Distributing Free Fresh Fruit and Vegetables at School: Results of a Pilot Outcome Evaluation

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SYNOPSIS

Objectives. Consumption of fruit and vegetables among children is generally below recommended levels. This evaluation addressed two questions: (*1*) To what extent did children's attitudes toward, familiarity with, and preferences for fruit and vegetables change during the school year? and (*2*) To what extent did children's consumption of fruit and vegetables change during the school year?

Methods. During the 2004–2005 school year, the Mississippi Department of Education, Child Nutrition Programs initiated a pilot program to distribute free fruit and vegetables to students (kindergarten through 12th grade) during the school day. Data were collected in 2004–2005 within a one-group pretest/posttest design using a self-report questionnaire ($n=725$) and 24-hour dietary recalls ($n=207$) with a sample of students from five schools in Mississippi. Data were analyzed in 2006–2007.

Results. Results showed greater familiarity with fruit and vegetables at all grade levels ($p<0.05$) and increased preferences for fruit among eighth- and 10th-grade students ($p<0.01$). Eighth-grade students also reported more positive attitudes toward eating fruit and vegetables ($p<0.01$), increased perceived self-efficacy to eat more fruit ($p<0.01$), and increased willingness to try new fruit. Finally, results showed increased consumption of fruit, but not vegetables, among eighth- and 10th-grade students ($p<0.001$).

Conclusions. Distributing free fruit and vegetables at school may be a viable component of a more comprehensive approach for improving students' nutrition attitudes and behaviors. More program emphasis is needed on ways to promote vegetable consumption.

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Diets rich in fruit and vegetables are associated with better health status.[1] A number of school-based programs have shown positive effects on children's dietary behaviors; some have focused broadly on nutrition, physical activity, and heart health,[2,3] whereas others have focused more specifically on fruit and vegetable consumption.[4–6] Despite these successes, consumption of fruit and vegetables among adolescents is generally below recommended levels,[7,8] supporting a need to identify effective strategies for promoting fruit and vegetable consumption, among other healthful dietary patterns.

Several states are now implementing programs in which they provide free fresh fruit and vegetable snacks to students during the school day. These programs stemmed from an initial pilot program proposed by Senator Tom Harkin in 2001[9] in which free fruit and vegetables were provided to schoolchildren in four states and one Indian tribal organization. The pilot later became a permanent initiative funded by the U.S. Department of Agriculture (USDA). The goal of these programs is to increase students' access to an array of fresh fruit and vegetables, thereby increasing the potential for influencing their preferences for and consumption of fruit and vegetables.[10] Distributing fruit and vegetables at school also is consistent with socioecological models that support the need to address individual behaviors in the context of important environments, such as schools and homes.[11]

During the 2004–2005 school year, the Mississippi Department of Education (MS DOE), Office of Child Nutrition Programs received funding from the Centers for Disease Control and Prevention (CDC) for the Mississippi Fresh Fruit and Vegetable Program (MFVP). This initiative provided all children in 25 participating Mississippi schools with a variety of free fresh fruit and vegetables as a healthy snack option. CDC also funded an initial evaluation of the pilot program. This article describes the outcome evaluation results from the program's first year.

METHODS

Fruit and vegetable distribution program

The MFVP was coordinated and supported through the Office of Child Nutrition Programs of the MS DOE. As part of the program, schools received funding to buy and distribute free fresh fruit and vegetable snacks (e.g., apples, oranges, carrots, and celery) during the school day. Schools typically distributed the snacks in classrooms or in a central area. The most common methods of distribution included baskets, trays, and carts. Most schools served the snacks at morning break. Teachers and school personnel (e.g., nutrition services staff) distributed the snacks most of the time, with assistance from administrators and students at times. Schools used a variety of promotional and supplemental educational activities throughout the school year to promote program awareness and encourage students to try new fruit and vegetable snacks (e.g., food tasting events, newsletters, promotional posters, and classroom lessons). More details about program implementation are reported elsewhere.[12]

Evaluation design

The evaluation featured a one-group pretest/posttest design involving five schools (two elementary, one middle, one middle/high combination, and one high school) selected from the 25 school sites funded for program implementation during the 2004–2005 school year. The evaluation schools were selected based on grade levels served, geographic region, urbanicity, and racial/ethnic composition. The schools were spread across all five regions of the state (hills, delta, capital, coastal, and pines). Three of the five schools were considered rural, one was suburban, and one was urban. Most students at the five schools (57% to 99%) were eligible for free or reduced price lunch.

All students in grades five, eight, and 10 from the evaluation schools were invited to participate in the student questionnaire. A subset of students in grades eight and 10 were invited to take part in dietary recall interviews. We conducted the evaluation during the 2004–2005 school year.

Measures

Student questionnaire. A self-report student questionnaire assessed demographics as well as a number of psychosocial constructs related to eating fruit and vegetables. We pilot-tested the questionnaire with a sample of fifth-, eighth-, and 10th-grade students (n=21) from Mississippi. We based final question modifications on pilot testing and input from CDC, USDA, and MS DOE. We computed Cronbach's alpha coefficients for each composite scale separately by grade level using baseline questionnaire data.

Attitudes toward eating fruit and vegetables included nine items measured on a five-point scale (1 = disagree a lot to 5 = agree a lot) from Baranowski et al.[4] Reliability was good (Cronbach's alpha ranged from 0.70 for grade five to 0.75 for grade 10).

Perceived self-efficacy to eat more fruit or vegetables included two items each with composite scores ranging from 1 to 5 (1 = disagree a lot to 5 = agree a lot); the items were drawn from Resnicow and colleagues.[13] Reliability was lower for fruit than for vegetables; Cronbach's alpha coefficients ranged from 0.46 (grade five) to 0.65 (grade 10) for fruit and from 0.77 (grade 10) to 0.79 (grade five) for vegetables.

Willingness to try new fruit or vegetables included three items, each measured on a five-point scale (1 = dislike very much to 5 = like very much). These items were developed expressly for the evaluation and showed good reliability (Cronbach's alpha ranged from 0.76 to 0.90).

Familiarity with fruit and vegetables and preferences for fruit and vegetables were drawn from Domel and colleagues.[14] Familiarity scores were created separately for fruit and vegetables and reflected the proportion of items students reported ever having eaten from a list of 13 fruits (12 fresh and one dried fruit) and seven raw vegetables. The list of items was based on input from MS DOE and from students during the questionnaire pilot test process. Cronbach's alpha coefficients ranged from 0.65 to 0.78. Preference scores were based on a three-point scale measuring how much students liked each fruit and vegetable on the list (1 = a lot, 2 = a little, 3 = not at all). Cronbach's alpha coefficients for these items ranged from 0.70 to 0.79. All exposure and preference items included pictures of the fruit and vegetables to provide a visual reference.

Intentions to eat more fruit or vegetables included two items, each measured on a four-point scale (1 = I never would to 4 = I would most of the time). We adapted the items from similar items used in the evaluation of the USDA Fruit and Vegetable Pilot Program.[9] As with perceived self-efficacy, baseline reliability was lower for fruit than for vegetables. Cronbach's alpha coefficients for intentions to eat fruit ranged from 0.49 (grade eight) to 0.65 (grade 10). Coefficients for intentions to eat vegetables ranged from 0.76 (grade eight) to 0.78 (grades five and 10).

Frequency of eating fruit and vegetables served with the school meal program included four items that were analyzed individually. Each item assessed how often students reported eating the fruit or vegetable offered with the school breakfast and lunch programs (never to most/all of the time).

Dietary recall interview. We collected dietary recall data among eighth- and 10th-grade students using a paper-and-pencil adaptation of the 24-hour dietary recall interview protocol used in the Child and Adolescent Trial for Cardiovascular Health intervention study.[2] Self-reported dietary recalls have been found to be valid with children as young as age 8[15] and can be used to estimate food intake at a group level.[16]

Data collection

Consistent with local practice in the schools studied, we used passive parental permission for all data collection activities, with a follow-up notification to the subset of students who were selected to take part in the dietary recall interviews. We distributed the parent permission forms in specific classrooms at school. Students whose parents did not opt out of the evaluation were asked if they agreed to participate. All data collection procedures and assessment tools were reviewed and approved by the Institutional Review Board of ETR Associates.

Student questionnaire. Trained data collectors administered the pretest and posttest student questionnaires in classrooms. Students filled out the paper-and-pencil questionnaires individually; most students finished in 30–35 minutes.

Dietary recall interview. Dietitians and trained nutrition interviewers from Mississippi collected the dietary recall data during the school day. They administered interviews one-on-one in a private location (e.g., school library) during school hours. They used props (e.g., two-dimensional food model cards and measuring cups) to help participants complete the interviews. They recorded students' verbal responses to interview questions on standard paper-and-pencil forms (food intake form, recipe form, and a supplemental foods form). They conducted interviews on a Tuesday, Wednesday, or Thursday to assess consumption during the school week and to maximize school attendance. Recalls required 30–40 minutes to complete each time.

Student sample and attrition

Student questionnaire. The final questionnaire sample included 725 students (179 in grade five, 306 in grade eight, and 240 in grade 10) who had permission and provided assent. Of these students, 660 (91%) completed both pretest and posttest assessments; follow-up rates were similar across grade levels (94%, 91%, and 90% in grades five, eight, and 10, respectively).

Dietary recall. The sample for the dietary recall interview included 207 randomly selected students in grade eight (n=106) or grade 10 (n=101). We intentionally restricted the sample to 207 students based on budgetary resources available for the evaluation. A total of 191 (92%) of these students completed both pretest and posttest recall interviews.

Student demographic characteristics. Baseline characteristics of the students completing questionnaires and recall interviews are provided in Table 1.

Statistical analysis

We analyzed pretest/posttest changes in student questionnaire data between baseline and follow-up separately by grade level using paired t-tests. We set

Table 1. Baseline demographic characteristics of Mississippi fifth-, eighth-, and 10th-grade students who participated in the questionnaire (*n*=660) and dietary recall interviews, MFVP 2004–2005 (*n*=191)[a]

	Gender		*Race/ethnicity*			*Mean age (in years)*
Characteristic	*Female (percent)*	*Male (percent)*	*Black (percent)*	*White (percent)*	*Other (percent)*	
Questionnaire: grade five (*n*=168)	57.7	42.3	53.0	35.1	11.9	10.4
Questionnaire: grade eight (*n*=277)	53.1	46.9	76.5	18.4	5.1	13.4
Questionnaire: grade 10 (*n*=215)	51.6	48.4	71.2	27.4	1.4	15.5
Dietary recall interviews: grades eight and 10 (*n*=191)	47.4	52.6	62.0	35.0	3.1	14.4

[a]Demographic characteristics of the sample reflect those of the schools that students attend.

MFVP = Mississippi Fruit and Vegetable Program

statistical significance at $p \leq 0.05$. We analyzed dietary recall interviews for fruit and vegetable servings based on USDA's Pyramid Servings Database (version 2).[17] Because the program focused on distributing fresh fruit and vegetables, we analyzed data on fruit and vegetable servings in two ways: total number of servings of fruit and vegetables consumed and number of fresh fruit and vegetable servings. We analyzed the number of vegetable servings with and without white potatoes and with and without fried potatoes.

We also analyzed recall data for selected vitamins, minerals, and macronutrients with the Food Intake Analysis System, which uses the 1994–1996 and 1998 USDA Continuing Survey of Food Intakes by Individuals Nutrient Database.[18,19] We analyzed pretest/posttest changes in dietary recall data between baseline and follow-up with paired *t*-tests. We set statistical significance at $p \leq 0.05$. We completed analyses in 2006–2007 using SPSS® software.[20]

RESULTS

Changes in attitudes toward, self-efficacy, and willingness to eat fruit and vegetables varied by grade level (Table 2). For example, at posttest eighth-grade students reported more positive attitudes toward eating fruit and vegetables ($p<0.01$), beliefs that they could eat more fruit ($p<0.01$), and willingness to try new fruit ($p<0.01$), but this pattern was not evident among fifth- or 10th-grade students. Among fifth-grade students, willingness to try new fruit ($p=0.01$), willingness to try new vegetables ($p=0.03$), and beliefs that they could eat more vegetables ($p=0.04$) decreased significantly.

Students' familiarity with fruit and vegetables increased across all grade levels. As shown in Table 3, the variety of fruit and vegetables ever eaten increased significantly among fifth-, eighth-, and 10th-grade students.

Changes in students' preferences for fruit and vegetables also varied by grade level (Table 4). Preferences for fruit increased significantly among eighth- and 10th-grade students ($p=0.01$ and $p<0.01$, respectively), but decreased significantly among fifth-grade students ($p=0.03$). Preferences for vegetables decreased significantly among fifth- and eighth-grade students ($p<0.01$ and $p=0.01$, respectively), but remained unchanged among 10th-grade students.

Students' intentions to eat fruit increased significantly among 10th-grade students ($p=0.01$) but not among fifth- and eighth-grade students. We did not detect significant changes in intentions to eat vegetables for fifth, eighth-, or 10th-grade students.

According to data collected using 24-hour recall interviews, students' consumption of fruit in school and overall increased significantly, by 0.34 and 0.61 servings per day, respectively ($p<0.01$) (Table 5). Students' consumption of all vegetables (including fried and white potatoes) in school decreased significantly ($p=0.05$), but consumption of all vegetables overall did not change.

We noted similar patterns when restricting analyses to fresh fruit and vegetables only. Students' consumption of fresh fruit in school increased significantly ($p=0.02$); consumption of fresh fruit overall did not change. Consumption of fresh vegetables in school and overall remained unchanged. The decrease in the number of vegetable servings consumed in school was still present when we analyzed vegetables excluding

Table 2. Pretest to posttest changes in Mississippi fifth-, eighth-, and 10th-grade students' attitudes and beliefs related to eating fruit and vegetables by grade level, MFVP 2004–2005

Student questionnaire construct	*Grade*	N	*Pretest mean score*	*Posttest mean score*	*Change*[a]	P-*value*[b]
Attitudes toward eating fruit and vegetables (score range 1–5)[c]	5	168	4.10	4.09	NS	0.92
	8	273	4.00	4.11	+	<0.01[d]
	10	213	4.01	4.02	NS	0.83
Perceived self-efficacy to eat more fruit (score range 1–5)[c]	5	166	4.38	4.36	NS	0.69
	8	275	4.21	4.41	+	<0.01[d]
	10	213	4.36	4.35	NS	0.90
Perceived self-efficacy to eat more vegetables (score range 1–5)[c]	5	166	3.71	3.50	–	0.04[d]
	8	274	3.51	3.52	NS	0.80
	10	214	3.36	3.44	NS	0.30
Willingness to try new foods: fruit (range 1–95)[c]	5	167	4.06	3.89	–	0.01[d]
	8	270	3.69	3.86	+	<0.01[d]
	10	212	3.77	3.72	NS	0.37
Willingness to try new foods: vegetables (range 1–5)[c]	5	166	3.42	3.22	–	0.03[d]
	8	273	3.13	3.13	NS	0.95
	10	214	3.03	3.08	NS	0.43

[a]A significant positive (+) or negative (–) change in the mean from pretest to posttest

[b]*P*-values from within-group pretest/posttest (no comparison) paired *t*-tests

[c]Higher numbers on ranges refer to more positive attitudes, stronger beliefs, and more willingness to try new foods.

[d]Statistically significant at $p<0.05$

MFVP = Mississippi Fruit and Vegetable Program

NS = not significant

fried potatoes or excluding all white potatoes; however, the decrease was no longer significant (Table 5).

Intake of vitamin C increased overall ($p=0.03$) and intake of dietary fiber increased in school ($p=0.02$). Consumption of other nutrients (vitamin A, carotene, folate, and potassium) did not change significantly (Table 5).

As part of the self-report questionnaire, we asked students to report how often they ate the fruit and vegetables offered at school breakfast and lunch. Reported consumption of fruit with the school breakfast and lunch varied by grade level (Table 6). Changes in consumption were most consistent among 10th-grade students, with the exception of eating fruit at school

Table 3. Mississippi fifth-, eighth-, and 10th-grade students' familiarity with fruit and vegetables, pretest to posttest changes by grade level, MFVP 2004–2005

Student questionnaire construct	*Grade*	N	*Pretest mean*	*Posttest mean*	*Change*[a]	P-*value*[b]
Familiarity with fruit (proportion score)[c]	5	167	0.85	0.86	+	0.051[d]
	8	274	0.90	0.92	+	<0.01[d]
	10	215	0.89	0.91	+	<0.01[d]
Familiarity with vegetables (proportion score)[c]	5	168	0.61	0.66	+	0.01[d]
	8	271	0.66	0.71	+	<0.01[d]
	10	214	0.64	0.68	+	0.02[d]

[a]A significant positive (+) or negative (–) change in the mean from pretest to posttest

[b]*P*-values from within-group pretest/posttest (no comparison) paired *t*-tests

[c]Number of types of fruit and vegetables students have ever eaten divided by total number of types of fruit and vegetables asked about in the questionnaire (13 fruit and seven vegetables)

[d]Statistically significant at $p<0.05$

MFVP = Mississippi Fruit and Vegetable Program

Table 4. Mississippi fifth-, eighth-, and 10th-grade students' preferences for fruit and vegetables, pretest to posttest changes by grade level, MFVP 2004–2005

Student questionnaire construct		*Grade*	N	*Pretest mean*	*Posttest mean*	*Change*[a]	P-*value*[b]
Preference for fruit and vegetables	Preference for fruit (score range 0–2)[c]	5	167	1.44	1.39	−	0.03[d]
		8	273	1.41	1.44	+	0.01[d]
		10	213	1.32	1.37	+	<0.01[d]
	Preference for vegetables (score range 0–2)[c]	5	166	0.85	0.68	−	<0.01[d]
		8	263	0.73	0.68	−	0.01[d]
		10	199	0.59	0.61	NS	0.39
Intention to eat fruit and vegetables	Intention to eat more fruit (score range 1–4)[c]	5	163	3.27	3.21	NS	0.21
		8	275	3.05	3.12	NS	0.07
		10	215	2.98	3.10	+	0.01[d]
	Intention to eat more vegetables (score range 1–4)[c]	5	165	2.55	2.44	NS	0.14
		8	272	2.18	2.16	NS	0.76
		10	211	1.94	2.03	NS	0.07

[a]A significant positive (+) or negative (−) change in the mean from pretest to posttest

[b]*P*-values from within-group pretest/posttest (no comparison) paired *t*-tests

[c]Higher numbers on ranges refer to stronger preferences and intentions.

[d]Statistically significant at $p<0.05$

MFVP = Mississippi Fruit and Vegetable Program

NS = not significant

lunch. Consumption by fifth-grade students either decreased or remained unchanged. For eighth-grade students, consumption of fruit or vegetables at breakfast remained unchanged; however, reported consumption of fruit at lunch increased and the increase was statistically significant ($p=0.01$).

DISCUSSION

The results of this pilot evaluation suggest that the MFVP may have helped to increase students' exposure to fruit and vegetables across all grade levels, which is consistent with the program's primary aim. The data suggest that the program modestly affected eighth- and 10th-grade students' attitudes, preferences for, and intentions to eat more fruit; it also appears to have helped to increase eighth- and 10th-grade students' consumption of fruit and fresh fruit during the school year. These results are similar to selected findings in other studies examining the effects of distributing free fresh fruit and/or vegetables.

For example, Jamelske and colleagues[21] found that students at schools distributing fresh fruit and vegetable snacks were more willing to try new fruit and vegetables at school than were control-group students; these effects did not appear to transfer to home. Similarly, Fogarty and colleagues[22] found that children's fruit consumption increased as a result of a national school fruit program in which children aged 4–6 years were given a daily piece of fruit at school. The effects dissipated after children aged out of the program. Further, Bere et al.[23] found strong effects of a fruit and vegetable snack and educational program on students' fruit and vegetable consumption at school and overall (school and home combined). Effects were still observed one year after the distribution of free fruit and vegetable snacks had ended (parents could and did subscribe to the program at a minimal cost).

The Mississippi program did not appear to increase vegetable consumption, with one exception—on the student questionnaire, 10th-grade students reported that they were more likely to eat the vegetables offered at school breakfast and lunch. These results were consistent with observations of administrators, parents, and students, suggesting that vegetables were less popular than fruit. Other studies aimed at improving fruit and vegetable consumption have noted similar findings. For example, Acheampong and colleagues[24] noted that the program entitled "5 a Day the Bash Street Way" increased consumption of fruit but not vegetables. In focus groups, students in Mississippi indicated a preference for cooked vs. raw vegetables, which may be a difficult challenge to overcome for these types of programs. Other strategies, such as offering low-fat dips, may be more feasible. School staff reported that serving vegetables with dip increased students'

willingness to try them. Students reported similar views. The recall data suggested that students' consumption of all vegetables decreased at school; however, this finding was no longer significant when potatoes were excluded from vegetable servings, suggesting that, at a minimum, the program did not have a negative impact on eating vegetables promoted by the program.

The program appeared to be more successful with eighth- and 10th-grade students than with fifth-grade students. Elementary school students' willingness to try and preferences for new fruit and vegetables actually decreased. The lack of positive findings among fifth-grade students is consistent with research on food preferences across the life span.[25,26] Younger children tend to prefer sweeter, more energy-dense foods (e.g., foods with high caloric content by weight, such as butter) over energy-dilute foods (e.g., foods with low calorie content by weight, such as vegetables and plain popcorn), a pattern that is thought to be influenced by physiological needs, and one that begins to change at puberty.[25] Children are also predisposed to reject new foods—except those that are sweet or salty[26]—and they have lower preferences for vegetables.[27] Skinner and colleagues[27] also found that the number of disliked foods increased as children tasted new foods; our findings were consistent with this research. Indeed, the fifth-grade students reported tasting more fruit and vegetables during the school year; at the same time, they reported liking fewer of the fruit and vegetables they tasted.

Despite the many factors contributing to children's food preferences, current research suggests that it is possible to influence food preferences through repeated tastings or exposures. For example, Wardle and colleagues found that children's liking and consumption of sweet red pepper increased significantly with repeated daily exposures during the course of eight days.[28] Others have noted that between eight and 15 exposures are needed to alter preferences.[29] During the MFVP, staff reported that they tended to stop purchasing vegetables that were rejected immediately by children to avoid waste and to maintain students' interest in the program. It may be important to consider a different strategy for introducing new vegetables through school-based fruit and vegetable snack programs to maximize success. For example, it

Table 5. Pretest to posttest changes in 24-hour recall reports of fruit, vegetables, and nutrients consumed by Mississippi eighth- and 10th-grade students by food and nutrient and by setting, MFVP 2004–2005

	Consumed in school (n=105)				*Consumed in and out of school (n=191)*			
Food/nutrient	*Pretest mean*	*Posttest mean*	*Change*[a]	P-*value*[b]	*Pretest mean*	*Posttest mean*	*Change*[a]	P-*value*[b]
Servings of fruit and vegetables								
Fruit servings: total	0.49	0.83	+	<0.01[c]	1.01	1.62	+	<0.01[c]
Fruit servings: fresh fruit only	0.11	0.26	+	0.02[c]	0.27	0.38	NS	0.14
Vegetable servings: total	1.31	0.93	−	0.05[c]	2.80	2.78	NS	0.93
Vegetable servings: fresh vegetables only	0.13	0.11	NS	0.85	0.20	0.25	NS	0.41
Vegetable servings: total, no fried potatoes	0.72	0.64	NS	0.47	1.56	1.69	NS	0.43
Vegetable servings: total, no white potatoes	0.40	0.38	NS	0.88	1.07	1.21	NS	0.29
Vitamins/minerals								
Vitamin A (international unit)	996.9	1,269.1	NS	0.18	3,568.1	4,151.6	NS	0.28
Carotene (retinol equivalent)	41.8	73.3	NS	0.11	210.0	273.4	NS	0.22
Vitamin C (milligram)	29.7	36.3	NS	0.22	89.7	111.8	+	0.03[c]
Dietary fiber (gram)	4.4	5.4	+	0.02[c]	11.9	12.6	NS	0.36
Folate (milligram)	108.1	101.4	NS	0.39	337.8	332.6	NS	0.78
Potassium (milligram)	1,055.3	1,028.2	NS	0.67	2,444.9	2,456.0	NS	0.92

[a]A significant positive (+) or negative (−) change in the mean from pretest to posttest

[b]*P*-values from within-group pretest-posttest (no comparison) paired *t*-tests

[c]Statistically significant at $p<0.05$

MFVP = Mississippi Fruit and Vegetable Program

NS = not significant

Table 6. Mississippi fifth-, eighth-, and 10th-grade students' consumption of fruit and vegetables based on student self-report questionnaire, pretest to posttest changes by grade level, MFVP 2004–2005

Student questionnaire construct		*Grade*	N	*Pretest mean*	*Posttest mean*	*Change*[a]	P-*value*[b]
Consumption of fruit with school breakfast or lunch	Frequency of eating fruit offered at school breakfast?[c]	5	112	3.04	2.79	−	0.05[d]
		8	129	2.52	2.51	NS	0.94
		10	117	2.44	2.76	+	0.01[d]
	Frequency of eating fruit offered at school lunch?[c]	5	157	3.43	3.33	NS	0.17
		8	260	2.95	3.12	+	0.01[d]
		10	187	3.07	3.19	NS	0.06
Consumption of vegetables with school breakfast or lunch	Frequency of eating vegetables offered at school breakfast?[c]	5	110	2.30	2.13	NS	0.17
		8	121	1.83	1.85	NS	0.78
		10	116	1.49	1.67	+	0.04[d]
	Frequency of eating vegetables offered at school lunch?[c]	5	151	2.74	2.60	NS	0.10
		8	121	1.83	1.85	NS	0.78
		10	182	2.10	2.29	+	0.01[d]

[a]A significant positive (+) or negative (−) change in the mean from pretest to posttest

[b]*P*-values from within-group pretest-posttest (no comparison) paired *t*-tests

[c]Based on a four-point scale ranging from 1 = never to 4 = most/all of the time

[d]Statistically significant at $p<0.05$

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may be helpful to host tasting events during repeated days (eight to 10 days) with new vegetables before buying them for school-wide distribution.

Other research emphasizes the importance of family influences and availability in fruit and vegetable consumption. For example, eating with family members, especially parents, is associated with increased consumption of fruit and vegetables.[30,31] Similarly, availability, particularly at home, is linked to increased consumption.[32] Finally, parental modeling is important to promote consumption.[27,33] These factors could be beneficial leverage points for fresh fruit and vegetable programs. Future programs may consider capitalizing on this potential by emphasizing parents' role in increasing fruit and vegetable consumption through eating as a family, making fruit and vegetables available at home, and modeling consumption. Anecdotal evidence from the evaluation suggests that the free fresh fruit and vegetable program could help with these influences. During focus group interviews with parents, several parents of children at varying grade levels commented that their children asked them to buy fruit and vegetables that were served at school, which they did.

Interestingly, staff reactions alone would have suggested much stronger outcomes for fifth-grade students than were captured with the student questionnaire. More research is needed on how to best assess the effects of this type of program on younger children. Although there is empirical support for collecting self-administered nutrition-related questionnaires from fourth- and fifth-grade students,[14] and there did not appear to be significant comprehension challenges during questionnaire pilot testing or administration, it is possible that the younger students may have had more challenges than the older students in understanding some of the questionnaire items. Nonetheless, the research on collecting data from children suggests that, in general, children aged 9 years and older are capable of contributing valid information about their own feelings, experiences, behaviors, and physical symptoms through many of the traditional data collection methods, such as diaries, in-person interviews, written surveys, and computer-based surveys.[34]

Limitations and strengths

The evaluation had several limitations. Data were collected within a one-group (no comparison group) pretest/posttest design, limiting the ability to attribute changes in students' attitudes, preferences, and eating

behaviors to the program. Without a comparison group, the influences of factors such as seasonality, national attention on the issue of obesity, or other unknown trends cannot be ruled out.

If seasonality were an issue, biases resulting from seasonal availability of produce would have had the most significant effect on the types of fruit and vegetables eighth- and 10th-grade students reported eating on the food frequency scale and 24-hour recall interviews. It is possible that students in Mississippi may have had more fresh fruit and vegetable options available in fall than in spring (Personal communication, Dr. T. Carithers, University of Mississippi, August 2005); however, the program may have helped equalize the availability of fresh produce in spring somewhat by providing fresh fruit and vegetable snacks at school. Further, analyses compared data collected in early fall (pretest) and late spring (posttest) rather than from two stark opposite seasons (e.g., summer and winter); this may have helped to minimize the threat of seasonality. Finally, for both types of data, we examined the total number of servings of fruit and vegetables (fresh, frozen, dried, or canned), further minimizing the biases that might result from examining consumption of fresh produce alone.

Other important limitations include the sample size for the dietary recall interviews, intervention intensity, and the stage of intervention implementation. The sample for the dietary recall interviews was relatively small. We established the sample size to allow for overall group estimates, with an expectation of being able to detect small to medium effects in the mean number of servings of fruit or vegetables. The sample size was too small to support tests of subgroup differences (e.g., gender or grade-level differences), limiting the ability to assess program effects among subgroups.

The intervention (distributing free fruit and vegetables) was relatively modest. Schools augmented the distribution with a variety of nutrition education activities, but students' exposure to these activities was not assessed at the individual level, thereby limiting conclusions about how these may have affected the outcomes.

Finally, at the time of this evaluation, the MFVP was a new program for Mississippi schools, and the evaluation year represented the first year of implementation. Schools experienced a range of start-up and implementation challenges that could have affected the program's overall impact; nonetheless, schools suggested the challenges were limited, and program coordinators reported that they were able to address most of the challenges relatively early in the school year.

The study also had a number of strengths. For example, it had high participation and retention rates in both the student surveys and 24-hour recall interviews. It included both elementary and secondary-level students, and analyzed their survey data separately. Similarly, this study examined fruit- and vegetable-related data separately. Although some studies have taken a similar approach, many studies have combined fruit and vegetable indicators, potentially obscuring differential program impacts. This study more specifically addressed the program's goals by examining the recall data with and without potatoes and only fresh vs. all fruit and vegetables, providing a more specific analysis of how these programs might impact student outcomes. Finally, we examined consumption of fruit and vegetables as measured in the recall both in school and overall, providing an opportunity to better understand where behavioral influences may be occurring.

CONCLUSION

This pilot evaluation demonstrated the potential of the fresh fruit and vegetable distribution program in enhancing familiarity with a variety of fruit and vegetables among elementary and secondary school students, and increasing fruit consumption and related attitudes among secondary school students. Overall, the program effects detected in this pilot evaluation were relatively modest, but findings for older youth are encouraging, especially given recent evidence suggesting that fruit and vegetable consumption declines during transitions from early to middle and middle to late adolescence.[8]

More program emphasis is needed on identifying, packaging, and promoting vegetable consumption among all students. Additionally, program effects may be stronger if implemented as a component of a more comprehensive program aimed at improving children's nutrition in and out of school.[35] Further evaluation is needed to study the effects of this type of program under a randomized, controlled design. More focus on the age-related findings is also warranted. Based on the factors measured in this evaluation, the benefits for younger children are less clear; yet, anecdotal evidence suggests value for the entire school community, including elementary school communities.

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