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THE IMPACT OF A FRUIT AND VEGETABLE INTERVENTION ON SCHOOL
CAFETERIA FRUIT AND VEGETABLE SELECTION AND CONSUMPTION IN A RURAL,
APPALACHIAN MISSISSIPPI ELEMENTARY SCHOOL

A Thesis

presented in partial fulfillment of requirements

for the degree of Master of Science

in the Department of Nutrition and Hospitality Management

The University of Mississippi

by

Michelle A. Weber

May 2019

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ABSTRACT

Fruit and vegetable intake for children in the United States is low, which puts them at risk for poor health in the future. The National School Lunch Program meal pattern and nutrition standards for participating schools include increased fruits and vegetables, compared to previous standards. Using a pretest-posttest design, this study examined the effect of a fruit and vegetable intervention on fruit and vegetable food selection and consumption in a rural, Appalachian Mississippi elementary school. A six-week intervention (nutrition education, cafeteria tastings, fruit and vegetables for home usage/backpack program) was implemented. The unannounced fruit and vegetable selection and waste measurements evaluated the identical menu served at both pre- and post-intervention. The menu included raw broccoli florets, raw grape tomatoes, baked French fries, raw red grapes, and canned/frozen peaches. Food selection was measured by calculating the proportion of students selecting each item. At both pre- and post-intervention, 10 servings of each item were weighed prior to lunch. Total served was calculated by multiplying the number of each item served by its average sample weight. All tray items not consumed were weighed, and total waste was calculated relative to amount served. Data were analyzed using a 2-proportion z-score test and paired t-test to compare school-level and school-level per person fruit and vegetable food selected and consumed from pre- to post-intervention. Pre- and post-intervention meals served/measured were 256 and 283, respectively. Only the proportion of

students selecting peaches changed (pre, 33%; post, 43%; $p=.01468$). The percentage selection of fruit and vegetable menu components (mean \pm standard deviation) did not significantly change from pre- ($45.6 \pm 29.8\%$) to post-intervention ($50.9 \pm 33.0\%$) [Mean change, -5.3% ; 95% Confidence Interval (CI), -13.6 to 3.1% ; $t(3) = -1.994$; $p = .140$]. Only French fries consumption increased ($p=.00068$), and only peach, broccoli, and grape tomato consumption decreased ($p<.00001$). School-level percentage consumption of fruit and vegetable menu components (mean \pm standard deviation) did not significantly change from pre- ($57.3 \pm 14.4\%$) to post-intervention ($36.2 \pm 33.3\%$) [Mean change, -21.1% ; 95% CI, -13.2 to 55.3% ; $t(4) = 1.709$; $p = .163$]. School-level consumption per person was calculated by dividing the amount of fruit and vegetable components consumed at both pre- and post-intervention by dividing: 1) by the number of reimbursable lunches; and 2) by the number of children who selected that component. School-level (reimbursable lunch method) consumption per person of fruit and vegetable menu components (mean \pm standard deviation) did not significantly change from pre- ($19.3 \pm 18.2g$) to post-intervention ($17.2 \pm 16.9g$) [Mean change, $2g$; 95% CI, -8 to 12 ; $t(4) = 0.566$; $p = .602$]. School-level consumption per person (selection method) of fruit and vegetable menu components (mean \pm standard deviation) did not significantly change from pre- ($42.4 \pm 42.0g$) to post-intervention ($27.2 \pm 25.7g$) [Mean change, $15g$; 95% CI, -17 to 47 ; $t(4) = 1.313$; $p = .259$]. A fruit and vegetable intervention was not effective in changing most foods selected or consumed by elementary school children. The short duration of the intervention may have influenced this. More research is needed to determine how to best encourage fruit and vegetable

selection and consumption among school children.

DEDICATION

This work is dedicated to my father, Jeff Weber.

ACKNOWLEDGMENTS

I would like to thank Dr. David H. Holben for the opportunity to complete this research and for believing in me and being my biggest supporter. I would also like to thank Dr. Yunhee Chang and Dr. Laurel Lambert for being on my committee and for their help. I would also like to thank my family and friends for their constant love and support. In addition, special thanks to Sydney Antolini and Kelsey Dismukes for data collection and entry and to Dr. John P. Holcomb for data analysis advice.

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CHAPTER I: INTRODUCTION

Eating more fruits and vegetables adds nutrients to diets (Kim, Moore, & Galuska, 2014). Regular consumption of fruits and vegetables can reduce the risk for cardiovascular disease, some cancers, hypertension, stroke, and diabetes (Mytton, Nnoaham, Eyles, Scarborough, Mhurchu & Cliona, 2014; Moore & Thompson, 2015). Research has also shown that eating a variety of fruits and vegetables can help children grow and maintain a healthy weight (Centers for Disease Control and Prevention, 2016).

Recommendations for children range from 1-2 cups of fruit per day and 1-3 cups of vegetables per day (CDC, 2017). However, one of the most prominent poor dietary behaviors seen in children is inadequate consumption of fruits and vegetables. For example, one-third of adolescents report consuming fruits and vegetables an average of less than one time daily (United States Department of Health and Human Services, 2013).

Mississippi has the second lowest rate of fruit and vegetable consumption in the nation (CDC, 2013). In Mississippi, 51.1% of adolescents consume fruit less than one time daily, and 44.8% of adolescents consume vegetables less than one time daily (CDC, 2013). Because of the benefits of eating fruits and vegetables and because childhood dietary patterns are associated with food patterns later in life, finding ways to increase fruit and vegetable consumption in children is necessary (Kim et al., 2014).

In 2014, the National School Lunch Program (NSLP) implemented new guidelines that require schools to include one full serving of both a fruit and vegetable at lunch daily (Healthy,

Hunger-Free Kids Act of 2010, 2010). The NSLP is one of the largest federal meal assistance programs in the United States, and it serves over 30 million children annually (USDA, 2017). Schools are an important place to increase fruit and vegetable consumption, because participants of the NSLP consume up to 47% of their daily calories at school (Briefel, Wilson, & Gleason, 2009). There is conflicting research to determine if the new guidelines have increased fruit and vegetable intake, but many people have had concerns that the new guidelines will contribute to a significant amount of plate waste (Turner & Chaloupka, 2014).

The NSLP includes the Offer Versus Serve program (OVS), which is a concept that applies to menu planning and meal service (Institute of Child Nutrition, 2017). OVS allows students to decline some of the food offered in a reimbursable lunch and is only required at the high school level (ICN, 2017). The goals of OVS are to reduce food waste and to permit students to choose the foods they want to eat (ICN, 2017).

The estimated cost of plate waste of the NSLP is \$600 million annually (USDA, 2013). Plate waste can be defined as the edible portion of food uneaten (Byker, Farris, Marcenelle, Davis, & Serrano, 2014; Martins, Cunha, Rodrigues, & Rocha, 2014). Plate waste is a significant issue because it indicates that children might not be getting what they need nutritionally from the food. It is also a financial concern for schools. Developing methods to help reduce plate waste in schools could lead to an overall increase in fruit and vegetable consumption in children.

In the last decade, food-based interventions have become increasingly utilized, especially in schools (Aloia, Shockey, Nahar, & Knight, 2016). Interventions can both help reduce plate waste and increase fruit and vegetable consumption, especially tasting interventions (Alaimo, Carlson, Eisenmann, Paek, Betz, & Norman, 2015). Research has shown that participation in

tasting programs, including repeated tastings, in school cafeterias can be an effective way to improve children's acceptance of foods that were previously not accepted (Lakkakula, Geaghan, Zanovec, Pierce & Tuuri, 2010). The "What's for Lunch" intervention by Struempfer, Parmer Mastropietro, Arsiwalla, & Bubb (2014) included weekly tastings and showed a significant increase in fruit and vegetable consumption in third grade students. Another food-based school intervention by Cohen, Richardson, Austin, Economos & Rimm (2013) offered healthier options at school lunch to 1st through 6th graders and showed an increase in vegetables and combined fruit and vegetable consumption. Finally, a multi-component school nutrition intervention by Alaimo et al. (2015) included tastings and nutrition education in the classroom and increased consumption of fruits, vegetables, and whole grain breads in 3rd to 6th grade students.

In addition to tastings, overall exposure may be important to changing fruit and vegetable intake behaviors. As such, different types of exposures to fruits and vegetables can have an impact on fruit and vegetable consumption in children (Osborne & Forestell, 2013). A study by Osborne & Forestell (2012) found that eight days of home exposure to information about fruits and vegetables and a variety of fruits and vegetables increased consumption of fruit, but not vegetables in four to eight-year old children. Another study found that being offered a range of fruits and vegetables at home and eating a range of fruit and vegetables at home increased the willingness of elementary school children to eat more fruits and vegetables offered at school lunch, including typically disliked items, such as cucumbers and tomatoes (Korinek, Bartholomew, Jowers, & Latimer, 2015). Determining which exposures are most effective could help increase fruit and vegetable consumption in children.

The purpose of this research was to assess the impact of a school-based fruit and

vegetable intervention on fruit and vegetable selection and consumption at lunch of elementary school children in a rural, Appalachian Mississippi school district. The research questions and hypotheses are summarized in Table 1.

Table 1

Research Questions and Hypotheses

Research Question	Hypotheses
What is the impact of a school-based fruit and vegetable intervention on school-level fruit and vegetable selection at lunch?	A school-based intervention will increase school-level fruit and vegetable selection.
What is the impact of a school-based fruit and vegetable intervention on school-level fruit and vegetable consumption at lunch?	A school-based intervention will increase school-level fruit and vegetable consumption.
What is the impact of a school-based fruit and vegetable intervention on school-level fruit and vegetable consumption per person at lunch?	A school-based intervention will increase school-level lunch fruit and vegetable consumption per person.

CHAPTER II: REVIEW OF LITERATURE

The purpose of this research was to assess the impact of a school-based fruit and vegetable intervention on fruit and vegetable selection and consumption of elementary school children in a rural, Appalachian Mississippi school district.

Fruit and Vegetable Intake and Health

Cancer and cardiovascular disease are the two leading causes of death in the United States and in Mississippi (Mississippi State Department of Health, 2014). In 2011, 25.1% of all deaths in Mississippi were due to heart related diseases, and 21.4% of all deaths were due to cancer (MSDH, 2014). Factors that can reduce the occurrence of these diseases, such as increasing fruit and vegetable consumption, could contribute to improvements in health (Wang et al., 2014).

Eating more fruits and vegetables adds nutrients to diets (Kim, et al., 2014). Regular consumption of fruit and vegetables can reduce the risk for cardiovascular disease, some cancers, hypertension, stroke, and diabetes (Mytton et al., 2014; Moore & Thompson, 2015). Fruit and vegetable intake may even positively affect weight control and adiposity (Ledoux, Hingle, & Baranowski, 2011).

Fruit and vegetable consumption for adults is low across the United States (Moore & Thompson, 2015). According to the USDA, in 2013, only 8.9% of adults met daily vegetable

intake recommendations, and 13.1% met fruit intake recommendations (Moore & Thompson, 2015). Since fruit and vegetable consumption is low and affects multiple health outcomes, there is an increased need to improve consumption (Moore & Thompson, 2015). Research has suggested that one way to improve fruit and vegetable intake in adults is to improve intake during childhood (Moore & Thompson, 2015; Kim et al., 2014).

Child Fruit and Vegetable Intake

Childhood dietary patterns are associated with food patterns later in life (Kim et al., 2014). Regular consumption of fruit and vegetables by children can prevent heart disease, hypertension, and diabetes (Mytton et al., 2014). Research has also shown that eating a variety of fruits and vegetables can help children grow and maintain a healthy weight (CDC, 2016).

According to the Centers for Disease Control and Prevention, recommendations for the amount of fruit and vegetables children should consume are based on the child's age, gender, and level of physical activity. Depending on a child's age, produce intake recommendations are 1-2 cups of fruit and 1-3 cups of vegetables daily (CDC, 2017). American children are not eating enough fruits and vegetables (CDC, 2017). From 2003 to 2010, the amount of whole fruit that children consumed increased by 67%, but the amount of whole fruit still remained low, as 6 out of 10 children did not eat enough fruit from 2007 to 2010 (CDC, 2017). During 2007 to 2010, 9 out of 10 children did not eat enough vegetables (CDC, 2017). Furthermore, 36% of adolescents report consuming fruits less than one time a day and 37.7% report consuming vegetables less than one time a day (CDC, 2013). In Mississippi, 39.8% of adolescents report consuming fruits less than one time daily and 42.4% report consuming vegetables less than one time daily, both above the national average (CDC, 2013). Assessing child fruit and vegetable intake is necessary to identify problems and attempt to find solutions to increase fruit and vegetable intake, which

could lead to better eating habits later in life (Kim et al., 2014).

The National School Lunch Program

With about 60 million children in the United States attending child care or school, schools and the food served in schools have an important role in increasing fruit and vegetable intake, especially since most children eat at least one meal at school per day (CDC, 2017). The NSLP is a federally-assisted meal program operating in over 100,000 public and non-profit private schools and residential child and adult care institutions in the United States (USDA, 2017; Bellows, Conlon, Cunningham & Johnson, 2015; Cohen et al., 2015; Gase, McCarthy, Robles & Kuo, 2014). In 2016, the program provided nutritionally balanced, reduced-price, or free lunches to more than 30 million children each school day (USDA, 2017). Any child at a participating school may purchase a meal through the NSLP, but only eligible families are eligible for free and reduced meals. To be eligible for free meals, children must be from families with incomes at or below 130 percent of the poverty level. To be eligible for reduced-price meals, children must be from families between 130 and 185 percent of the poverty level (USDA, 2017).

The NSLP includes the OVS program, which is a concept that applies to menu planning and the meal service (Institute of Child Nutrition, 2017). OVS allows students to decline some of the food offered in a reimbursable lunch and is only required at the high school level (ICN, 2017). OVS includes requirements for food components and food items (USDA, 2015). A food component is one of the five food groups that comprise a reimbursable lunch, which includes meat/meat alternatives, grains, fruit, vegetables, and fluid milk (ICN, 2017). OVS requires students to take at least three of the components in the required serving sizes, and one selection must be at least one serving from either the fruit or vegetable component (USDA, 2015). A

food item is a specific food offered in a reimbursable lunch from the five food components (ICN, 2017).

The NSLP has implemented guidelines to attempt to increase the consumption of fruit and vegetables and, ultimately, decrease childhood obesity (Healthy, Hunger-Free Kids Act of 2010, 2010). In 2010, the Healthy Hunger-Free Kids Act updated the meal patterns and nutrition standards for the NSLP. The goals of this act were to meet the nutrition needs of school children and enhance the diet and health of school children (Healthy, Hunger-Free Kids Act of 2010, 2010). The updated guidelines focused on providing five meal components that include fruits, vegetables, whole grains, low-fat dairy, and meat/meat alternative. The guidelines also require a daily serving of fruit and vegetables and a weekly requirement for three servings of dark green, red/orange, beans/peas, starchy and other vegetables. The meal patterns differ by grade level and the guidelines are summarized in Table 2.

Table 2

NSLP Lunch Meal Patterns

Lunch Meal Patterns			
	Grades K-5	Grades 6-8	Grades 9-12
Amount of food eaten per week (minimum per day)			
Fruits (cups)	2.5 (0.5)	2.5(0.5)	5 (1)
Vegetables (cups)	3.75 (0.75)	3.75(0.75)	5 (1)
Dark green	0.5	0.5	0.5
Red/Orange	0.75	0.75	1.25

Beans and peas (legumes)	0.5	0.5	0.5
Starchy	0.5	0.5	0.5
Other	0.5	0.5	0.75
Additional Vegetables to	1	1	1.5
Reach Total (cups)			
Grains (oz eq)	8-9 (1)	8-10(1)	10-12 (2)
Meats/Meat Alternates (oz)	8-10 (1)	9-10(1)	10-12(2)
Fluid milk (cups)	5 (1)	5(1)	5(1)

Note. From “Final Rule Nutrition Standards in the National School Lunch and Breakfast Programs,” by USDA Food and Nutrition Service, 2012. Retrieved from <https://www.fns.usda.gov/school-meals/nutrition-standards-school-meals>

Limited research has been conducted on the effectiveness of the new guidelines for the NSLP. Before the new guidelines were implemented, a study found that participants in the NSLP consumed less energy-dense food at school than nonparticipants of the program (Briefel et al., 2009). Energy-dense foods include items like chips, baked goods, and fries (Briefel et al., 2009), and the new guidelines mandate that energy-dense foods must now meet specific nutritional guidelines (Guthrie, Newman, Ralston, Prell, & Ollinger, 2013).

According to the USDA, the goals of the updated guidelines and the OVS program are to reduce food waste in school meal programs and to permit students to decline foods they do not intend to eat. Although the goal of the new standards is to reduce plate waste, many researchers have questioned that (Byker, et al., 2014; Schwartz, Henderson, Read, Danna & Ickovics, 2015; Amin, Taylor, Yon & Johnson, 2013). Byker et al. (2014) completed a plate waste study after the new guidelines were implemented and found that 45.3% of food and beverages served during

a full week of school were wasted. Another study completed after the updated OVS guidelines were implemented found different results. Schwartz et al. (2015) found that students choosing a vegetable decreased from 68% to 52%, but students selecting vegetables ate 20% more of them, which lowered vegetable plate waste. The authors also found that entrée consumption increased from 71% to 84%, which also decreased plate waste. Another study compared the plate waste of pre-portioned fruit and vegetables, as OVS, to the plate waste of salad bars in an elementary school. These results showed that 6.6% more students selected a pre-portioned fruit and vegetable meals than the salad bar (Amin et al., 2013). Another study by Goggans, Lambert, and Chang (2011) compared OVS and serve only service methods in fourth and fifth grade elementary students and found that fruit and vegetable plate waste was significantly lower in the school using OVS, compared to the school using serve only. This study also found that there was no significant difference in fruit and vegetable consumption of all students participating in each of the two service methods. These results show that the OVS method has the potential to increase the amount of fruits and vegetables selected. The literature and these results also illustrate that more research needs to be done to determine the effect of the new meal pattern guidelines on plate waste.

School Lunch Plate Waste

Plate waste studies have been utilized for more than 40 years to assess nutrient intake, dietary quality, and effectiveness of the National School Lunch Program (Shanks, Banna, & Serrano, 2017). School lunch plate waste is most commonly defined as the amount of edible food served to students that is uneaten (Byker et al., 2014; Martins et al., 2014). Plate waste in children's school lunches is traditionally measured using four different methods. These include the direct weighing method and indirect methods (visual estimation, digital photography, and

food consumption recalled by children) (Martins et al., 2014). A systematic review by Shanks et al. (2017) found that from 1978 to 2015, the most common method used to measure plate waste was the direct weighing method. The direct weighing method is also considered to be the most accurate, with both original servings of food and unconsumed food being weighed for each participant (Buzky & Guthrie, 2002). Although direct weighing is the most accurate method, more research needs to be done to establish more uniform metrics to measure and report on plate waste (Shanks et al., 2017).

Plate waste data are commonly used to assess the NSLP, including the effectiveness of menu performance and acceptance, dietary intake adequacy, and nutritional adequacy of school meals (Cohen et al., 2013; Nicklas et al., 2012; Upton, D., Upton, P., & Taylor, C., 2013). Plate waste data can also be used to determine the economic impact and efficacy of nutritional education programs (Cohen et al., 2013; Nicklas et al., 2012; Upton et al., 2013). The estimated cost of plate waste for the NSLP is over \$600 million annually (USDA, 2017).

In addition to the economic cost, plate waste may also reduce the potential health benefits of school lunches for children. If a majority of the fruits and vegetables that are served to children is thrown away, students may not be getting the intended health benefits. This waste may especially affect low-income students who depend on school meals for up to half of their energy intake (Briefel et al., 2009; Cohen et al., 2012).

Many plate waste studies have been conducted, with mixed results. A study conducted by Byker et al. (2014) used the direct weighing method and found that 45.3% of food served was wasted in one week from one pre-kindergarten class and five kindergarten classes. The greatest amount of food waste was from vegetables, the main entrée, and milk. A study conducted by Handforth, Gilboy, Harris, & Melia (2016) used the digital photography method and found that

elementary school students consumed significantly less whole and cut-up fruits and vegetables than high school students. This study also found that whole fruits and raw vegetables were highly selected, but also highly wasted. The current plate waste studies show that there is a need for further research focused on how to simultaneously increase fruit and vegetable consumption and decrease plate waste.

Interventions to Improve Fruit and Vegetable Intake

Children spend more than one-third of their waking hours at school, and many students eat up to two meals and snacks each day at school (CDC, 2017). Because of this, school-based interventions have become increasingly utilized and could play an important role in promoting positive dietary behavior change among children and adolescents (Story, Kaphingst, & French, 2006).

Although the NSLP has been effective in reducing the amount of empty calories children consume at school and improving food insecurity, researchers have suggested that there are additional ways to increase fruit and vegetable consumption in children both at school and home (Bica, Jamselske, Lagorio, 2016; Ralston & Coleman-Jensen, 2017). Some of these ways include produce interventions, school gardens, and farm-to-school programs. Produce interventions are the most commonly suggested interventions, likely because these interventions are the most feasible (Bica et al., 2016).

Exposure-based interventions in schools can be an effective way to increase consumption of fruits and vegetables (Wardle, Herrera, Cooke, Gibson, 2003). Exposure-based nutrition interventions rely on the repeated exposures to nutrient-rich foods (Wardle et al., 2003). Types of exposures include nutrition education classes, cooking lessons, fruits and vegetables served in school lunch meals, tastings of fruits and vegetables, and gardens (Wardle et al., 2003; Story et

al., 2006). More research needs to be done on each type of exposure to determine which is most effective.

The USDA Fresh Fruit and Vegetable Program (FFVP) is a school-based program that has had positive outcomes related to children's fruit and vegetable consumption (USDA, 2013). This program provides funding for schools to serve free fruit and vegetable snacks to students at times other than lunch (USDA, 2013). The program is designed for elementary schools where at least 50% of students qualify for free or reduced priced school meals (USDA, 2013; Bica, et al., 2016). Studies have shown that this program has been successful in increasing fruit and vegetable consumption, but other studies have shown that the increased fruit and vegetable consumption may not extend beyond the snack period at school (Bica et al., 2016; Bica & Jamelske, 2012; Davis, Cullen Watson, Konarik & Radcliffe, 2009; Coyle, Potter, Schneider, May, Robin, Seymour & Debrot, 2009).

Fruit and Vegetable Tastings

One type of exposure that has proven to be effective is tastings. Repeated tastings of foods in younger students in preschool through sixth grade has been associated with high acceptability of fruits and vegetables (Kaiser et al., 2012). Children in this age group have also been found to be receptive to trying new foods in the school environment (Kaiser et al., 2012; Lakkakula et al., 2010). A study conducted among 2,945 children in third through sixth grade found that after a taste-testing in schools, along with nutrition education, the percentage of children reporting liking the food increased from 55.8% to 65.2% (Cirignano, Fitzgerald, Hughes, Savoca, Morgan, Greci, 2014). This study also found that children who were familiar with the foods before the tasting were more likely to accept the foods. However, even among those who had not tried or liked the foods before, acceptance increased after the tasting

(Cirignano et al., 2014).

Another study conducted found that monthly tastings of fruits and vegetables, along with related in-class activities and parent newsletters, increased fruit consumption by 0.3 servings from pre- to post-intervention in sixth to eighth grade students (Voorhees, Goto, Bianco-Simeral, Wolff, 2011). Bellows et al. (2015) also had success with a study that included food tastings. This study implemented a “tasting challenge” activity in the classroom and found that 89.8% of students were willing to try a new fruit or vegetable (Bellows et al., 2015). Another successful tasting study utilized a pretest-posttest design, and it served local sweet potatoes as part of the NSLP OVS program, had a tasting of local sweet potatoes in the cafeteria two weeks later, and served the local sweet potatoes as part of NSLP lunch again (Bristow, Jenkins, Kelly, Mattfeldt-Beman, 2017). The results showed that after the tasting, the percentage of sweet potatoes selected during lunch service increased by 47% (Bristow et al., 2017).

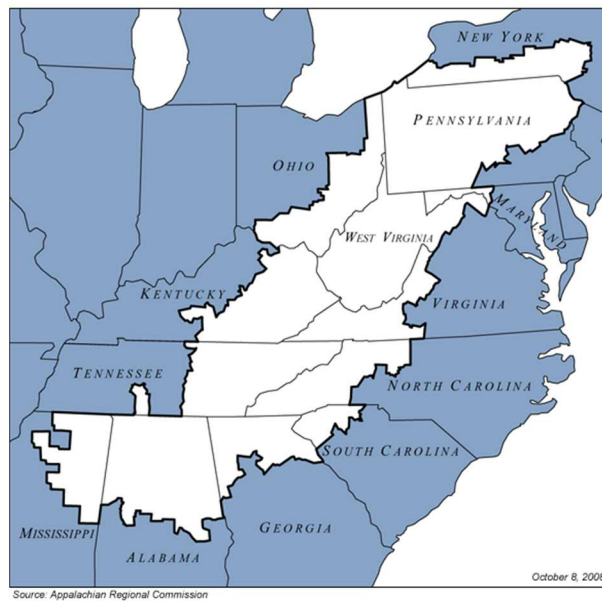
Fruit and Vegetable Exposure

Additional research has shown that different types of exposures to fruits and vegetables can have an impact on fruit and vegetable consumption in children (Osborne & Forestell, 2013). A study by Osborne & Forestell (2012) found that eight days of home exposure to information about fruits and vegetables and a variety of fruits and vegetables increased consumption of fruit, but not vegetables in four to eight-year old children. Another study found that being offered a range of fruits and vegetables at home and eating a range of fruit and vegetables at home increased the willingness of elementary school children to eat more fruits and vegetables offered at school lunch, including typically disliked items, such as cucumbers and tomatoes (Korinek, Bartholomew, Jowers, & Latimer, 2015). More research needs to be conducted to determine if exposure, in general, has a direct link to fruit and vegetable consumption in children.

Setting for this Study - Appalachia

This study was conducted in rural, Appalachian Mississippi. Appalachia is defined as a 205,000-square-mile region that follows the spine of the Appalachian Mountains from southern New York to northern Mississippi (Appalachian Regional Commission, 2017). Figure 1 shows a map of the Appalachian region.

Figure 1: The Appalachian Region

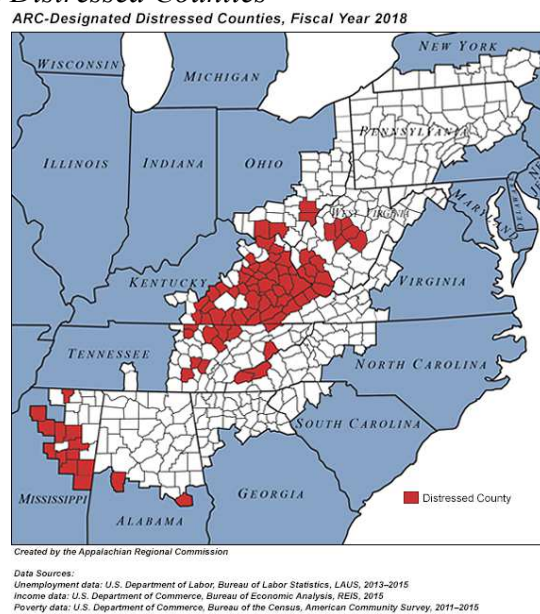


Note. From the Appalachian Regional Commission. Reprinted with permission of the author. Retrieved from https://www.arc.gov/appalachian_region/mapofappalachia.as

Forty-two percent of the Appalachian Region's population is rural (ARC, 2017). Rural areas are generally defined as an area with a population less than 50,000 (Rockymore, Moscetti, Fountain, 2014). The Appalachian Regional Commission uses an index-based county economic classification system to identify and monitor the economic status of Appalachian Counties (ARC, 2017). Each county's averages for three-year average unemployment rate, per capita market income, and poverty rate are compared with national averages and used to create a

composite index value for each county (Appalachian Regional Commission). Each county is then ranked and designated as distressed, at-risk, transitional, competitive, or attainment (Appalachian Regional Commission). Fifty eight percent of Appalachian Mississippi is distressed, including Calhoun County, Mississippi (Appalachian Regional Commission). Figure 2 shows a map of the Appalachian Mississippi Region that highlights the distressed regions, and table 3 lists the Appalachian Mississippi counties for 2017.

Figure 2: ARC-Designated Distressed Counties



Note. From Appalachian Regional Commission. Reprinted With permission of the author. Retrieved from <https://www.arc.gov/programareas/mapofarcdesignateddistressedcountiesfiscalyear2017.asp>

Table 3

2017 Appalachian Mississippi Counties and Designation

Appalachian Mississippi Counties			
County	2017 ARC designation	County	2017 ARC designation

Alcorn	At-Risk	Montgomery	Distressed
Benton	Distressed	Noxubee	Distressed
Calhoun	Distressed	Okitbbeh	Distressed
Chickasaw	At-Risk	Panola	Distressed
Choctaw	Distressed	Ponotoc	Transitional
Clay	Distressed	Prentiss	At-Risk
Itawamba	Transitional	Tippah	Distressed
Kemper	Distressed	Tishomingo	At-Risk
Lee	Transitional	Union	At-Risk
Lowndes	At-risk	Webster	At-Risk
Marshall	At-Risk	Winston	Distressed
Monroe	At-Risk	Yalobusha	Distressed

Note. From the Appalachian Regional Commission. Retrieved from https://www.arc.gov/appalachian_region/Mississippi.asp

CHAPTER III: METHODOLOGY

The purpose of this research was to assess the impact of a school-based fruit and vegetable intervention on fruit and vegetable selection and consumption of elementary school children in a rural, Appalachian Mississippi school district. The research questions and hypotheses are summarized in Table 1.

Ethics Approval

This study utilized the *Farm-to-YOUth!* project conducted in fall 2016. This study was approved by the University of Mississippi Institutional Review Board, as part of the *Farm-to-YOUth!* program. The school district also approved this study.

Setting

The study was implemented in an elementary school in Calhoun County School District, located in a rural, Appalachian Mississippi school county. Calhoun County is assigned an USDA Rural-Urban Continuum Code 9 (USDA, 2016), which means that it is completely rural and not adjacent to a metro area (USDA, 2016). It is also USDA-designated as a no persistent poverty (USDA, 2017) county. ARC designates Calhoun County as a distressed county (ARC, 2017), which means that it is ranked in the worst 10 percent of the nation's counties, based upon unemployment, income, and poverty data (ARC, 2017).

The population of Calhoun County is 14,610, and the largest racial/ethnic groups are

White (69.8%), African-American (28.5%) and Hispanic (5.6%) (United States Census Bureau, 2016). In summary, of Calhoun County residents age 25 years or older, 74.6% have a high school degree or higher, and 10.9% have a bachelor's degree or higher (United States Census Bureau, 2016). The median household income of Calhoun County is \$31,141 (United States Census Bureau, 2016), and 21.9% of residents live in poverty (United States Census Bureau, 2016).

According to National Center for Educational Statistics (National Center for Education Statistics, 2018), Bruce Elementary School includes students from pre-kindergarten to third grade. The racial/ethnic groups include White (60.1%), African-American (34.9%), and Hispanic (4.0%) (National Center for Education Statistics, 2018). Regarding gender, 48% of students attending Bruce Elementary are female, and 52% of students are male (National Center for Education Statistics, 2018). Regarding National School Lunch eligibility, 271 students (70.6%) are eligible for free school lunch, and 31 students (8%) are eligible for reduced-price lunch.

Study Design and School-based Fruit and Vegetable Intervention

This study utilized a pretest-posttest design to assess the impact of a school-based fruit and vegetable intervention on fruit and vegetable selection and consumption of elementary school children in a rural, Appalachian Mississippi school district. The intervention was a six-week fruit and vegetable nutrition education program implemented in Bruce Elementary School, Bruce, Mississippi, in October 2016. The program included nutrition education sent home with children and fruit and vegetable tastings in the cafeteria. A tasting station was in the cafeteria twice weekly. During the first tasting of the week, the fruit or vegetable was given to the students without any additional seasonings or flavorings. The second tasting of the week

included the fruit or vegetable incorporated into a recipe, from the cookbook given to each student prior to the program. All students were invited to taste the samples and self-selected to participate in the tasting, whether they ate the school meal or brought their own lunch.

Along with the tastings, on the last day of the week, all students received a bag of the fresh produce to take home to prepare the dish being sampled. The bag of produce included the ingredients to make the recipe that was sampled during the week. Students absent from school may not have received a bag of produce. The details of the intervention are in Table 4.

Table 4

School-based Fruit and Vegetable Intervention

Week (Day/Date)	Food Item or Research Strategy	Recipe or Backpack List	Evaluation or Education Sent to Home
Pre-Survey (September 27, 2016)	Pre-Study Survey	-	<u>Evaluation</u> : Survey (Pre) <u>Education</u> : Program Information, cookbook ^a <u>Bag for Transporting Home</u> : Therm-O-Snack Lunch Bag
Pre-Survey/Week 1 (October 3, 2016)	Food Waste Study (intervention school only)	-	-
Week 1 (October 4, 2016)	Fresh Cucumber Slices	-	-
Week 1 (October 6, 2016)	Marinated Cucumber Tomato Salad	Page 69, Cookbook	-
Week 1 (October 7, 2016)	Cucumber Salad Produce-pack (intervention school only)	4 slicing cucumbers 2 cherry tomato packs 1 large red onion 1 small basil pack	<u>Evaluation</u> : - <u>Education</u> : Recipe <u>Bag for Transporting Home</u> : Non-woven Drawstring Backpack (375, Red/Blue)

Week 2 (October 13, 2016)	Fresh Pineapple Spears	-	<u>Evaluation:</u> - <u>Education:</u> <ul style="list-style-type: none"> • Produce Food Safety Handout • Make Plate Half Fruits and Veg Handout <u>Kitchen Gadget:</u> Vegetable Cleaning Brushes (carrot, potato) <u>Bag for Transporting Home:</u> Cotton Corded Drawstring Bag
Week 2 (October 14, 2016)	Fruit Salad Produce-pack (intervention school only)	1 pineapple 3 navel oranges 3 # bag of apples 1 small mint pack	<u>Evaluation:</u> - <u>Education:</u> <ul style="list-style-type: none"> • Cutting a Pineapple Handout • Seasonal Fruit with Fresh Mint Recipe <u>Bag for Transporting Home:</u> Striped Tote
Week 3 (October 18, 2016)	Fresh, Lightly Steamed Brussels Sprouts	-	-
Week 3 (October 20, 2016)	Brussels Sprouts with Cherry Tomato Salad	Page 37, Cookbook	-
Week 3 (October 21, 2016)	Brussels Sprouts Salad Produce-pack (intervention school only)	1 bag of Brussels sprouts 1 cherry tomato pack 1 garlic bulb 1 small basil pack	<u>Evaluation:</u> - <u>Education:</u> Recipe <u>Bag for Transporting Home:</u> Striped Tote
Week 4 (October 25, 2016)	Fresh Baby Kale Kale Chips	-	-
Week 4 (October 27, 2016)	Easy Kale and Tomatoes	Page 95, Cookbook	<u>Evaluation:</u> - <u>Education:</u> <ul style="list-style-type: none"> • Produce Storage Handout <u>Kitchen Gadget:</u> Produce Storage Bags <u>Bag for Transporting Home:</u> Cotton Corded Drawstring Bag
Week 4 (October 28,	Easy Kale and Tomatoes	2 bags kale 2 cherry	<u>Evaluation:</u> - <u>Education:</u> Recipe

2016)	Salad Produce-pack (intervention school only)	tomato packs 2 large sweet onions	<u>Bag for Transporting Home:</u> Striped Tote
Week 5 (November 1, 2016)	Fresh Mango Chunks	-	-
Week 5 (November 3, 2016)	Mango Cilantro Salsa with Tortilla Chips	Page 63, Cookbook	-
Week 5 (November 4, 2016)	Mango Cilantro Salsa Produce-pack (intervention school only)	4 mangos 2 avocados 1 lime 1 small red onion 1 small cilantro pack 1 garlic bulb	<u>Evaluation:</u> - <u>Education:</u> <ul style="list-style-type: none"> • Cutting a Mango Handout • Recipe <u>Bag for Transporting Home:</u> Striped Tote
Week 6 (November 8, 2016)	Roasted Sweet Potato Chunks	-	-
Week 6 (November 10, 2016)	Apple-roasted Sweet Potatoes and Winter Squash	Page 148, Cookbook	<u>Evaluation:</u> Survey (Post) <u>Education:</u> Kid-friendly Veggies and Fruits 10 Tips Handout <u>Kitchen Gadget:</u> Vegetable Steamer <u>Bag for Transporting Home:</u> Striped Tote
Week 6 (November 11, 2016)	Apple-roasted Sweet Potatoes and Winter Squash Produce-pack (intervention school only)	5 # bag of sweet potatoes 1 small acorn or butternut squash 1 small rosemary pack	<u>Evaluation:</u> - <u>Education:</u> Recipe <u>Bag for Transporting Home:</u> Striped Tote

^a *From Asparagus to Zucchini – A Guide to Cooking Farm-Fresh Seasonal Produce. Third edition.* Madison, Wisconsin: Jones Books.

Participants

All parents/caretakers of students attending Bruce Elementary School were informed

about the intervention using an information sheet (Appendix 1), which was sent home with a produce cookbook, *From Asparagus to Zucchini: A Guide to Cooking Farm-Fresh Seasonal Produce* (Madison Area Community Supported Agriculture Coalition, 2004). Students attending Bruce Elementary ranged from pre-kindergarten (age 4) through 3rd grade (n=363). Only students who consumed lunch prepared by the school cafeteria were eligible to participate in the plate waste study.

Fruit and Vegetable Selection and Consumption

For the purpose of this study, fruits and vegetables were defined as the fruits and vegetables served that day, which included fresh, frozen, and canned fruits and vegetables. Fruit and vegetable selection was defined as the proportion of students selecting each item. Fruit and vegetable consumption was defined as the amount of fruits and vegetables eaten (not wasted) by the students.

Selection and consumption were measured at both pre- (October 3, 2016) and post- (November 4, 2016) intervention. Measurement days were on the same day of the week (Monday) and had the same menu served. Table 5 summarizes the fruit and vegetable components served on the measurement days. Condiments (e.g. salad dressings, ketchup) were available for students, and they were served on the side.

Table 5

Fruit and Vegetable Components Served

Pre-Intervention Menu (Week 0)	Post-Intervention Menu (Week 7)
Raw Broccoli Florets	Raw Broccoli Florets
Raw Grape Tomatoes	Raw Grape Tomatoes
Baked French Fries	Baked French Fries
Raw Red Grapes	Raw Red Grapes
Canned Yellow Peaches	Canned Yellow Peaches ^a

^aAt post-intervention, frozen peaches were substituted for canned peaches by the school.

Fruit and vegetable selection was assessed at the school-level by utilizing the cashier database records, coupled with the inventory of food items served. To determine school-level selection for each component, the inventory of items served was tallied. The percentage selected was determined by dividing the number of servings served by the total reimbursable meals served, as recorded by the cashier. The research school utilizes OVS, and students were permitted to select all fruit and vegetable components offered without restriction.

A plate waste study, using a modified direct-weighing method of Byker et al. (2014), was conducted to determine fruit and vegetable consumption. All investigators were trained in use of the scales and in recording data. First, ten samples of each produce item served were weighed to determine the average reference weight for each fruit and vegetable component. To determine the amount of fruits and vegetables served, the number of servings selected for each separate fruit and vegetable component was multiplied by its average reference weight.

Prior to collecting fruit and vegetable waste, foil pans were labeled. Individual pans were utilized to collect waste for each fruit and vegetable that was on the menu. Before collection of waste, each scale was calibrated. Researchers also weighed and tared the foil pans. When students finished their lunch period, they returned trays to the return window, and the research team separated produce items into their respective pans. While it was rare, if any condiments were left on the fruits or vegetables, researchers crudely removed the condiments by wiping the fruit or vegetable on the side of the tray, to ensure the condiments did not add to the weight of the waste. At the end of each lunch period, foil pans containing the components were weighed in grams and recorded. Waste from each lunch period was summed to determine the total amount wasted for each component.

School-level fruit and vegetable consumption was determined by subtracting the amount of each component wasted from the total amount served. The percent of fruit and vegetables consumed was determined by dividing the mass consumed by the total consumed and multiplying by 100% for each component.

School-level fruit and vegetable consumption per person was calculated, using two different methods,: 1) by dividing the amount of fruit and vegetable components consumed at the school-level the number of reimbursable lunches purchased; and 2) by dividing the amount of fruit and vegetable components consumed at the school-level by the number of children who selected that component.

Statistical Measures Performed

Pre- and post-intervention raw data were entered into the IBM Statistical Package for the Social Sciences (SPSS, 2017, version 24.0, Chicago, IL) to compute fruit and vegetable selection and consumption. Next, Social Science Statistics (Social Science Statistics, www.socstatistics.com, 2018, Jeremy Stangroom) was used to compute a 2-proportion z-test to assess for differences in school-level fruit and vegetable selection and consumption, from pre- to post-intervention. Finally, paired t-tests were computed using SPSS to determine significant differences in school-level selection, school-level consumption, and school-level consumption per student of fruit and vegetable components. Specifically, the statistical measures performed are summarized in Table 6. The variables utilized are summarized in Table 7.

Table 6

Research Questions and Analytical Methods

Research Question	Statistical Procedure
What is the impact of a school-based fruit and vegetable intervention on school-level fruit and vegetable selection at lunch?	2-proportion z-score test Paired t-test

What is the impact of a school-based fruit and vegetable intervention on school-level fruit and vegetable consumption at lunch? 2-proportion z-score test
Paired t-test

What is the impact of a school-based fruit and vegetable intervention on school-level fruit and vegetable consumption per person at lunch? Paired t-test

The variables utilized are summarized in Table 7.

Table 7

Variable Definitions and Measurements

Variables	Definition	Coding
School-level fruit and vegetable consumption	Total amount of each fruit and vegetable component served minus the amount wasted divided by the factor of interest (e.g., number of children who selected that component; number of reimbursable meals)	Grams
School-level fruit and vegetable selection	The number of students selecting each fruit and vegetable component	Percentage

CHAPTER IV: RESULTS

Participant Characteristics

Students attending the school ranged from pre-kindergarten through 3rd grade (n=363). Lunch menu component selection and consumption were measured for meals served by the school cafeteria on October 3, 2016, and November 4, 2016. At pre-intervention, 256 students (77.6% of the student body) participated, and, at post-intervention, 283 students (85.8% of the student body) participated.

Fruit and Vegetable Selection

Fruit and vegetable selection at pre- and post- intervention are shown in Table 8.

Table 8

Fruit and Vegetable Lunch Menu Components Selected at Pre- and Post-Intervention

Fruit and Vegetable Component	Pre-intervention (n=256)		Post-intervention (n=283)		z-score	p-value
	n	Percent	n	Percent		
Raw Broccoli Florets and Raw Grape Tomatoes	26	10.2%	23	8.1%	-0.8183	.41222
Baked French Fries	199	77.0%	238	84.1%	1.8838	.06010
Raw Red Grapes	159	62.1%	192	67.8%	1.3951	.16152

Canned Yellow Peaches ^a	85	33.2%	123	43.5%	2.4434	.01468
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^aAt post-intervention, frozen peaches were substituted for canned peaches by the school.

Only the proportion of students selecting canned/frozen yellow peaches significantly increased from pre- (33.2%) to post-intervention (43.5%) ($p=.01468$). No other significant changes in selection were noted from pre- to post-intervention. In summary, the proportion of students selecting raw broccoli florets and raw grape tomatoes was 10.2% at pre-intervention and 8.1% at post-intervention ($p=.41222$). The proportion of students selecting baked French fries was 77.0% at pre-intervention and 84.1% at post-intervention ($p=.06010$). The proportion of students selecting raw red grapes was 62.1% at pre-intervention and 67.8% at post-intervention ($p=.16152$).

A paired t-test was run on the sample of four fruit and vegetable menu components (see Table 8) that were selected at pre- and post-intervention to determine whether there was a statistically significant mean difference between the percentage of fruit and vegetable menu components selected at pre- and post-intervention. The percentage selection of fruit and vegetable menu components (mean \pm standard deviation) did not significantly change from pre- ($45.6 \pm 29.8\%$) to post-intervention ($50.9 \pm 33.0\%$) [Mean change, -5.3% ; 95% Confidence Interval (CI), -13.6 to 3.1% ; $t(3) = -1.994$; $p = .140$].

Fruit and Vegetable Consumption

The amount of fruit and vegetable components served and average reference weights at pre- and post-intervention are summarized in Table 9.

Table 9

Fruit and Vegetable Components Served and Average Reference Weights at Pre- and Post-Intervention

Fruit and Vegetable Component	Number of Servings Pre (n)	Reference Weight Average Pre (g)^a	Amount Served Pre (g)^b	Number of Servings Post (n)	Reference Weight Average Post (g)^a	Amount Served Post (g)^b
Raw Broccoli Florets	26	18.0	468	23	18.6	428
Raw Grape Tomatoes	26	18.6	484	23	18.3	421
Baked French Fries	199	50.9	10,129	238	50.1	11,924
Raw Red Grapes	159	86.4	13,738	192	75.3	14,458
Canned Yellow Peaches ^c	85	148.2	12,597	123	134.1	16,494

^a10 components were randomly selected and weighed to determine average reference weight for each component.

^bAmounts served at pre- and post-intervention were rounded to whole grams.

^c At post-intervention, frozen peaches were substituted for canned peaches by the school.

The amounts of fruit and vegetable components served and consumed on pre- and post-intervention collection days, as well as pre- and post-intervention consumption percentages, are shown in Table 10.

Table 10

School-level Fruit and Vegetable Components Served and Consumed at Pre- and Post-

Intervention

Fruit and Vegetable Component	Amount Served Pre (g)	Amount Consumed Pre (g)	Percentage Consumed Pre^a	Amount Served Post (g)	Amount Consumed Post (g)	Percentage Consumed Post^a
Raw Broccoli Florets	468	185	39.5%	428	27	6.3%
Raw Grape Tomatoes	484	247	51.0%	421	7	1.7%
Baked French Fries	10,129	5,235	51.7%	11,924	7,883	66.1%
Raw Red Grapes	13,738	9,976	72.6%	14,458	10,741	74.3%
Canned Yellow Peaches ^b	12,597	9,019	71.6%	16,494	5,691	32.7%

^aCalculated by dividing amount consumed by amount served and multiplying by 100%.

^bAt post-intervention, frozen peaches were substituted for canned peaches by the school.

Table 11 summarizes the changes in percentage of fruit and vegetable components consumed from pre- to post-intervention.

Table 11

School-level Change in Fruit and Vegetable Components Consumed from Pre- to Post-

Intervention

Fruit and Vegetable Component	Consumption Percentage Pre	Consumption Percentage Post	z-score	p-value
Raw Broccoli Florets	39.5%	6.3%	-9.2846	<.00001

Raw Grape Tomatoes	51.0%	1.7%	-13.1990	<.00001
Baked French Fries	51.7%	66.1%	3.4041	.00068
Raw Red Grapes	72.6%	74.3%	0.4400	.65994
Canned Yellow Peaches ^a	71.6%	32.7%	-9.0208	<.00001

^aAt post-intervention, frozen peaches were substituted for canned peaches by the school.

Only baked French fries consumption increased from pre- (51.7%) to post-intervention (66.1%) ($p=.00068$). Raw broccoli floret consumption decreased from pre- (39.5%) to post-intervention (6.3%) ($p\leq.00001$). Raw grape tomato consumption decreased from pre- (51.0%) to post-intervention (1.7%) ($p\leq.00001$). Canned/frozen yellow peach consumption decreased from pre- (71.6%) to post-intervention (32.7%) ($p\leq.00001$). However, raw red grape consumption did not significantly change from pre- (72.6%) to post-intervention (74.3%) ($p=.65994$).

A paired t-test was run on the sample of five fruit and vegetable components (see table 10) that were consumed at pre- and post-intervention to determine whether there was a statistically significant mean difference between the percentage of fruit and vegetable menu components consumed at pre- and post-intervention. School-level percentage consumption of fruit and vegetable menu components (mean \pm standard deviation) did not significantly change from pre- ($57.3 \pm 14.4\%$) to post-intervention ($36.2 \pm 33.3\%$) [Mean change, -21.1% ; 95% CI, -13.2 to 55.3% ; $t(4) = 1.709$; $p = .163$].

As summarized in the methods (Chapter 3), school-level consumption per person was calculated by dividing the amount of fruit and vegetable components consumed at both pre- and post-intervention by dividing: 1) by the number of reimbursable lunches; and 2) by the number of children who selected that component. Tables 12 and 13 summarize these results.

Table 12

*School-level Fruit and Vegetable Components Consumed Per Person at Pre- and Post-**Intervention (Reimbursable Lunch Method)*

Fruit and Vegetable Component	Number of Reimbursable Lunches Pre	School-level Amount Consumed Pre (g)	School-level Amount Consumed Per Person Pre (g)^a	Number of Reimbursable Lunches Post	School-level Amount Consumed Post (g)	School-level Amount Consumed Per Person Post (g)^a
Raw Broccoli Florets	256	185	0.72	283	27	0.10
Raw Grape Tomatoes	256	247	0.96	283	7	0.02
Baked French Fries	256	5,235	20.45	283	7,883	27.86
Raw Red Grapes	256	9,976	38.97	283	10,741	37.95
Canned Yellow Peaches ^b	256	9,019	35.23	283	5,691	20.11

^a Calculated by dividing the amount of fruit and vegetable components consumed at both pre- and post-intervention by dividing by the number of reimbursable lunches. Due to the small intake amount for some components, two decimal places were utilized.

^bAt post-intervention, frozen peaches were substituted for canned peaches by the school.

A paired t-test was run on the sample of five fruit and vegetable components (see Table 11) that were consumed at pre- and post-intervention to determine whether there was a statistically significant mean difference between the amount of fruit and vegetable menu components consumed at pre- and post-intervention. School-level (reimbursable lunch method)

consumption per person of fruit and vegetable menu components (mean \pm standard deviation) did not significantly change from pre- ($19.3 \pm 18.2\text{g}$) to post-intervention ($17.2 \pm 16.9\text{g}$) [Mean change, 2g; 95% CI, -8 to 12; $t(4) = 0.566$; $p = .602$].

Table 13

School-level Fruit and Vegetable Components Consumed Per Person at Pre- and Post- Intervention (Selection Method)

Fruit and Vegetable Component	Number of Servings Selected Pre	School-level Amount Consumed Pre (g)	School-level Amount Consumed Per Person Pre (g)^a	Number of Servings Selected Post	School-level Amount Consumed Post (g)	School-level Amount Consumed Per Person Post (g)^a
Raw Broccoli Florets	26	185	7	23	27	1
Raw Grape Tomatoes	26	247	10	23	7	0
Baked French Fries	199	5,235	26	238	7,883	33
Raw Red Grapes	159	9,976	63	192	10,741	56
Canned Yellow Peaches ^b	85	9,019	106	123	5,691	46

^a Calculated by dividing the amount of fruit and vegetable components consumed at both pre- and post-intervention by dividing by the number of children who selected that component.

^b At post-intervention, frozen peaches were substituted for canned peaches by the school.

A paired t-test was run on the sample of five fruit and vegetable components (see Table 11) that were consumed at pre- and post-intervention to determine whether there was a statistically significant mean difference between the amount of fruit and vegetable menu

components consumed at pre- and post-intervention. School-level (selection method) consumption per person of fruit and vegetable menu components (mean \pm standard deviation) did not significantly change from pre- (42.4 \pm 42.0g) to post-intervention (27.2 \pm 25.7g) [Mean change, 15g; 95% CI, -17 to 47; $t(4) = 1.313$; $p = .259$].

CHAPTER VI: DISCUSSION

The purpose of this research was to assess the impact of a school-based fruit and vegetable intervention on fruit and vegetable selection and consumption at lunch of elementary school children in a rural, Appalachian Mississippi school district. The results of this study showed that a six-week intervention that included nutrition education, cafeteria fruit and vegetable tastings, and take-home produce had minimal impact on fruit and vegetable selection and waste in elementary school children.

Fruit and Vegetable Selection

The findings of this study do not support the hypothesis that a school-based intervention increases fruit and vegetable selection. In this study, only the proportion of students selecting peaches significantly increased from pre- to post-intervention ($p=.01468$). At pre-intervention, 33.2% of students selected peaches, and, at post-intervention, 43.5% of students selected peaches. Other research has found different results. Voorhees et al. (2011) found that monthly tastings of fruits and vegetables increased fruit consumption by 0.3 servings from pre- to post-intervention in sixth to eighth grade students. Bellows et al. (2015) had success with a study that included a “tasting challenge” activity of fruits and vegetables and found that 89.9% of students were willing to try a new fruit or vegetable. One reason for the significant results of these two studies could be the length of the interventions. Both interventions were four or more months

long, which gives children more time to accept and therefore select more fruits and vegetables, compared to this short-term intervention. Utilizing a pretest-posttest design, Bristow et al. (2017) included local sweet potatoes as part of their NSLP OVS lunch and found that the percentage of sweet potatoes selected during lunch service increased by 47%.

Another reason could be that only one menu was evaluated. Examining selection over an entire cycle may have yielded different results.

Fruit and Vegetable Consumption

The findings of this study do not support the hypothesis that a six-week school-based intervention will increase fruit and vegetable consumption. Only baked French fries consumption increased from pre- to post-intervention ($p=.00068$). Consumption percentage was 51.7% pre-intervention and 66.1% post-intervention. Peach, broccoli, and cherry tomato consumption decreased from pre- to post-intervention ($p<.00001$). These results are consistent with existing plate waste studies, which have mixed results. Similar to a study conducted by Handforth, et al. (2016), who used the digital photography method and found that elementary school students consumed significantly less whole and cut-up fruits and vegetables than high school students, the current study also found that whole fruits and raw vegetables selected were highly wasted.

Other related research includes a study by Cohen et al. (2014) who found that post-implementation of the new NSLP standards, vegetable consumption increased by 16.2%, and fruit consumption remained the same. A study conducted by Byker et al. (2014) found that 45.3% of food served during one week was wasted from one pre-kindergarten class and five kindergarten classes, with the greatest amount of waste from vegetables, the main entrée, and milk.

The findings of this research and other research warrant more research to be conducted on how to increase fruit and vegetable consumption in elementary school children. As such, more research to assess a variety of fruits and vegetables. This could include research on different preparations of fruits and vegetables served during lunch or testing more than one day and one menu for plate waste, as highlighted in the previous section. Other research that warrants further exploration would be incorporation of fruits and vegetables from cafeteria tastings into school meals, followed by measurement of selection and consumption of those specific fruits and vegetables.

Limitations

This study had several limitations. A primary limitation of this study was that all the fruit and vegetables utilized in the cafeteria tastings and take-home produce were not incorporated into the school lunch menu evaluated at pre- and post-intervention, which could have provided insight on the selection and consumption of those specific fruits and vegetables. Using the method of Bristow et al. (2017) would have improved the current study.

Another limitation of this study of this study was that there was no control group. A control group that included schools that did not participate in the intervention would have allowed for better evaluation of the impact of it on fruit and vegetable selection and waste.

Another limitation of this study was the short length of the intervention, which only lasted six-weeks. As seen in the literature, other studies that had longer interventions had more positive results.

Another limitation was only measuring selection and waste for one meal, as supposed to several meals or an entire cycle, provided limited insight in selection and consumption patterns. Finally, another limitation that could have impacted the results is that the peaches were not

served in the same form during pre- and post-intervention data collection days. At pre-intervention, canned peaches were served, and, at post-intervention, frozen peaches were served. In addition, at post-intervention, the peaches were still partly frozen when the children consumed them. This may have led to increased selection because they looked more appealing, but decreased consumption because they were still frozen.

Conclusions and Recommendations

Overall, this study did not find a significant impact of a six-week nutrition education and take-home fruit and vegetable intervention on fruit and vegetable selection and consumption in elementary school children, nor does it support that exposure to fruits and vegetables, in general, at the home and through tastings on fruit and vegetable impact selection and consumption. However, this is another potential avenue for future research. Although some fruit and vegetable interventions have been successful in improving fruit and vegetable selection, continued research on ways to improve fruit and vegetable consumption in children in schools is needed before nutrition professionals can determine the most effective strategies to increase consumption. More research is also necessary to determine how to reduce fruit and vegetable waste in schools to not only increase nutrition provided to students, but also to decrease cost of the program.

This study demonstrates that it may take more than fruit and vegetable tastings and take-home fruits and vegetables to increase consumption to increase consumption of produce in youth. Options for further research include partnering with teachers in classrooms to incorporate nutrition education and fruit and vegetable tastings into lesson plans. Another strategy would be to collaborate with school nutrition staff and wellness coordinators to develop more permanent ways to incorporate fruit and vegetable education and tastings into schools.

This study contributes to the literature related to the development of fruit and vegetable

interventions to increase fruit and vegetable consumption in children. Continued research on this topic is important because increased fruit and vegetable consumption by individuals during childhood may decrease their risk for chronic disease in the future. Continued research is also important because increased fruit and vegetable consumption could lead to lower food costs for the NSLP.

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List of Appendices

LIST OF APPENDICIES

1. Information Sheet.....54

INFORMATION SHEET – PLEASE KEEP THIS COPY FOR YOUR RECORDS

Title: Farm-to-YOUth! Evaluation of a Produce Education Program for Youth and Families

Investigators

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ARE YOU 18 YEARS OF AGE OR OLDER?

By checking this box I certify that I am 18 years of age or older.

Description

The purpose of this research project is to determine the effect of school-based food and nutrition education in Calhoun County, Mississippi, on both parents and elementary school children. Parents will complete a survey before and after the program, when enrolled into the study. Children will not complete a survey but will be asked to rate foods in the cafeteria. Food waste will also be observed before and after the program. Your name or any other identifying information will not be on the survey, but you will have a subject number so that we can link your pre- and post-study information. If you have more than one child enrolled in the elementary school, please return all surveys together.

Cost and Payments

The pre- and post-surveys take about 10-minutes (each) to complete. Completing the survey means that you have enrolled into the study. You will not receive payment for participation, you will receive a cookbook with the pre-survey and a kitchen gadget with the post-survey. You will also receive education materials and kitchen gadgets during the program. Some children may also bring home produce for you to taste.

Risks and Benefits

Parents: You may feel uncomfortable with some of the questions asked about the food situation in your household. For example, some questions ask if you worry about having enough money to buy food. We do not think that there are any other risks. A lot of people enjoy taking questionnaires. Information from the study may help to develop programs that benefit people in Mississippi and other areas of the country.

Children: When rating foods, some children may feel uncomfortable rating a food differently than a classmate. We do not think that there are any other risks. We do not anticipate any problems with food allergies in the cafeteria; however, the school nurse will be contacted if your child has an allergic reaction to a food.

Confidentiality

No identifiable information will be recorded for you or your children, therefore we do not think you can be identified from this study. We do ask your address so that we can map how far you live from a supermarket.

Right to Withdraw

You or your children do not have to take part in this study, and you may stop participation at any time. If you start the study and decide that you do not want to finish, all you have to do is to tell Dr. Holben or Ms. Antolini, Reece, or Weber in person, by letter, or by telephone (contact information listed above). You may skip any questions you prefer not to answer.

IRB Approval

This study has been reviewed by The University of Mississippi's Institutional Review Board (IRB). If you have any questions, concerns, or reports regarding your rights as a participant of research, please contact the IRB at (662) 915-7482 or irb@olemiss.edu.

Statement of Consent

I have read and understand the above information. By completing the survey, I consent to participate in the study.

VITA

Michelle Weber

EDUCATION

B.A, Dietetics, University of Cincinnati, May 2015