

Offer versus Serve or Serve Only: Does Service Method Affect Elementary Children's Fruit and Vegetable Consumption?

Margaret Harbison Goggans, RD, LDN; Laurel Lambert, PhD, RD, LD; Yunhee Chang, PhD

Please note that this study was published before the implementation of Healthy, Hunger-Free Kids Act of 2010, which went into effect during the 2012-13 school year, and its provision for Smart Snacks Nutrition Standards for Competitive Food in Schools, implemented during the 2014-15 school year. As such, certain research may not be relevant today.

ABSTRACT

Purpose/Objectives

The purpose of this study was to determine if the use of the Offer versus Serve (OVS) provision in the National School Lunch Program would result in a significant difference in fruit and vegetable consumption by fourth and fifth grade elementary students, and in plate waste cost.

Methods

Weighted and visual plate waste data were collected for five consecutive days at two elementary schools. School A used serve only service (SO), serving students all five food components of the lunch meal, and School B used the OVS provision, allowing students to select as few as three of the five food components of the lunch meal. Food waste costs were determined using an average cost from invoices. Differences in consumption of fruits and vegetables, cost, and plate waste data were analyzed.

Results

Fruit and vegetable plate waste was significantly lower ($p < .05$) in the school using the OVS compared to the school using SO. Plate waste cost per student also showed significant difference ($p < .01$), with a \$.03 cost per student in the school using OVS and a \$.07 cost per student in the school using SO. However, this study showed no significant difference in fruit and vegetable consumption comparing consumption of all students participating in each of the two service methods.

Application to Child Nutrition Professionals

This study provides useful data for school nutrition program directors when deciding on the use of SO versus OVS in elementary schools.

INTRODUCTION

The National School Lunch Program (NSLP) was initiated in 1946 for the purpose of providing nutritionally-balanced lunches to school children (Child Nutrition and WIC Reauthorization Act of 2004). The NSLP must meet USDA nutrition standards, including requirements that meals contain no more than 30% of calories from fat and less than 10% from saturated fat. Meals must also provide at least one-third of the Recommended Dietary Allowances of protein, vitamin A, vitamin C, iron, calcium, and Calories. For lunches, these nutrients are provided using five food items that include meat/meat alternates, milk, grains/breads, and 2 servings of vegetables/fruits.

It has been shown that elementary school students who participate in the NSLP are provided a greater variety of foods and are more likely to meet the dietary guidelines, including a greater variety

of nutrients, than students who bring their lunch to school (Rainville, 2001). Additionally, students participating in the NSLP are twice as likely to report a higher consumption of fruits and vegetables as nonparticipants (Cullen & Zakeri, 2004). NSLP is a critical program for improving children's dietary intake as in the general population only 24% of students ages 6 to 11 consume the 5 to 9 servings of fruits and vegetables recommended in the *Dietary Guidelines for Americans* (Enns, Mickle, & Goldman, 2002).

Research has identified several barriers to fruit and vegetable consumption in children, including taste, lack of encouragement from parents, a high availability of other snack foods, and negative peer support (Molaison, Connell, Stuff, Yadrack, & Bogle, 2005). When children do consume fruits and/or vegetables they tend to favor vegetables cooked with sugar or cheese and fruits that have a sweet taste (Molaison et.al, 2005).

School nutrition program directors who provide these nutritious meals in elementary schools have an option regarding the type of service to be provided to students. Using the serve only option (SO), students are served all five food components of the lunch meal. The offer versus serve option (OVS) allows students the choice of selecting as few as three of the five food items offered in the lunch meal (Child Nutrition Reauthorization Act of 1998). The OVS provision was implemented to minimize plate waste and encourage directors to offer more food options in school meal programs.

Plate waste measures are used to gather data on what students are actually consuming in school meals. An analysis of plate waste data was conducted by Buzby and Guthrie which showed that NSLP participants dispose on average 12% of calories in foods served and disposed more fruits and vegetables than any other food item offered (2002). Robichaux and Adams conducted a plate waste study to determine the differences in plate waste between SO and OVS and reported that neither method was superior on the basis of consumption; both had significant plate waste (1985). While increasing children's consumption of fruits and vegetables is a constant challenge, several studies have shown increased exposure to foods increases consumption of those foods (Birch & Marlin, 1982; Sullivan & Birch, 1990; Wardle et al., 2003; Wardle, Herrera, Cooke & Gibson, 2003).

The purpose of this project was to use plate waste methods to determine if there is a significant difference in fruit and vegetable consumption among fourth and fifth grade elementary students who participate in the NSLP OVS option compared to the SO option. Additionally, costs of disposed fruits and vegetables were calculated. The University of Mississippi's Institutional Review Board approved this study.

METHODOLOGY

Participants

Plate waste data were collected for five consecutive days in two elementary schools during October, 2009. All students participating in the plate waste study were in fourth or fifth grade and shared the same lunch schedule. School A used the SO option and School B used the OVS option of service. These schools were selected because of their similar demographics and geographic proximity. Prior to the study, researchers and school nutrition directors from both schools met to view the menu that would be offered in both schools during the five days that data were measured. Both directors ordered their food items through the same state contracted vendors for comparable price and product.

Handouts and informed consent forms describing the purpose of the study were sent home with students prior to the study. Parents who did not wish to have their child involved in the study had the option of contacting the director to have their child excluded. Teachers were also informed and provided the opportunity to ask questions.

Data Collection

Data collectors were recruited from students enrolled in the University of Mississippi's dietetics courses. One researcher trained all data collectors on proper methods for accurate weighed plate

waste measurements. An ESA Series Economical Precision Balance Digital scale (Salter Brecknell, Fairmont, MN) was used to determine plate waste in ounces.

Pre-measurement of portion sizes was completed based on types of menu offerings. Fruits and vegetables measured in both schools were applesauce, diced peaches, diced pears, fresh apples, bananas, raw carrots, green beans, black-eyed peas, mixed vegetables, and French fries. Canned fruits were packed in light syrup. A 4-ounce scoop/dipper was used to serve the applesauce, diced peaches, and diced pears in a disposable dish; the weight of the portion was recorded in ounces. Each serving was weighed with a standard variance of plus or minus two-tenths of an ounce. For apples and bananas, a visual measurement was used to record the amount consumed. For the hot vegetables, including green beans, black-eyed peas, and mixed vegetables, a 4-ounce slotted spoodle was used. Tongs were used for french fries, and a serving was approximately 11 fries.

Prior to meal service, each server received an explanation of the importance of achieving equal serving sizes, and was requested to provide a representative serving sample of the hot vegetable. This sample was weighed (minus the serving dish) to obtain a weight in ounces that was used as a baseline. During each service, four additional representative samples were measured to ensure consistent weights of portion sizes. Raw carrots were counted and weighed (minus the serving dish) to ensure consistent size and number of carrots within the established weight range. The mean weight was used to determine the number of ounces served.

During service, data collectors documented the number of fruits and/or vegetables that were served, in School A or selected by each student in School B. After students were finished eating, their meal trays were collected at the disposal area. Data collectors gathered any uneaten portions of fruits and vegetables. Uneaten applesauce, diced peaches, and diced pears were collected in the disposable dish and weighed. The green beans, raw carrots, black-eyed peas, mixed vegetables, and french fries remaining on the tray were collected in buckets. Total waste in the buckets was then weighed. Apples and bananas were collected and measured visually: 1) apples were categorized as whole, one bite eaten, two bites eaten, one-quarter eaten, one-half eaten, three-quarters eaten, and eaten except the core, and then combined to give an equivalent number of whole apples; and 2) bananas were categorized using the same method as the apples but without the peel, and an equivalent number of bananas was calculated.

Data Analyses

The total weight of fruits and vegetables disposed was divided by the number of students served the item to determine the percent of items consumed. The cost of items served but disposed of by students was calculated using state vendor prices per commercial-sized can divided by the weight of the can in ounces to determine the cost per ounce for applesauce, peaches, pears, green beans, black-eyed peas, and mixed vegetables. The cost per ounce was then used to calculate cost per serving and the cost of food disposed, using the weight of the items served and disposed. Cost of french fries and raw carrots were calculated using the estimated number of servings per container. Apples and bananas were priced based on number of product per container. All statistical analyses were performed using Stata/SE 10.0 for Windows.

RESULTS AND DISCUSSION

Fourth and fifth grade enrollment in SO and OVS were 402 and 474 students, respectively. Student participation in the NSLP was 266 (66%) in School A and 383 (81%) in School B. The results of student plate waste for fruits and vegetables are shown in Table 1. In School A, 100% of students were served fruits and vegetables, and results indicated that applesauce (57%) and peaches (42%) had the highest consumption. The highest percentages of fruits served in School B were applesauce (72%) and pears (67%), with applesauce and pears also having the highest consumption of 81% and 70%, respectively. An unanticipated number of bananas and apples were taken out of the cafeteria. Therefore, consumption results for these fruits could not be captured and were not included in the study.

Table 1. *Student Plate Waste*

Food Item and School	Number of students participating in NSLP	Number of students served item	Students served item (%)	Total weight of item served (oz)	Total weight of item disposed (oz)	Amount of item consumed by student(%)
Applesauce						
School A (SO)	268	268	100	964.8	416.4	56.84
School B (OVS)	388	281	72.4	1011.6	195.4	80.68
Peaches						
School A (SO)	259	259	100	932.4	539.3	42.16
School B (OVS)	387	213	55.0	937.2	381.0	59.35
Pears						
School A (SO)	246	246	100	787.2	475.1	39.75
School B (OVS)	392	264	67.4	844.8	253.5	69.99
Carrots						
School A (SO)	268	268	100	536.0	278.4	48.36
School B (OVS)	388	97	25.0	184.3	60.6	67.12
Green Beans						
School A (SO)	259	259	100	673.4	173.6	32.97
School B (OVS)	387	258	66.7	656.4	285.3	56.54
Black-eyed Peas						
School A (SO)	246	246	100	688.8	508.3	29.00

Food Item and School	Number of students participating in NSLP	Number of students served item	Students served item (%)	Total weight of item served (oz)	Total weight of item disposed (oz)	Amount of item consumed by student(%)
School B (OVS)	392	171	43.6	513.0	191.7	63.93
Mixed Vegetables						
School A (SO)	274	274	100	849.4	613.5	26.98
School B (OVS)M	387	168	43.4	537.6	228.5	58.24
French Fries						
School A (SO)	282	282	100	564.0	153.6	72.31
School B (OVS)	398	395	99.3	908.5	303.0	66.57

Note. NSLP = National School Lunch Program; SO = serve only service; OVS = offer versus serve service.

A study by Molaison and colleagues reported that fruits are consumed primarily because of their sweet taste (2005). In this study, both schools added cherry gelatin to unsweetened applesauce to make the applesauce "rosy" which provided increased sweetness and color. This may have made the fruit more desirable.

In School B, the highest percentages of vegetables selected by students were french fries (99%) and green beans (67%). Caine-Bish and Scheule reported that pizza and french fries are the two most preferred school lunch foods (2007). Despite the popularity and high consumption of french fries, 28% in School A and 33% in School B of french fries served were disposed of by the students. One explanation may be that french fries are offered every Friday at these schools and students may be selecting the french fries out of routine.

While green beans had the second highest selection in OVS, it had the lowest consumption, at 57%. Since students were not interviewed regarding fruit and vegetable selection and consumption, the researchers may only hypothesize about the discrepancy. The high selection may have been influenced by an attractive presentation of the item on the service line. The low consumption could be due to the green beans not tasting the same as usual or that students ate the other menu items first and were full.

The least often selected items at School B were carrots (25%), mixed vegetables (43%), and black-eyed peas (44%). In School A, mixed vegetables and black-eyed peas had the lowest consumption at 27% and 29%, respectively. In a study by Caine-Bish and Scheule, black-eyed peas were reported as the least-preferred food item on the school lunch menu, with 45% of students identifying black-eyed peas as a food they would not eat (2007). However, in this study, students who selected carrots and black-eyed peas in School B had a higher consumption, at 67% and 64%, respectively.

Over the 5-day study, a range of 28% to 45% of students in School B opted not to select the fruit offered and therefore were not exposed to a fruit serving. With the exception of french fries, a range of 44%-75% of students in School B did not select a vegetable serving during the five days of data collection. Despite the potential lack of exposure to fruits and vegetables in OVS, the percentage consumed of all fruits and vegetables, except french fries, was higher in School B than in School A.

Plate waste cost was also addressed. Table 2 shows the cost of foods disposed and the cost of disposed food per student served. Cost of foods disposed per student served at both schools was within a \$0.01 difference for peaches, carrots, green beans, and french fries. School A had a \$0.03 to \$0.04 higher cost of food disposed per student compared to School B for applesauce, pears, black-eyed peas, and mixed vegetables.

Table 2. *Cost of Disposed Food Items*

Food Item and School	Number of students served food item	Mean serving weight of food item (oz)	Total weight of food items served (oz)	Total weight of foods disposed (oz)	Cost per serving of food item (\$)	Cost of total food items disposed (\$)	Cost of disposed foods per student served (\$)
Applesauce							
School A (SO)	268	3.6	964.8	416.4	0.14	16.65	0.06
School B (OVS)	281	3.6	1011.6	195.4	0.14	7.82	0.03
Peaches							
School A (SO)	259	3.6	932.4	539.3	0.14	21.57	0.08
School B (OVS)	213	4.4	937.2	381.0	0.18	15.24	0.07
Pears							
School A (SO)	246	3.2	787.2	475.1	0.13	19.00	0.08
School B (OVS)	264	3.2	844.8	253.5	0.13	10.15	0.04
Carrots							
School A (SO)	268	2.0	536.0	139.2	0.14	9.74	0.04

Food Item and School	Number of students served food item	Mean serving weight of food item (oz)	Total weight of food items served (oz)	Total weight of foods disposed (oz)	Cost per serving of food item (\$)	Cost of total food items disposed (\$)	Cost of disposed foods per student served (\$)
School B (OVS)	97	1.9	184.3	60.6	0.13	4.24	0.04
Green Beans							
School A (SO)	259	2.6	673.4	173.6	0.13	8.68	0.03
School B (OVS)	258	2.5	656.4	285.3	0.13	5.61	0.02
Black-eyed Peas							
School A (SO)	246	2.9	688.8	508.3	0.12	20.33	0.08
School B (OVS)	171	3.1	513.0	191.7	0.12	7.67	0.04
Mixed Vegetables							
School A (SO)	274	3.1	849.4	613.5	0.12	24.54	0.09
School B (OVS)	168	3.3	537.6	228.5	0.13	9.14	0.05
French Fries							
School A (SO)	282	2.0	564.0	153.6	0.08	6.14	0.02
School B (OVS)	395	2.3	908.5	303.0	0.09	12.12	0.03

Note: SO = serve only service; OVS = offer versus serve service.

Discrepancies occurred in mean serving weight with peaches and french fries. School A received canned peaches, but School B received frozen peaches in 4-ounce cups. Additionally, the School B ran out of the regular french fries during the third lunch period and substituted a different type of

french fries causing the mean serving weight to be slightly higher than the allowed variance of plus or minus two-tenths of an ounce.

Table 3 summarizes the study results, showing that School A was significantly higher than School B for disposal per serving ($p < 0.01$), disposal per student ($p < 0.01$), cost disposed per serving ($p < 0.03$), and the cost disposed per student ($p < 0.01$). School A was significantly lower than School B for overall consumption per serving ($p < 0.01$). The only measure that was not significantly different between the two schools was consumption per student, with a mean consumption of 1.57 ounces School A and 1.45 ounces in School B.

Table 3. *Disposal, Consumption, and Cost Differences*

	School A (SO) Mean \pm SD	School B (OVS) Mean \pm SD	<i>p</i>
Disposal per Serving	51.99% \pm 19.99	32.15% \pm 11.74	<0.01
Disposal per student participating in NSLP	1.70 oz \pm .77	0.65 oz \pm .40	<0.01
Consumption per serving	48.01% \pm 19.98	67.85% \pm 11.74	<0.01
Consumption per student participating in NSLP	1.57 oz \pm .91	1.45 oz \pm .74	0.72
Cost disposed per serving	\$0.07 \pm .03	\$0.05 \pm .02	0.03
Cost disposed per student participating in NSLP	\$0.07 \pm .03	\$0.03 \pm .01	<0.01

Note. SO = serve only service; OVS = offer versus serve service

Although no significant difference in consumption per student was found in this study, students in schools using the SO option are repeatedly exposed to fruits and vegetables, and this frequent exposure may increase consumption. A study of fruit and vegetable consumption among students points out that multi-aspect interventions have been successful at increasing consumption (Kandiah & Jones, 2001). Encouragement of fruit and vegetable consumption by school nutrition staff and exposure to new fruits and vegetables may guide students to try new fruits and vegetables.

The relatively small sample size of two local elementary schools limits the applicability of the study to larger populations and different geographical areas. Another study limitation is that data collectors were located in the cafeteria just outside the waste disposal area. This may have influenced students to eat more or less knowing that their uneaten fruits and vegetables were being collected and weighed. In addition, food items offered were not tasted by the researchers, so differences in taste or quality of foods, for example resulting from cooking skills of employees or added seasonings, were not accounted for. Finally, some foods ordered were not consistent with the planned menu, such as peaches, which were received in both canned and frozen forms.

CONCLUSIONS AND APPLICATIONS

School nutrition program directors have many responsibilities and make many decisions when managing NSLPs. One of those decisions is which type of meal service they believe will best serve their student population. This study was designed to assist directors in their decision, regarding type of meal service, by providing a comparison between the SO and OVS options relating to consumption, amount of plate waste, and cost of plate waste.

This study resulted in a significantly reduced amount of plate waste in a school site using OVS versus a school site using SO. In addition, students participating in the NSLP at the OVS site, were more likely to consume a greater amount of the fruits and vegetables that they selected. However, this study also showed that there was no significant difference between SO and OVS in fruit and vegetable consumption based on total student participation in the NSLP at the two study sites. Since the study design only measured total consumption, not individual consumption, this suggests that more students consumed some amount of the fruits and vegetables served at the SO school site, potentially increasing future consumption of fruits and/or vegetables through repeated exposure.

School nutrition program directors are faced with finding a balance between serving all students fruits and vegetables and therefore increasing exposure and potential consumption, and operating a fiscally viable NSLP. If importance is placed on increasing student exposure and potential consumption of fruits and vegetables, the SO option may be more beneficial in achieving this goal. If program priorities require lowering overall plate waste and cost, OVS may be a more favorable option.

Future research to further investigate creative ways to encourage and increase fruit and vegetable consumption of elementary students, while maintaining a fiscally-sound program, will assist directors in reducing plate waste and providing elementary students with nutritious and appealing meals through the NSLP.

REFERENCES

- Birch, L. L., & Marlin, D. W. (1982). I don't like it; I never tried it: Effect of exposure on two-year-old children's food preferences. *Appetite*, 3, 353-360.
- Buzby, J. C., & Guthrie, J. F. (2002). *Plate waste in school nutrition programs: Final report to Congress*. Retrieved from U.S. Department of Agriculture, Economic Research Service <http://www.ers.usda.gov/publications/efan02009/efan02009.pdf>
- Cain-Bish, N., & Scheule, B. (2007). Food preferences of school age children and adolescents in an Ohio school district. *The Journal of Child Nutrition & Management*, 31(2). Retrieved from [JCN&M 2001 Issue 1](#)
- Child Nutrition Reauthorization Act of 1998, P.L. 105-336 §105 (1998).
- Child Nutrition and WIC Reauthorization Act of 2004, P. L. 108-265 § 204 (2004).
- Cullen, K., & Zakeri, I. (2004). Fruits, vegetables, milk and sweetened beverages consumption and access to á la carte/snack bar meals at school. *American Journal of Public Health*, 94(3), 463-467.
- Enns, C. W., Mickle, S. J., & Goldman, J. D. (2002). Trends in food and nutrient intakes by children in the United States. *Family Economics and Nutrition Review*, 14 (2), 56-68.
- Kandiah, J., & Jones, C. (2002). Nutrition knowledge and food choices of elementary school children. *Early Child Development and Care*, 172 (3), 269-273.
- Molaison, E. F., Connell, C. L., Stuff, J. E., Yadrick, M. K., & Bogle, M. (2005). Influences on fruit and vegetable consumption by low-income Black American adolescents. *Journal of Nutrition Education and Behavior*, 37(5), 246-251.
- Rainville, A. (2001). Nutritional quality of reimbursable school lunch compared to lunches brought from home in elementary school in two southeastern Michigan districts. *Journal of Child Nutrition & Management* 2 (1). 25(1). Retrieved from <http://docs.schoolnutrition.org/newsroom/jcnm/07fall/>
- Robichaux, F., & Adams, S. (1985). Offer vs. serve foodservice in lower elementary school lunchrooms. *Journal of the American Dietetic Association*, 85 (7), 853-854.
- Sullivan, S. A., & Birch, L. L. (1990). Pass the sugar, pass the salt: Experience dictates preference. *Developmental Psychology*, 26, 546-551.
- Wardle, J., Cooke, L., Gibson, E.L., Sapochnik, M., Sheiham, A., & Lawson, M. (2003). Increasing children's acceptance of vegetables; A randomized trial of parent-led exposure. *Appetite*, 40(2), 155-162.
- Wardle, J., Herrera, M.L., Cooke, L., & Gibson, E.L. (2003). Modifying children's food preferences: The effects of exposure and reward on acceptance of an unfamiliar vegetable. *European Journal of Clinical Nutrition*, 57,341-348.

BIOGRAPHY

Margaret Harbison Goggans is Dietetic Student, Department of Nutrition and Hospitality Management, University of Mississippi; Laurel Lambert is Associate Professor, Department of Nutrition and Hospitality Management, University of Mississippi; Yunhee Chang is Assistant Professor, Department of Nutrition and Hospitality Management, University of Mississippi.