the schools (59.7%) served student populations in which at least 51% of their student body was eligible for free or reduced priced meals.

Results from the two-sided t-tests suggests a significant increase ($p<0.5$) between mean pre- and post-Scorecard total scores across all school grade groups regardless of the percentage of students participating in the school meal program groups, and whether or not a student team was or was not formed (Table 2).

Table 2. *Mean Changes in Smarter Lunchroom Scorecard Scores By School Characteristics (N=67)*

Categories		Sample Size	Mean[a] Pre-Score Standard Error (SE[c])	Mean[a] Post-Score (SE[c])	Mean[a] Change	P-value[b]
School Grades	K-5 [d]	40	47.9 (2.0)	63.73 (14.8)	15.9	0.00
	6-8 [d]	6	54.5 (4.2)	67.17 (4.5)	12.7	0.01
	9-12[d]	10	52.4 (4.4)	68.10 (3.2)	15.7	0.00
	K-8 [d]	5	41.4 (8.2)	60.40 (8.6)	19.0	0.03
	6-12[d]	6	50.0 (5.3)	65.33 (4.5)	15.3	0.02
Percent Free/Reduced Price Meals	<25%	7	44.6 (3.0)	65.14 (4.9)	20.6	0.00
	26-50%	20	52.4 (2.9)	69.65 (3.0)	17.3	0.00
	51 -75%	22	50.4 (2.9)	64.05 (3.1)	13.6	0.00
	76-100%	18	44.6 (3.1)	59.39 (3.0)	14.8	0.00
Schools That Formed Student Teams	With	57	49.2 (1.8)	65.4 (1.8)	16.2	0.00
	Without	10	46.9 (2.6)	60.0 (4.2)	13.1	0.00
Total		67	48.8 (1.6)	64.6 (1.7)	15.7	0.00

[a] Mean Scorecard values were compared to post values using a two-sided paired t-test, with significance testing at $p<0.05$. Maximum Scorecard value was 100.

[b] All p-values shown are significant at a p-value < 0.05

[c]Standard error (SE) is used to describe the confidence levels around the mean. The standard error includes both the standard deviation and the sample size. SE = Standard Deviation/√(sample size).

[d] K -5 (Kindergarten through fifth grade); 6-8 (Sixth grade through eighth grade); 9-12 (Ninth through Twelfth grade); K-8 (Kindergarten through eighth grade); 6-12 (Sixth through Twelfth grade)

Note: "Percent Free/Reduced Price Meals" refers to the percentage of students who participate in the National School Lunch Program and qualify for free and/or reduced priced meals.

Fruit and vegetable selection by students from production record data by school grades, percent school meal participation, and formation of student team appear in Table 3. Thirty-seven schools provided complete pre-production record data, and 31 of these schools provided complete post-production record data. There were 30 schools with both pre-and post-production records used for statistical analysis. There was one statistically significant change for the elementary and middle grade group ($p=0.03$), with an increase in the cups of fruit selected by students, as measured by the production records, before and after the implemented changes.

Table 3. *Five-Day Mean Selection of Cups of Fruits and Vegetables Per Student by School (N=30) Characteristics.*

Categories		Sample Size	Mean Pre-cups/ student Fruit (SE[b])	Mean Post- cups/ student Fruit (SE[b])	Mean Fruit Change cups/ student Fruit (SE[b])	p-value[a]	Mean Pre-cups/ student Veg (SE[b])	Mean Post- cups/ student Veg (SE[b])	Mean cups/ student Veg (SE[b])	p-value[a]
School Grades	K-5[c]	18	0.5 (0.0)	0.5 (0.1)	0.0	0.56	0.6 (0.6)	0.6 (0.1)	0.0	0.90
	6-8[c]	1	0.0	0.0	0.0	--	0.1	0.2	0.0	--
	9-12[c]	4	0.4 (0.2)	0.4 (0.2)	0.1	0.42	0.5 (0.1)	0.6 (0.1)	0.1	0.45
	K-8[c]	5	0.3 (0.1)	0.4 (0.1)	0.1	0.03[a]	0.5 (0.1)	0.5 (0.1)	0.0	0.94
	6-12[c]	2	0.5 (0.3)	0. 6 (0.3)	0.0	0.20	0.3 (0.0)	0.3 (0.1)	0.0	0.94
Percent Free/Reduced Price Meals	<25%	2	0.3 (0.1)	0.4 (0.0)	0.1	0.35	0.3 (0.0)	0.3 (0.0)	0.0	0.93
	26-50%	10	0.3 (0.1)	0.2 (0.1)	0.1	0.10	0.5 (0.1)	0.4 (0.1)	0.2	0.12
	51 -75%	7	0.6 (0.1)	0.7 (0.1)	0.1	0.07	0.6 (0.1)	0.8 (0.1)	0.2	0.10
	76-100%	11	0.5 (0.1)	0.6 (0.1)	0.2	0.06	0.5 (0.1)	0.7 (0.1)	0.1	0.38
Schools That Formed Student Teams	With	28	0.4 (0.0)	0.5 (0.6)	0.1	0.26	0.5 (0.1)	0.6 (0.1)	0.0	0.63
	Without	2	0.6 (0.1)	0.7 (0.2)	0.1	0.41	0.4 (0.1)	0.3 (0.2)	0.1	0.63
Total of All Schools		30	0.4 (0.0)	0.5 (0.1)	0.1	0.29	0.5 (0.1)	0.6 (0.1)	0.0	0.68

[a] Results significant at a p-value < 0.05.
[b]Standard error (SE) is used to describe the confidence levels around the mean. The standard error includes both the standard deviation and the sample size. SE = Standard Deviation/√(sample size).
[c] K -5 (Kindergarten through fifth grade); 6-8 (Sixth grade through eighth grade); 9-12 (Ninth through Twelfth grade); K-8 (Kindergarten through eighth grade); 6-12 (Sixth through Twelfth grade)

Note: Menus may have been different for pre vs post production record data collection.

A regression analysis was performed to determine if schools with improvement in overall Scorecard score demonstrated greater increases in cups of fruits and vegetables selected per student. Of the 67 schools with paired pre- and post-Scorecard scores and the 30 schools with paired pre- and post-production records, a total of 29 schools submitted both pre- and-post Scorecard and pre- and post- production record data. There were no statistically significant associations between changes in Scorecard score, fruit and vegetable scores, and cups of fruits ($p=0.48$), vegetables ($p=0.54$), and fruit and vegetable combined ($p=0.48$) selected by students (data not shown).

DISCUSSION

This study found that a program which paired MSU Extension Community Nutrition Instructors with school nutrition professionals in an effort to improve Smarter Lunchroom Scorecard scores led to an increase in these scores in Michigan school cafeterias. However, we also found that improvements in Smarter Lunchroom Scorecard scores did not translate to increased selection of fruits and vegetables by children during lunchtime. Because it is reported that thousands of schools across the U.S. are implementing some aspect of the Scorecard, it is important to understand the evidence regarding Scorecard strategies. Our review of the literature found limited evidence supporting the efficacy and effectiveness of many of these strategies.

While some of the studies assessing effectiveness of the Scorecard strategies used in this study for increasing student selection and consumption of fruits and vegetables ("Focusing on Fruit" with 12 strategies and "Promoting Vegetable and Salad" with 15 strategies) have shown positive results, other studies investigating these strategies have either not been conducted (to our knowledge), have shown mixed results, or have not included school characteristics in the assessment. For example, age of students (Swanson, Branscum, & Nakayima, 2009), type of fruit and vegetable offered (Lakkakula, Geaghan, Zanovec, Pierce, & Tuuri, 2010), availability of other food in the environment (Kubik, Lytle, Hannan, Perry, & Story, 2003), and attitudes of adult staff serving food (Meyer & Conklin, 1998) all appear to influence selection and consumption. It is also important to note that the above studies were conducted prior to implementation of the Healthy, Hunger-Free Kids Act of 2010.

One study tested the influence of the strategy of offering more than one type of fruit at lunchtime and found this significantly increased consumption of fruit by kindergarten through eighth grade children, as measured by observation and plate waste weighing (Hakim & Meissen, 2013). This finding was also supported by four other studies (Adams et al., 2005, 2016; Bean et al., 2018; & Johnson et al., 2017). A cross-sectional study within fourteen elementary schools concluded that slicing or precutting fruit for second and third grade students (another Scorecard strategy) was positively associated with greater fruit consumption (Ang et al., 2019). Other investigators have tested the effect of slicing apples and oranges during lunch and found elementary students selected and consumed significantly more sliced oranges than uncut, yet there was no effect of slicing apples on students' selection and consumption over the whole apple (Swanson et al., 2009). In contrast, a study of middle school students found that selection and consumption of apples increased when they were sliced (Wansink, Just, Hanks, & Smith, 2013). In a cross-sectional study of middle and high school students, it was reported that when the visual appearance of fruit was rated "good or excellent," the odds of students self-reporting consumption of fruit at school increased (Gosliner, 2014). In another cross-sectional study of eighth, tenth, and twelfth grade students, it was reported that fruit consumption was greater in high schools serving fruit from nine or more sources, regardless of venue type compared to

schools with fruit available in three or fewer sources, 51% to 45%, respectively (Terry-McElrath, O'Malley, & Johnston, 2014). No published research was found to have tested the six other fruit strategies listed on the Scorecard among school aged youth, including fruit being easily seen by students; providing age appropriate names for fruit; displaying a variety of fruit together; bundling fruit in a grab-n-go option; and writing fruit options legibly on a menu board.

Among the vegetable strategies listed on the Scorecard, to our knowledge, only six of the 15 strategies have been studied in the school setting. In one study, investigators found that having two or more vegetable options was positively associated with greater consumption of vegetables among second and third grade students (Ang et al., 2019). Bucher et al. (2014) reported that children between the ages of seven to ten who were given a choice of two vegetables served themselves significantly more than children offered only carrots or only beans (Bucher, Siegrist, & van der Horst, 2014). Among kindergarten through eighth grade students, one study found that offering more than one kind of vegetable at lunch significantly increased consumption of vegetables (Hakim & Meissen, 2013). Another study reported that when the visual appearance of vegetables served at school was rated “good or excellent,” the odds of middle and high school students self-reporting that they consumed vegetables at school were greater (Gosliner, 2014). Similarly, Terry-McElrath et al. (2014) reported that high school students’ consumption of vegetables was greater when they were offered vegetables from nine or more locations within the school cafeteria compared to availability at three or fewer venues (Terry-McElrath et al., 2014). Any studies of strategies regarding self-serve salad bar utensils, daily vegetable options in at least two different locations, bundled or pre-plated vegetable options, and naming of vegetables in the school cafeteria setting have not been published.

Four of the 15 vegetable strategies assessed in this study relate to salad bars, which have also been promoted by the Let’s Move Salad Bars to Schools initiative (Hopkins, 2016; Bruening, Adams, Ohri-Vachaspati, & Hurley, 2018). One study concluded that there was a significant increase in frequency of fruit and vegetables consumed after introduction of a fruit and vegetable salad bar along with education, marketing, and field trips (Slusser, Cumberland, Browdy, Lange, & Neumann, 2007). Another study found increased odds of vegetable consumption (OR = 1.48) among students in schools with salad bars compared to consumption by students without salad bars in their schools (Gosliner, 2014). Terry-McElrath et al. (2014) looked at associations between the presence of salad bars and student fruit and vegetable intake and found that consumption of green vegetables was 7% greater when salad bars were present. However, Bean et al. (2018), reported that exposure to salad bars increased selection, but decreased fruit and vegetable consumption by 0.65 cups among first through fifth graders. An earlier study led by Adams, Pelletier, Zive, & Sallis (2005) found that the presence of salad bars was not associated with greater fruit and vegetable consumption by fourth and fifth grade students, yet the number of fruit and vegetable items on the salad bar was associated with the greater consumption. In a more recent study, Adams, Bruening, Ohri-Vachaspati, & Hurley (2016) found that students at schools with salad bars inside the service line showed an increase in the amount of fruits and vegetables selected and consumed compared to students in schools with self-standing salad bars outside the line. Johnson et al. (2017) reported that median cups of fruits and vegetables consumed per student was higher in schools without a salad bar (0.76 cups), compared to schools with a salad bar (0.50 cups). In summary, many factors appear to influence the efficacy of Scorecard strategies related to salad bars. Moreover, according to Adams, Ohri-Vachaspati, Richards, Todd, & Bruening (2019), "no rigorous randomized trials have examined whether salad bars increase students' [fruit and vegetable] consumption." (p. 37).

Despite finding limited research supporting some of the individual fruit and vegetable strategies listed on the Scorecard, it is possible that bundling these strategies together, like our study did, creates a stronger effect. Three studies were found in the literature that combined strategies listed on the scorecard: Greene, Gabrielyan, Just, & Wansink (2017); Thompson, Johnson, Leite-Bennett, Ding, & Mehrotra (2017); and Song, Grutzmacher, & Munger (2016). Greene et al. (2017) found that changes to the convenience, visibility, and attractiveness of fruits and vegetables within ten middle schools significantly increased fruit selection by 36% and consumption by 23%. Thompson et al. (2017) tested multiple strategies (labels, menu boards, slicing, etc.) in two elementary schools and did not find any significant increases in the number of students selecting or consuming fruits and vegetables, except for the percentage of students selecting apples. Song et al. (2016) found that combining cafeteria environmental changes and nutrition education increased the self-reported consumption of fruit and vegetables by elementary school students.

This study that investigated all 12 fruit and all 15 vegetable and salad strategies from the Scorecard had several limitations. First, the school sample was self-selected; thus schools that choose to participate may have been more likely to be supportive of making changes within the cafeteria than the general population of schools. Secondly, schools were not excluded based on changes which may have already been made to their cafeterias; therefore schools entering the program may already had made changes listed on the Scorecard. Schools from the same district were included in the sample which could have led to bias based on leadership values. Another limitation was the lack of a comparison group and randomization. For example, because of the lack of a comparison group, the investigators cannot be certain if increases in Scorecard scores resulted from how the Scorecard may have been completed or whether other external factor(s) or outside influence(s) led to improvements. Moreover, the fact that the schools were not randomized prevents the findings from being generalizable to other schools outside of those participating in this study. In addition, given that all 12 fruit and the 15 vegetable strategies were required to be implemented by participating schools, it is difficult to ascertain which specific strategy led to increases in Scorecard scores.

As noted earlier, the Scorecard has limitations as a research tool. The breadth and flexibility of the strategies included on the Scorecard allows for multiple ways these can be implemented. The flexibility makes it difficult to control “the intervention.” For example, the strategy to display a mixed variety of whole fruit together could be implemented in many ways. One school might display oranges, bananas, and apples on a brightly colored farm-themed table top near the register, whereas another school may display one bowl of a variety of different colored apples. In both cases, the schools will have implemented the strategy successfully.

Furthermore, even though Extension CNIs completed the same Smarter Lunchroom Technical Assistance Provider training, each school district was paired with a different Extension CNI who assisted with completing the pre- and post-Scorecards. This may have resulted in variability in scoring approaches. Even though schools were “required” to complete all the fruit or all the vegetable strategies contained on the Scorecards, researchers relied on self-reporting to confirm that changes in the cafeteria were made.

Analyses of the production record changes also contributes limitations to the study. The production records were self-reported by school staff, and low compliance with submitting complete and useable production records may have also impacted results. Given that the implementation time period was lengthy, schools may have experienced staff changes, increased

variations of strategy implementations, or other school-based decisions may have influenced school meal programming.

CONCLUSIONS AND APPLICATION

Given its popularity, an evidence-based understanding of the impact of the Smarter Lunchroom program and other behavioral economic strategies to improve selection and consumption of healthy foods are important. The results of this study demonstrated that continued investigation to identify effective school-based healthy eating programming using behavioral economic approaches is necessary. Our review of the evidence supporting each of the fruit and vegetable Scorecard strategies raises many questions. For example, which strategies and for which age groups do these work best? If strategies are done in concert and at greater "dosage", will a greater effect be observed? Do strategies work best if an outside community health worker assists a child nutrition professional in implementation? Should future iterations of the Scorecard only include strategies supported by research conducted within schools and among students in grades kindergarten through twelfth? Moreover, is there a need for identifying evidence-based strategies by grade level? Answering these questions may assist child nutrition professionals in identifying which strategies to implement to increase selection of fruits and vegetables.

The results also demonstrated the challenges in conducting school-based research such as collection of food production records, and controlling for external confounding variables such as type of menu choices being served, differences in leadership skills and style at each school site, support by child nutrition staff for making changes, student grade levels, con-current external health promotion events, etc. Despite these challenges, continued investigation to identify effective school-based programming using behavioral economic approaches is needed. Although this study found significant increases in reported Smarter Lunchrooms Scorecard scores, it was not evident that changes in Scorecard scores resulted in changes in fruit and vegetable selection. Further research is needed to identify effective strategies that will lead to behavior changes by students. Future work might implement only one strategy at a time in order to better control for internal and external confounding variables and demonstrate how use of a specific strategy led to changes in selection of the target food or beverage in a particular setting.

Finding effective strategies to encourage young people to select healthier foods remains an important endeavor. We encourage child nutrition professionals and researchers to further evaluate and test the effectiveness of behavioral economic approaches designed to improve selection and consumption of healthy foods by students.

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