

## **The Effects of a Nutrition Education Intervention on Third- and Fifth-Grade Students' Fruit and Vegetable Knowledge, Preference and Consumption**

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### **ABSTRACT**

#### **Purpose/Objectives**

Most American school children fail to meet recommended intakes of fruits and vegetables (F/V). Possible solutions to increase intake include nutrition education interventions paired with access to a cafeteria salad bar (SB). The aim of this research was to determine if a F/V-targeted nutrition education intervention would increase F/V knowledge, preference, and consumption among elementary school-aged students.

#### **Methods**

This repeated measures experimental design examined the effects of a nutrition education intervention among third- and fifth-grade students (n=149). Pre- and post-intervention surveys, as well as pre and post SB specific plate waste analyses, were used to measure change in F/V knowledge, preference, and consumption. Participants received eight weekly 20-minute nutrition education lessons focused on the benefits of consuming F/V. A series of two-way ANOVA models with interactions were used to examine changes in F/V knowledge, preference, and consumption in each grade.

#### **Results**

A few significant improvements in nutrition knowledge and F/V preference were observed. There were slight differences in overall nutrition knowledge and F/V preference between grades but not a change post-intervention within grades. Fifth-grade students generally possessed a better understanding about the benefits of consuming F/V and a greater preference for F/V. Non-significant increases in F/V consumption were noted post-intervention.

#### **Application to Child Nutrition Professionals**

The results of this study suggest that targeted nutrition interventions may be effective in increasing F/V intake among elementary school-aged students. Positive outcomes seem to depend on several factors, including the existence and duration of other F/V promotional programs like SB, as well as peer- and adult-modeling of F/V consumption. This study as well as previous research indicates exposure and modeling are powerful tools in order to increase pre-adolescent F/V consumption.

**Keywords:** elementary schools, nutrition education, plate waste, fruit and vegetables, childhood obesity

## INTRODUCTION

The epidemic of overweight and obese children in the United States (U.S.) remains a public health priority. Results from the 2013-2014 National Health and Nutrition Examination Survey (NHANES) reported that approximately 33.4% of children are classified as overweight and 17.4% are classified as obese (Skinner, Perrin, & Skelton, 2016). While some research had suggested a decline in obesity among 2-5 year old children, the prevalence of severe obesity ( $\geq 99^{\text{th}}$  percentile for age- and sex-specific body mass index [BMI]) among children of all ages, genders and ethnicities continues to increase (Skinner et al., 2016). Overweight and obese children are more likely to become overweight and obese adults and develop obesity-related chronic diseases. Examples include hypertension, Type 2 diabetes, atherosclerosis, metabolic syndrome, and select cancers (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001; Simmonds, Llewellyn, Owen, & Woolacott, 2016), all diseases which were once thought to only affect adults (Freedman, 2001; Hannon, 2005; Lo, et al., 2014; Weiss, et al., 2004). In addition to chronic obesity-related diseases, cognitive impairments and psychological disorders have also been identified in obese children and adults that may adversely affect academic performance, long-term job potential, and overall quality of life (Finkelstein, DiBonaventura, Burgess, & Hale, 2010; Sjoberg, 2005; Yates, Sweat, Yau, Turchiano, & Convit, 2012; Yau, Castro, Tagani, Tsui, & Convit, 2012).

Obesity is a multifactorial disease with a mix of contributing factors including genetics, environment, and lifestyle. Factors identified as contributing to the obesity epidemic include but are not limited to: overconsumption of energy-dense foods, decreased physical activity, obesogenic community and environmental factors, and a general shift away from home-cooked meals and family dinners (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004; Fiscella & Williams, 2004; Hernández, et al., 1999; Veugelers, & Fitzgerald, 2010; Trost, Kerr, Ward, & Pate, 2001). The American diet, characterized as high in saturated fats and added sugars and low in fruit and vegetables (F/V), is often targeted as a primary culprit (Frazao & Allshouse, 2003). Although research has shown that regular consumption of F/V reduces the risk of obesity and obesity-related chronic diseases, the vast majority of American youth are not meeting the recommended U.S. Dietary Guidelines (U. S. Health and Human Services [USHHS] & United States Department of Agriculture [USDA], 2015) for daily F/V intake (Adams, Bruening, & Ohri-Vachaspati, 2015; Bazzano, et al., 2002; He, et al., 2004; Vernarelli, Mitchell, Hartman, & Rolls, 2011; Wootan, 2012). A 2007-2010 report by the National Cancer Institute (NCI) showed that 60% of children between the ages of 1-18 years old did not meet the USDA's fruit intake recommendations and 93% did not meet vegetable intake recommendations (Kim et al., 2014), defined as 1 - 2 cups and 1- 2 ½ cups for F/V, respectively, depending on caloric needs (USHHS & USDA, 2015). One high impact, cost-effective method of addressing obesity may be to encourage greater consumption of F/V through increased nutrition education interventions in schools aimed at increasing nutrition knowledge and awareness. Nutrition interventions beginning at the elementary school level provide an ideal environment for setting standards, establishing nutrition curricula, and forming healthy behaviors that may last a lifetime.

Elementary schools offer an ideal learning platform as well as a large pre-adolescent audience (Story, 1999). These elements paired with the National School Lunch Program (NSLP) make for an ideal setting for nutrition interventions. The NSLP was established in 1946 to fill nutritional gaps in the American child's diet and it has continually evolved to meet changing dietary requirements (Gunderson, 1962; Ralston, Newman, Clauson, Guthrie, & Buzby, 2008). It is an

important source of daily nutrients for American school children (Gundersen & Ziliak, 2014), with over 30 million children served in 2016 (USDA, 2016). In conjunction with changing nutrition requirements, many schools have implemented their own healthy lifestyle initiatives in an attempt to reverse the childhood obesity epidemic (Khambalia, Dickinson, Hardy, Gill, & Baur, 2012).

Obesity prevention in the school setting calls for multi-pronged intervention research as no single, effective solution to combat obesity has been identified (Adams et al., 2015; Aloia, Shockey, Nahar, & Knight, 2016; Shirley et al., 2015). Previous studies have shown that interventions that incorporated a combination of methods such as nutrition education, parental involvement, and physical activity, seem to be the most effective in improving children's eating habits (Aloia et al., 2016). However, comprehensive obesity prevention programs can be expensive and difficult to implement (Graziose, Koch, Wang, Gray, & Contento, 2016). As a result, a large body of research is dedicated to finding cost-effective, easily adaptable solutions. One aspect of obesity prevention programs that is relatively easy and inexpensive to implement is nutrition education curriculum (Gonzalez-Suarez, Worley, Grimmer-Somers, & Dones, 2009) that is aimed at improving children's F/V nutrition knowledge and consumption (Anderson et al., 2005; Powers, Struempfer, & Parmer, 2005; Upton, Upton, & Taylor, 2013). Additionally, intervention effectiveness has been shown to be amplified when it is reinforced with other healthy lifestyle exposures, such as access to a lunch-time salad bar (SB) (Flock, 2003).

There are few studies to date that explore the knowledge, preference, and consumption outcomes of combining nutrition education interventions with SB access. The aim of this research was to examine the effectiveness of eight weekly 20-minute nutrition education classes on third- and fifth-graders' F/V knowledge, preference and consumption. It was hypothesized that following a nutrition education intervention, students would demonstrate greater knowledge about the importance of regular F/V intake, have a higher preference for F/V, and increase their consumption of F/V.

## **METHODOLOGY**

### **Study Design**

This repeated-measures study assessed how a nutrition education intervention, combined with access to a lunch-time SB, affected third- and fifth-grade students' F/V knowledge, preference, and consumption. The Institutional Review Board Human Subjects Review Committee approved this study prior to initiation and it was registered at ClinicalTrials.gov as NCT03179852. This study, including data collection and the education intervention, was conducted over a ten week-period in the winter of 2017. Data from validated surveys to assess F/V knowledge and preference (Baranowski et al., 2000), as well as plate waste data to assess F/V consumption, were collected during weeks one and ten. The education intervention was conducted for eight weeks (weeks two – nine).

### **Study Sample**

The third- and fifth-grade study participants (N=149) represented a convenience sample, recruited from a rural public elementary school located in central Washington. The elementary school had a 20-minute lunch period during which time students had access to the self-serve SB with F/V offerings varying daily. All third- and fifth-grade students, whose parents did not opt out, were included in the nutrition education intervention and plate waste study. The participant baseline demographics are presented in Table 1.

**Table 1. Baseline demographic characteristics of third- and fifth-grade students who participated in a nutrition education intervention (n, %).**

Characteristics*	3rd-grade	5th-grade
<b>Gender</b>		
Male	36 (47.4)	42 (59.2)
Female	40 (52.6)	29 (40.8)
<b>Ethnicity</b>		
Hispanic/Latino	16 (21.1)	9 (12.7)
Non-Hispanic White	60 (78.9)	62 (87.3)
<b>NSLP**</b>		
Free	37 (48.6)	28 (39.4)
Reduced	10 (13.2)	5 (7.0)
Paid	29 (38.2)	38 (53.5)

\*No significant differences were found between groups.

\*\*NSLP is the National School Lunch Program.

### **Nutrition Intervention**

A primary investigator and seven undergraduate co-investigators from Central Washington University’s Department of Health Sciences conducted the nutrition education intervention. Eight classroom-based nutrition education lessons based on California’s Power Play! Campaign (California Department of Public Health, 2009) were administered over eight weeks to six classrooms (three each in third- and fifth-grade). Each lesson lasted approximately 20 minutes and was led by the primary investigator, with two co-investigators assigned to assist with each lesson. The intervention focused on plant-based components, macro- and micronutrients, My Plate guidelines, serving sizes, diet-related disease prevention, preparing healthy snacks, and how to ask parents for more F/V (Morris & Zidenberg-Cherr, 2009). Each lesson included a snack component that featured targeted F/V including homemade hummus with celery and carrots, beet smoothies, green smoothies, and zucchini pumpkin muffins, among others.

### **Data Collection**

Identical baseline and post-intervention measurements were collected from students. A previously validated self-report survey developed by California’s Power Play! Campaign (Baranowski et al., 2000) as used to assess pre- and post-nutrition knowledge and F/V preference and contained 34 True/False and multiple-choice questions and two fill-in the blank questions.

Two to three co-investigators worked with the primary investigator during the plate waste data collection. Plate waste was assessed using the validated quarter-waste method, a visual estimation method that reports consumption in quarter percentage increments: 0%, 25%, 50%, 75% or 100% of the food was consumed using the original tray as a reference (Bontrager Yoder, Foecke, & Schoeller, 2015; Kenney et al., 2014; Swanson, 2008). The “before” and “after”

photos were captured with a Sony MHS-TS10 Bloggie digital camera fixed on tripods approximately 18” above trays.

### **Data Analyses**

Two co-investigators independently compared each “before” and “after” photo to visually estimate the amount of F/V consumed by each student. Differences in observations among the investigators that were greater than 50% were re-examined by the primary investigator. The two closest of the three independent estimates were averaged for the tray in question. Photographs were excluded if a tray lacked either a “before” or “after” meal image, if the photograph quality was too poor to determine an amount consumed, or if items had been added or removed from the tray between the two photographs. For example, while the students had been told not to share or trade, empty cookie wrappers would appear on the “after” tray when no cookies had been on the “before” tray. Similarly, items like oranges or bananas that had been in the “before” picture sometimes disappeared from the “after” along with evidence of their peel.

### **Statistical Analysis**

Chi-square contingency analysis was used to analyze the demographic data to test for bias in the convenience sample. Two-way ANOVAs with grade (third or fifth) and time (“before” and “after”) as main factors were used to test differences in F/V knowledge and preference in the survey data and the F/V consumption data. Because plate waste was associated with the same students before and after the intervention, the two-way ANOVA used to analyze these data included subject as a random effect. All statistical analyses were performed using the statistical software package R version 3.3.3 (R Core Team, 2017) with significance set at  $P < 0.05$ .

## **RESULTS AND DISCUSSION**

This study found that an eight-week nutrition intervention improved some aspects of third- and fifth-grade students’ F/V knowledge and preference, but not actual F/V consumption from the SB. The intervention increased preference for targeted F/V but not non-targeted F/V, as would be expected. There was an observed but non-significant increase in F/V consumption post-intervention.

**Table 2. Changes in fruit and vegetable knowledge and preferences pre- and post-nutrition education intervention.<sup>1</sup>**

	3 <sup>rd</sup> -grade		5 <sup>th</sup> -grade		<i>P</i>		
	Pre	Post	Pre	Post	Grade	Time	Interaction <sup>2</sup>
<b>Fruits and vegetables</b>							
Eating F/V protects you from diseases. (True)	60	52	46	53	**	ns	*
Most of the vitamin C we get comes from F/V. (True)	55	58	56	60	ns	ns	ns
How many servings of F/V do you think elementary school students should eat each day to be healthy?	3.2 (1.6)	3.4 (1.7)	3.1 (1.5)	3.5 (1.3)	ns	ns	ns
How many servings of vegetables do kids your age need every day?	3.1 (1.4)	2.6 (1.3)	2.9 (1.1)	2.8 (1.1)	ns	*	ns
<b>If I eat fruits and vegetables every day...</b>							
I will become stronger	4.6 (1.1)	4.3 (1.3)	4.5 (0.9)	4.5 (1.1)	ns	ns	ns
my friends will start eating them too	3.3 (1.5)	2.9 (1.4)	2.8 (1.2)	2.8 (1.2)	ns	ns	ns
I will have stronger eyes	3.9 (1.5)	4.0 (1.3)	3.9 (1.4)	4.4 (1.0)	ns	ns	ns
I will have a nicer smile	2.8 (1.6)	2.7 (1.5)	2.8 (1.5)	3.2 (1.5)	ns	ns	ns
I will be healthier	4.6 (1.0)	4.7 (0.9)	4.9 (0.5)	4.8 (0.9)	ns	ns	ns
I will think better in class	3.6 (1.5)	3.6 (1.4)	3.4 (1.4)	3.8 (1.3)	ns	ns	ns
it will keep me from getting fat	4.0 (1.4)	3.9 (1.4)	3.7 (1.5)	4.1 (1.4)	ns	ns	ns
I will have more energy	4.2 (1.4)	4.3 (1.3)	4.7 (0.8)	4.5 (1.0)	*	ns	ns
my family will be proud of me	4.4 (1.2)	4.0 (1.3)	3.9 (1.4)	4.0 (1.3)	*	ns	ns
I think I can write my favorite fruit or vegetable on the family's shopping list	3.5 (1.4)	3.4 (1.4)	4.1 (1.3)	4.0 (1.3)	*	ns	ns
I think I can ask someone in my family to buy my favorite or vegetable	4.1 (1.3)	4.0 (1.3)	4.3 (1.2)	4.4 (1.1)	*	ns	ns
I think I can go shopping with my family for my favorite fruit or vegetable	4.0 (1.4)	4.1 (1.3)	4.2 (1.3)	4.3 (1.2)	ns	ns	ns
I think I can pick out my favorite fruit or vegetable at the store and put it in the shopping basket	3.5 (1.6)	3.4 (1.6)	4.1 (1.4)	3.7 (1.5)	*	ns	ns

<sup>1</sup> For the first two questions, *n* is shown. For all other items, mean responses [1 SE standard error] to Likert scale questions (1 = disagree

very much; 5 = agree very much. Number of responses vary by each item.)

<sup>2</sup> "interaction between grade and time".

Significant differences are noted as follows: *ns* (Nonsignificant;  $P>0.05$ ; \*  $P<0.05$ ; \*\*  $P<0.01$ )

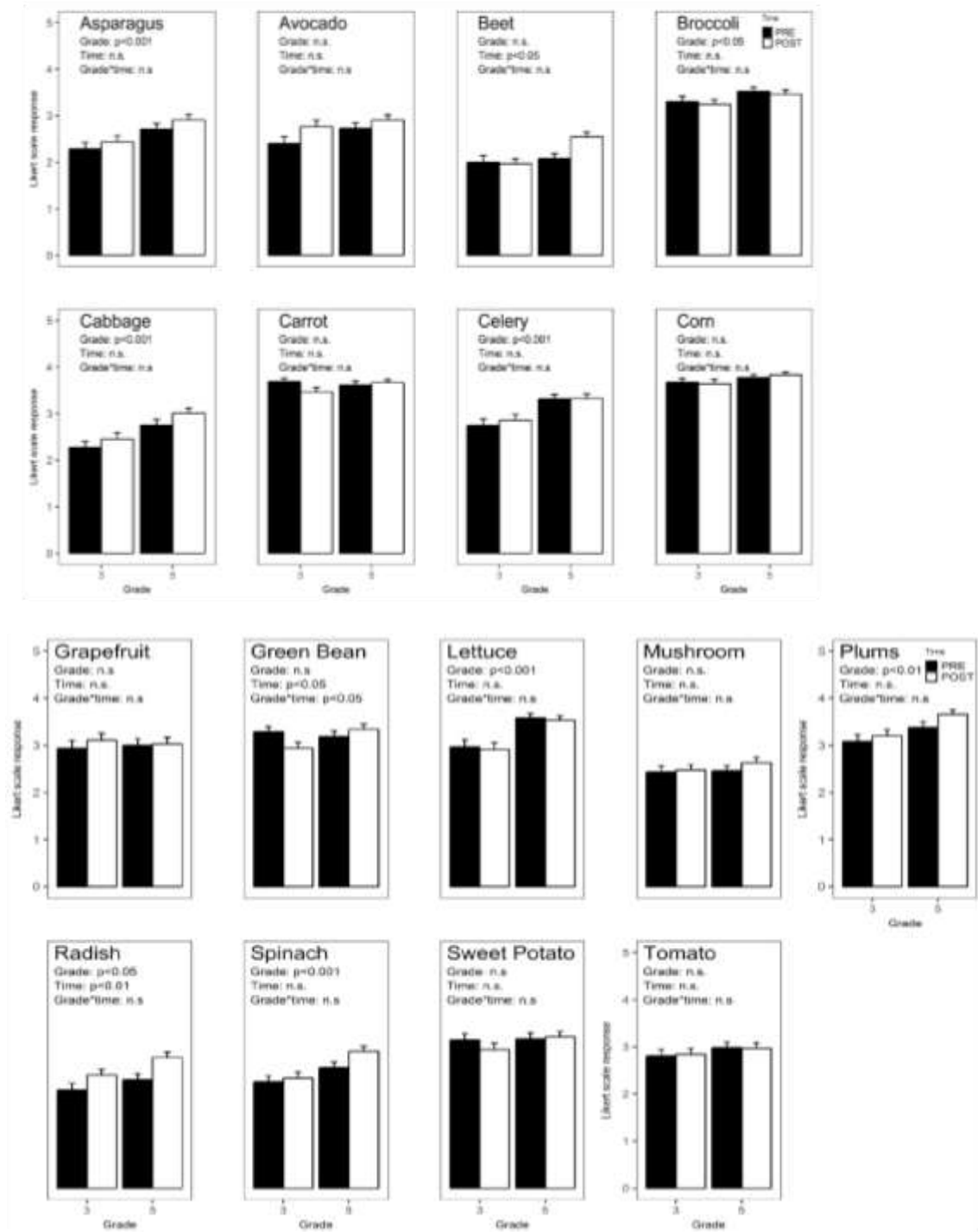
## **Nutrition Knowledge**

To determine change in nutrition knowledge after the intervention, 17 survey statements or questions were analyzed individually (Table 2). A few significant improvements in nutrition knowledge were observed between grades, but not a change post-intervention within grades. The first statement —“eating F/V protects you from disease”—had a significant interaction whereby fifth-grade students were more likely to have answered “True” in the post-survey compared to third-grade students ( $P < 0.05$ ). Question four asked students “how many servings of vegetables do kids your age need every day?” Prior to the intervention third-grade students were more likely to have answered “3 servings,” but after the intervention they were significantly more likely to have answered “2 servings” ( $P < 0.05$ ) while fifth-grade students did not significantly change their answers. Significant outcomes related to nutrition knowledge included but were not limited to the following: 1) “if I eat F/V every day I will have more energy” (fifth-grade students were significantly more likely to have answered “I agree a little,” whereas third-grade students were more likely to have answered “I agree very much” [ $P < 0.05$ ]); 2) “if I eat F/V every day my family will be proud of me” (third-grade students were more likely to have answered “I agree very much” compared to fifth-grade students [ $P < 0.05$ ]); and 3) “I think I can write my favorite F/V on the family shopping list” (fifth-grade students were significantly more likely to have answered “I agree very much” compared to third-grade students [ $P < 0.05$ ]).

The lack of a significant relationship observed between the nutrition education and improved F/V knowledge is inconsistent with other studies (Anderson et al., 2005; Powers, et al., 2005; Tuuri et al., 2009). Powers et al. (2005) identified a significant improvement in F/V knowledge in their elementary-aged treatment group following a six-week nutrition education program. Tuuri et al. (2009) also saw an improvement in F/V knowledge after a 12-week nutrition education intervention. However, it should be noted that those studies adopted a wider-scale nutrition education approach which included school assemblies to generate enthusiasm, parental involvement, hands-on activities for kids, classroom videos, school gardens, farm visits, F/V tastings, and assigned readings. This suggests that effective nutrition education programs aimed at increasing F/V knowledge, preference and consumption need to contain multiple components in order to be successful.

The current study found a significant difference in nutrition knowledge between grades. In general, fifth-grade students possessed greater knowledge than third-grade students about the health benefits of F/V pre- and post-intervention. They were also more likely to answer, “I agree a little” or “I agree very much” regarding questions that addressed one’s ability to succeed. For example, they were more likely to answer, “I agree very much” when asked whether they felt they could add their favorite F/V to the family-shopping list or put it in the shopping basket. Fifth-grade students also had a higher preference for a greater variety of F/V, both pre- and post-intervention. These findings suggest that as students age, their understanding around the health benefits of F/V consumption improves even without targeted nutrition education programs.

**Figure 1. Changes in fruit and vegetable preferences pre- and post-nutrition education intervention. Likert scale questions (1 = dislike very much; 4 = like very much) are shown as mean (1 SE.)**



\*n.s. = non-significant; dark bars = pre-intervention; light bars = post-intervention.



## **Fruit and Vegetable Preference**

Of the 17 questions, ten demonstrated significant outcomes ( $P < 0.05$ ) either between the pre- and post-intervention time frames or between grades (Figure 1). Several “targeted” F/V listed on the survey were also highlighted during the nutrition education lessons. For example, beets were offered in the form of a smoothie and radishes in a raw cut form. Researchers led students through a “tasting,” which involved describing the snack in terms of its physical and sensory characteristics and eating (“modeling”) the snack with the students. After the intervention, fifth-grade students increased their preference for beets and both grades increased their preference for radishes. The researchers visually observed that during the tasting, “modeling” by peers and instructors greatly influenced the students’ willingness to try the targeted F/V. For example, some children expressed dislike of certain items but were willing to try them during the lesson in order to actively participate in the activity and discussion. These observations are supported by previous research that suggests modeling and exposure, both positive and negative, can have a powerful effect on children’s food intake (Birch & Fisher, 1998; Fisher, Mitchell, Smiciklas-Wright, & Birch, 2002; Hendy, Williams, & Camise, 2005; Lowe, Horne, Tapper, Bowdery, & Egerton, 2004). For example, Lowe et al. (2004) found that elementary-aged children improved their liking for F/V following a 16-day intervention which involved watching videos with superhero cartoon characters who gained “special” powers from consuming F/V. Similarly, Fisher et al. (2002) found that F/V intake among five-year-old girls’ was positively related to their parents’ F/V intake. Parents who increased their consumption of F/V saw increased consumption in their daughters’ intake. Parents with lower F/V intake reported using greater pressure when feeding their children F/V, which correlated with lower intake in their children. In support of these findings, additional research has shown that repeated and consistent exposure to F/V increases children’s preference for and consumption of F/V (Lakkakula, Geaghan, Zanovec, Pierce, & Tuuri, 2010; Wardle, Herrera, Cooke, & Gibson, 2003). This finding demonstrated the importance of positive parental role modeling in increasing children’s consumption of F/V. It should be noted however, that the current study also identified the importance of positive role modeling by peers and instructors as being a crucial factor in increased willingness to try new F/V as well.

Preference for other items on the survey varied between grades. Some examples included: asparagus ( $P < 0.01$ ), green beans ( $P < 0.05$ ), broccoli ( $P < 0.001$ ), cabbage ( $P < 0.01$ ), celery ( $P < 0.001$ ), lettuce ( $P < 0.001$ ), plums ( $P < 0.01$ ), and spinach ( $P < 0.01$ ). While these results are of interest, it is likely more important to recognize the differing preferences of children based on grade level, suggesting that a wider variety of offerings of F/V will likely lead to overall greater consumption.

## **Fruit and Vegetable Consumption**

There was a non-significant increase in F/V consumption from the SB observed among grades post-intervention (data not shown). Previous research has shown mixed results on the effectiveness of nutrition education programs in increasing F/V consumption. Powers et al. (2005) found that children who received a nutrition education program improved their overall dietary behavior including greater consumption of F/V compared to children who did not receive the intervention (Powers et al., 2005), while Upton et al. (2013) found only short-term improvements in F/V consumption among students following a nutrition education intervention, as increased intake was not maintained 12 months post-intervention (Upton et al., 2013). Finally, Anderson et al. (2005) found that students who participated in a nutrition education intervention increased their fruit but not vegetable intake (Anderson et al., 2005). These findings along with

the results of the current research indicate that a variety of factors need to be considered in designing the intervention including the home environment, the length of the intervention, the variety and quantity of F/V offerings in the cafeteria, as well as modeling of F/V consumption by peers, instructors, and parents (Gonzalez-Suarez et al., 2009; Gosliner, 2014; Struempfer, Mastropietro, Parmer, Arsiwalla, & Smith, 2013).

### **Strengths and Limitations**

This study had several strengths. First, F/V consumption was measured through a validated plate waste analysis, rather than relying on less reliable dietary recall or observational methods (Biró, Hulshof, Ovesen, & Amorim, 2002). Second, the use of digitally-captured images to show F/V consumption allowed for minimal interruption to the students' lunch period permitting students to have the full 20-minute allotted lunch period to consume their meals (Nicklas et al., 2012). Lastly, all of the nutrition education lessons were led by the primary investigator; thus, the content, style, and length of the lessons was consistent between classrooms.

Limitations of this study included the convenience sample, which was based on the willingness of the teachers at the elementary school to participate. Only the third- and fifth-grade teachers volunteered for this study. This resulted in the need to find appropriate teaching materials and surveys that were consistent and understandable to both grades leading to the second major limitation as there is a clear difference in the learning ability, cognition, and memory retention between third- and fifth-grade students. For this reason materials appropriate to fourth-grade students were chosen and approved by the teachers in both grades prior to the start of the study. However, the researchers found the third-grade students had a more difficult time understanding some of the survey instructions and questions, possibly altering the outcomes measured. Finally, the 20-minutes allotted for lunch may have influenced whether or not the children were able to actually complete their meal. Perhaps if they were allowed more time, significant increases in F/V consumption would have been observed.

## **CONCLUSIONS AND APPLICATIONS**

As childhood obesity continues to be a public health crisis worldwide, the need for effective disease prevention policies remains a high priority. One possible solution is greater implementation of nutrition education programs in school settings, combined with other health-promoting initiatives that encourage F/V consumption, such as school gardens, cooking classes, and cafeteria SB. While school-based health programs can be effective in increasing children's consumption of F/V, an identified important factor in the prevention of obesity, the ideal approach to achieve this has yet to be identified (Shirley et al., 2015; Sobol-Goldberg, Rabinowitz, & Gross, 2013; Summerbell et al., 2012) As the current study and previous research have observed, increasing F/V intake among elementary-aged children requires a multifaceted approach (Adams et al., 2015; Aloia et al., 2016; Shirley et al., 2015).

To the knowledge of the researchers, this study is the first to examine plate waste associated with a targeted F/V nutrition education combined with a SB program in elementary-aged children. The findings from the current study indicate that several other considerations besides nutrition education alone need to be taken to improve students' F/V intake. One interesting aspect of this study that warrants further exploration is the role of modeling and exposure in increasing F/V intake. As suggested by previous research, peer, educator, and parental modeling can all have a significant impact, both positive and negative, on children's F/V consumption and should be a

core component of future interventions aimed at increasing F/V intake (Fisher et al., 2002; Reynolds et al., 2000; Wrotniak, Epstein, Paluch, & Roemmich, 2005). The length of the intervention also appears to be critical, as weekly interventions lasting longer than six months have proven to be more effective (Gonzalez-Suarez et al., 2009; Sobol-Goldberg et al., 2013; Summerbell et al., 2005). Other important aspects to consider include parental involvement, the home environment, and the incorporation of physical activity programs, as multifaceted approaches have been shown to be the most effective in eliciting long-term behavioral change (Katz, O'Connell, Njike, Yeh, & Nawaz, 2008; Shirley et al., 2015; Sobol-Goldberg et al., 2013). Yet, as stated previously, the multicomponent approach can be expensive and time-consuming for schools to implement. The aim of the current study was to find an affordable, highly adaptable program that most schools could adopt without extensive interruption to the normal school curricula and schedule. The results of this study illustrate the need for additional research in order to identify an effective, yet cost-efficient way to increase F/V consumption among elementary-aged children.

Previous research has shown that nutrition education programs in the school environment aimed at lowering childhood obesity can be successful in increasing F/V intake. The results of the present study offer limited support for the effectiveness of easy-to-implement, low-cost nutrition education programs. In order to be successful, it is evident that nutrition education programs need to include a long-term, multicomponent approach, which may prove costly and challenging to implement. This study highlighted the need for further work in establishing nutrition education curricula that is highly adaptable, affordable, and sustainable.

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## **BIOGRAPHY**

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