

Evaluation of a school-based multi-component education program to improve young children's fruit and vegetable consumption.

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Abstract:

Objective

To assess the impact of a multicomponent nutrition education program on student knowledge, attitudes, and behaviors related to consumption of fruits and vegetables (FVs).

Design

Quasi-experimental pretest/posttest research design; 3 study conditions (Intervention+, Intervention, Comparison).

Setting

Six schools from the Los Angeles Unified School District (LAUSD).

Participants

Three hundred ninety-nine low-income third-, fourth-, and fifth-grade students.

Intervention

The Intervention+ condition included 4 components: traditional Network–LAUSD program, new standardized nutrition curriculum, teacher training workshops, and parent nutrition education workshops. The Intervention condition included 2 components: traditional Network–LAUSD program and teacher training workshops.

Main Outcome Measures

Fruit and vegetable consumption, knowledge of food groups, attitudes and beliefs toward FVs, and parent/teacher influence on students' attitudes toward FVs.

Analysis

Linear mixed models.

Results

The Intervention+ resulted in a positive change in knowledge ($P < .05$), attitudes and beliefs toward vegetables ($P < .01$), and teacher influence on students' FV attitudes ($P < .05$).

Conclusions and Implications

Although this study influenced knowledge and attitudes regarding FVs, a significant increase in students' FV consumption was not observed. Given the ultimate aim of the LAUSD nutrition efforts is to increase FV consumption, future studies should consider adopting new intervention strategies, such as focusing on changing the school food environment.

Keywords: children | nutrition | child nutrition | nutrition education | secondary education | public health education | school nutrition programs

Article:

Introduction

Dietary habits greatly influence childhood obesity.¹ The school setting is known to influence students' eating patterns,² and 3 and because over 53 million students attend school every day, it has been identified as a key setting for nutrition-related obesity prevention programs in the United States.^{4, 5, 6, 7, 8} and 9 Because fruits and vegetables (FVs) are low-calorie food that is high in essential micronutrients and can be expected to reduce obesity risk,¹⁰ school nutrition

programs have often focused on increasing their consumption.^{11, 12, 13, 14 and 15} School-based nutrition education programs have shown some success at increasing the consumption of FVs,^{11, 13, 14, 16, 17 and 18} however, most of these programs used a single-component approach.^{11, 13 and 16}

To further improve the chances of success at increasing students' FV consumption, school-based nutrition education efforts should focus on culturally and geographically appropriate, multicomponent approaches that actively involve family members, schools and teachers, community members, and health and nutrition experts.⁴ The few reports on multicomponent school-based programs that have been published described significant increases in FV consumption.^{5, 17, 18 and 19} Much of the literature is focused on highly developed research interventions that were not designed to be disseminated through large, diverse, and complex school systems serving low-income children, many of whom are learners of English as a second language. Thus, there continues to be a need for evidence-based multicomponent studies that identify the most effective strategies for improving FV consumption in these school-aged children.

This article reports findings from a multicomponent, school-based nutrition education program in low-income schools in Los Angeles County that is designed to improve students' consumption of FVs. The program is a collaborative effort involving school administrators, parents, teachers, nutrition experts, public health experts, and pediatricians. In particular, the present study describes the impact of interventions that were primarily designed to be "doable" in a real classroom setting with little external program resources and using existing classroom teachers to reach a diverse student population.

The university research group, which includes nutrition experts, public health experts, and pediatricians, has been working for over a decade with the Los Angeles Unified School District (LAUSD) to evaluate various components of their nutrition education efforts. The LAUSD includes 885 schools, employs over 75,000 teachers, and enrolls approximately 700,000 students each year.²⁰ Typically, around 275 schools participate in nutrition-focused LAUSD activities. The LAUSD administers its main nutrition education programs through the Network for a Healthy California–LAUSD (Network–LAUSD), which was established in 2000 to encourage FV consumption and physical activity among students. Over the years, the collaborative evaluation studies have focused on different aspects of Network–LAUSD programming. In 2008, Network–LAUSD developed a parent nutrition education program. The results of the evaluation study showed that the program was effective in changing parent knowledge, attitudes, and behaviors related to healthful eating.²¹ With the new parent nutrition education program in place, in 2009, Network–LAUSD sought to improve their program by focusing on teacher

training using a standardized nutrition education model. Network–LAUSD built upon these previous 2 efforts by creating a multicomponent, school-based education program that includes parent involvement, teacher training, and a standardized nutrition education model.

The purpose of the current research is to evaluate the impact of the multicomponent, school-based nutrition education program on knowledge, attitudes, and behaviors related to nutrition and FV consumption among 399 third-, fourth-, and fifth-grade LAUSD students during the 2009-2010 school year. Specifically, this study aims to answer the following research question: is there a difference in improvement on elementary students' (a) FV consumption, (b) availability of FVs in the home, (c) knowledge about food groups and the benefits of FVs, (d) attitudes and beliefs regarding the consumption of FVs, and (e) perception of parent and teacher influence on FV attitudes among students who were exposed to 1 of 3 different study conditions? Results from the study are presented, as are the lessons learned in developing and implementing multicomponent nutrition education programs in a large, multiethnic, urban school system.

Methods

Participants and Recruitment

Schools in which 50% or more of the students qualified to receive free or reduced-price meals from the National School Meal program were eligible to participate in the study. Using a convenience sample, 6 elementary schools out of the eligible 389 were selected to participate in the study during the 2009-2010 school year. The LAUSD recruited the 4 intervention schools (36 classrooms), and University research staff recruited the 2 comparison schools (20 classrooms), which were eligible but not participating in the Network–LAUSD program. Both the intervention and comparison schools were part of LAUSD, however, comparison schools that were far enough away from the intervention schools to reduce chances of contamination were chosen to participate in the study. Classrooms were selected based on teachers' willingness to participate. Teachers from each of the classrooms delivered the program to their classroom only. A member of the University research team visited each classroom to describe the program and evaluation procedures.

Although only those students from the intervention schools received the nutrition education program, baseline and post-intervention questionnaires were to be completed by students from both the intervention and comparison schools. Students from the comparison schools would be eligible to participate in a future nutrition education program once their schools signed up for the Network–LAUSD program. All students were given consent forms for their parents to sign and

assent forms for them to sign if they were interested in participating in the study. Although all students from the 4 intervention schools were required to participate in the nutrition education activities, only those students who returned signed consent and assent forms completed the baseline and post-intervention questionnaires. Those students who chose not to participate in the evaluation portion (ie, complete questionnaires) were given another nonstudy activity to complete while the other students were completing the questionnaires. Participation was voluntary at the school, classroom, and student levels. The study received University of California–Los Angeles Institutional Review Board approval and LAUSD approval.

Study Design and Procedures

This study used a quasi-experimental pretest/posttest research design. Students were assigned to 1 of 3 study conditions (Intervention+, n = 53; Intervention, n = 185; or Comparison, n = 161). Only those students whose parents participated in the Network–LAUSD’s 2008 parent nutrition education program were eligible to be assigned to the Intervention+ condition. Students from all 3 study conditions completed the same baseline questionnaire at the beginning of the school year (September and October 2009) and post-intervention questionnaire at the end of the school year (May and June 2010). Questionnaires were group administered in each classroom and completed individually by students. Previous research has shown that third-, fourth-, and fifth-graders have no difficulty in completing the questionnaire on their own.²²

Intervention

The intervention was designed based on constructs from Social Cognitive Theory and the Theory of Planned Behavior,²² and ²³ and it used a cognitive-behavioral approach to motivate students to change nutrition and FV consumption behavior. The intervention also focused on teachers and parents as role models for behavior change. A total of 56 teachers and 53 parents (mothers only) participated in this study. Nutrition education sessions sought to increase knowledge about nutrition and healthful eating, and interactive activities were used to increase positive attitudes toward FVs.

Intervention+ condition

Students in the Intervention+ study condition were involved in the following 4 study components: the traditional Network–LAUSD program, standardized nutrition curriculum, teacher training workshops, and parent nutrition education workshops during the 2008-2009 school year. Teachers in this study condition had the freedom to develop their own lesson plans and instruction schedule as long as it included the traditional Network–LAUSD program and

standardized nutrition curriculum. Teachers were required to complete at least 10 hours of nutrition education per quarter (3-month reporting period). Previous work has shown that there is a range of 10-20 hours per quarter,¹² however, the exact number of hours was not monitored for this study. All participating teachers met the minimum requirement of hours in prior studies conducted by the Network–LAUSD. All nutrition education activities occurred during the regular school day in the classroom. Students stay in the same classroom all day, except for some exceptions such as music appreciation and physical education. Below is a detailed description of the Intervention+ condition programs and activities.

For the traditional Network–LAUSD program, each school used funding from LAUSD for a variety of LAUSD-defined activities as well as efforts created at the local school. The LAUSD activities included programs that brought chefs and farmers to the school, theatrical performances with a nutrition theme, physical activity, art, and the most common program, Harvest of the Month (HOM). Harvest of the Month is a classroom-based program that introduces a new type of fruit or vegetable to students each month. Participating schools were also eligible for teacher training conducted by LAUSD staff. Additionally, the school could use funds to create their own nutrition activities or purchase nutrition-focused resources.

Participating teachers committed to using 3 standardized nutrition education curricula: HOM program,²⁴ the Dairy Council of California,²⁵ and 5-A-Day PowerPlay!²⁶ The California Dairy Council provides nutrition education on the food groups and healthful eating. Instructional materials are based on the 2005 Dietary Guidelines and MyPyramid Food Guidance System. The purpose of 5-A-Day PowerPlay! is to motivate and empower children to eat 3-5 cups of FVs and get at least 60 minutes of physical activity every day.

For the teacher training component, teachers attended 2 workshops to develop the knowledge and skills necessary to effectively implement nutrition education. Teachers of grades 3, 4, and 5 received training on how to implement HOM in the classroom and use the Dairy Council materials. Teachers of grades 4 and 5 also received training in the 5-A-Day PowerPlay! program. The first teacher training workshop was a 1-hour training session, provided by Network–LAUSD and Dairy Council representatives, that was conducted during professional development. The second workshop was an additional 90-minute training session that informed teachers how best to use the HOM program with students, how to do tasting and sampling, and how to integrate nutrition lessons into the classroom curriculum. The latter included training by 5-A-Day PowerPlay! representatives and/or LAUSD staff, who demonstrated how 5-A-Day Power Play! could be integrated into lessons. All teachers from the Intervention+ schools who attended the enhanced training workshops were asked to use Dairy Council or 5-A-Day PowerPlay! materials

with students and provide monthly HOM nutrition lessons that included tasting and sampling of the monthly produce item.

The parent nutrition education program consisted of 5 workshops, each of which lasted approximately 90 minutes. Workshops were conducted at the different schools in the morning. Workshop components included activities that targeted nutrition-related knowledge and skills with the intent to result in behavior change. Workshop topics consisted of the following: (1) MyPyramid/food groups; (2) nutrients/vitamins and minerals/fruits and vegetables; (3) food labels; (4) meal planning; and (5) eating out and snacks/making healthful decisions. Instructors offered mixed-media classes, including overhead projection, interactive discussions, question and answer sessions, food preparation, and homework. Since more than 70% of the student population is Hispanic,²⁰ Network–LAUSD tailored this program to a Hispanic population.

Intervention condition

Students in the Intervention study condition were involved in the following 2 study components: the traditional Network–LAUSD program and teacher training workshops (as described under the Intervention+ section above). Teachers from both the Intervention+ and Intervention conditions were required to provide at least 10 hours of nutrition education per quarter regardless of the number of program components. Although all parents from the eligible schools were invited to participate in the parent nutrition program, parents of students in this group opted not to participate in the program.

Comparison condition

Students in the Comparison condition did not receive either of the 2 nutrition education curricula. The nutrition education they received was dependent upon the requirements of their respective schools. Teachers from the comparison schools did not attend the teacher training workshops, and parents of children attending the comparison schools did not attend the parent workshops.

Instruments

The student questionnaire included 5 sections that assessed the following outcome measures: students' FV consumption and availability of FVs at home; knowledge about food groups and the health benefits of FVs; attitudes and beliefs regarding the consumption of FVs; parent and teacher influence on students' FV attitudes; and demographics (Supplementary Table).

The first section assessed FV consumption using the Network for a Healthy California questionnaire, a validated instrument to assess FV frequencies in school-aged children.²⁷ Students were asked to report the number of times they ate FVs the previous day. Response categories were none, once, twice, 3 times, 4 times, and 5 or more times. Students were also asked whether FVs were available in their home (never, sometimes, or always).

The second section examined students' knowledge about food groups and the health benefits of FVs. Eight questions were developed based on 5-A-Day PowerPlay! and Dairy Council of California materials.²⁵ and ²⁶ For the analyses, a continuous scale ranging from 0-8 was created. The score was based on the mean number of correct responses. Cronbach α for the scale was .29.

The third section measured students' attitudes and beliefs regarding the consumption of FVs through 12 dichotomous (yes/no) items. Questions were adapted from existing validated instruments and from previous evaluation of the District's nutrition programs.²⁸ and ²⁹ For the analyses, a continuous scale was created. The scale ranged from 0 (representing most negative attitudes toward FVs) to 12 (representing most positive attitudes). Cronbach α for the scale was .73.

The fourth section contained 16 dichotomous (yes/no) items related to perceived parent and teacher influence and encouragement regarding students' FV attitudes. Questions were adapted from a previously validated instrument.²⁹ Two continuous scales were created (parent influence and teacher influence). For parent and teacher influence, scales ranged from 0 (lowest level of influence) to 8 (highest level of influence). Cronbach α for the 2 scales were .86 for parents and .88 for teachers.

The fifth section assessed demographic characteristics, including sex, grade (third, fourth, or fifth), and race/ethnicity (Hispanic/Latino, Asian, white, African American, and other).

Data Analysis

First, the distributions of all independent and dependent variables were examined. Second, demographic characteristics were assessed at baseline by intervention and comparison groups

using chi-square and Fisher exact tests. Third, using pretest and posttest data, linear mixed models were built for each of the dependent variables (fruit consumption, vegetable consumption, availability of FVs in the home, attitudes and beliefs toward FVs, and parent and teacher influence on students' FV consumption), as linear mixed models allow for unequal numbers of participants at pretest and posttest. In these models, the treatment condition (Intervention+, Intervention, and Comparison) and time (pretest and posttest) were included as fixed effects, and students were included as random effects to address the possibility that 1 student measured twice (at pretest and at posttest) is likely to be more similar than 2 students, 1 measured at pretest and 1 measured at posttest. Covariates (sex, grade, and race/ethnicity) were added to these models to control for factors that may have been unbalanced between the Intervention and Comparison groups. Adjusted means and standard errors were calculated from linear mixed regression models. Results for adjusted models for FV consumption and availability of FVs at home are not presented, since these models were not statistically significant. Further, there was insufficient variability to assess a clustering effect at the school level. All analyses were conducted using Stata (version 10.0, Stata Corp, College Station, TX, 2009).

Results

Demographic Characteristics

Demographic information is presented in Table 1. A total of 399 low-income, predominantly minority, third-, fourth-, and fifth-grade students (ages 8-11 years) participated in the nutrition program. There were no significant differences between the Intervention+, Intervention, and Comparison conditions on sex or grade, but there was a significant difference in race/ethnicity ($P < .001$). There were more Hispanic/Latino students in the Intervention+ condition as compared with the Intervention and Comparison conditions and more Asians in the Comparison condition as compared with the Intervention+ and Intervention conditions.

Table 1. Demographic Characteristics of Participants at Baseline by Intervention and Comparison Conditions, n (%) (Total n = 399)

Characteristic	Intervention+ (n = 53)	Intervention (n = 185)	Comparison (n = 161)	<i>P</i>
Sex				.25
Male	30 (57)	81 (44)	73 (45)	
Female	23 (43)	104 (56)	88 (55)	
Grade				.06
Third	24 (45)	80 (43)	52 (33)	

Characteristic	Intervention+ (n = 53)	Intervention (n = 185)	Comparison (n = 161)	<i>P</i>
Fourth	15 (29)	68 (37)	57 (35)	
Fifth	14 (26)	37 (20)	52 (32)	
Race/ethnicity ^a				< .001
Hispanic/Latino	41 (82)	123 (69)	98 (63)	
Asian	1 (2)	8 (5)	39 (25)	
White	5 (10)	31 (17)	7 (5)	
African American	1 (2)	10 (6)	2 (1)	
Other	2 (4)	6 (3)	10 (6)	

Note: Chi-square test for sex and the Fisher exact test for grade and race/ethnicity.

a Because of missing data, variable does not sum to the total n.

FV Consumption and Availability of FVs in the Home

Neither of the 2 intervention conditions had a significant effect on FV consumption, which was well below the national recommendation of 5 or more times per day.³⁰ Additionally, neither intervention condition had a significant effect on the availability of FVs in the home. However, availability of fruit was high at baseline for both the Intervention+ and Intervention conditions (Table 2).

Table 2. Unadjusted Mean Values of FV Consumption Based on Previous Day's Recall and Availability of FVs in the Home at Pretest and Posttest by Intervention Condition

Variable and Time	Intervention+ (n = 53)	Intervention (n = 185)	Comparison (n = 161)	<i>P</i>
Consumption of fruit				.10
Pretest, mean (SE)	1.70 (0.20)	1.81 (0.10)	1.76 (0.11)	
Posttest, mean (SE)	1.66 (0.21)	1.69 (0.11)	1.47 (0.12)	
Difference	-0.04	-0.12	-0.29	
Consumption of vegetables				.62
Pretest, mean (SE)	1.50 (0.22)	2.01 (0.12)	1.70 (0.13)	
Posttest, mean (SE)	1.63 (0.24)	1.93 (0.13)	1.50 (0.13)	

Variable and Time	Intervention+ (n = 53)	Intervention (n = 185)	Comparison (n = 161)	<i>P</i>
Difference	+0.13	-0.08	-0.20	
Availability of fruit at home				.34
Pretest, mean (SE)	1.75 (0.07)	1.78 (0.03)	1.69 (0.04)	
Posttest, mean (SE)	1.76 (0.07)	1.75 (0.04)	1.72 (0.04)	
Difference	+ 0.01	-0.03	+ 0.03	
Availability of vegetables at home				.24
Pretest, mean (SE)	1.71 (0.08)	1.62 (0.04)	1.57 (0.04)	
Posttest, mean (SE)	1.70 (0.08)	1.66 (0.04)	1.61 (0.04)	
Difference	-0.01	+0.04	+0.04	

FV indicates fruit and vegetable. Note: Scale range for fruit and vegetable consumption (0-5, low consumption to high consumption). Scale for availability of FVs in home ranges from 0-2 (0 = never, 1 = sometimes, 2 = always). Linear mixed regression models for main effect of intervention condition (Intervention+, Intervention, Comparison groups) from pretest to posttest.

Knowledge about Food Groups and Health Benefits of FVs, Attitudes and Beliefs Regarding the Consumption of FVs, and Parent and Teacher Influence on Students' FV Attitudes

Table 3 and Table 4 present the unadjusted and adjusted mean values for knowledge about food groups and health benefits of FVs, attitudes and beliefs regarding the consumption of FVs, and perception of parent and teacher influence on students' FV attitudes at pretest and posttest. These means were calculated from the linear mixed model for each variable. In the unadjusted model (Table 3), the Intervention+ condition resulted in a significant change in knowledge ($P < .05$). Knowledge increased for students in the Intervention+ condition from pretest to posttest (+0.42) and decreased for the students in the Comparison condition (-0.35). There was a small increase for students in the Intervention condition (+0.03).

Table 3. Unadjusted Mean Values of Knowledge about Food Groups and the Health Benefits of FVs, Attitudes and Beliefs toward the Consumption of FVs, and Parent and Teacher Influence on FV Attitudes at Pretest and Posttest by Intervention Condition

Variable and Time	Intervention+ (n = 53)	Intervention (n = 185)	Comparison (n = 161)	<i>P</i>
Scales				
Knowledge of food groups and				<

Variable and Time	Intervention+ (n = 53)	Intervention (n = 185)	Comparison (n = 161)	<i>P</i>
FVs				.05
Pretest, mean (SE)	3.74 (0.23)	4.10 (0.12)	4.17 (0.13)	
Posttest, mean (SE)	4.16 (0.24)	4.13 (0.13)	3.82 (0.13)	
Difference	+0.42	+0.03	-0.35	
Attitudes and beliefs toward FVs				< .01
Pretest, mean (SE)	8.72 (0.34)	9.45 (0.18)	8.75 (0.19)	
Posttest, mean (SE)	9.45 (0.35)	9.43 (0.19)	8.68 (0.19)	
Difference	+0.73	-0.02	-0.07	
Parent influence on FV attitudes				.90
Pretest, mean (SE)	7.17 (0.22)	7.06 (0.12)	7.09 (0.13)	
Posttest, mean (SE)	7.27 (0.24)	7.41 (0.13)	7.23 (0.13)	
Difference	+0.10	+0.34	+0.14	
Teacher influence on FV attitudes				.05
Pretest, mean (SE)	5.55 (0.35)	6.08 (0.19)	5.56 (0.20)	
Posttest, mean (SE)	5.78 (0.37)	6.20 (0.20)	5.54 (0.21)	
Difference	+0.23	+0.12	-0.02	

FV indicates fruit and vegetable; SE, standard error. Note: Knowledge of food groups and health benefits of FVs (mean number correct based on 8 items, scale range 0-8). Attitude toward the consumption of FVs (scale range 0-12, negative to positive). Scale range for parent and teacher influence on students' FV attitudes (0-8, low to high). Linear mixed regression models for main effect of intervention condition (Intervention+, Intervention, Comparison) from pretest to posttest.

Table 4. Adjusted Mean Values of Knowledge about Food Groups and the Health Benefits of FVs, Attitudes and Beliefs toward the Consumption of FVs, and Parent and Teacher Influence on FV Attitudes at Pretest and Posttest by Intervention Condition

Variable and Time	Intervention+ (n = 53)	Intervention (n = 185)	Comparison (n = 161)	<i>P</i>
Scales				
Knowledge of food groups and FVs				< .01
Pretest, mean (SE)	3.75 (0.24)	4.12 (0.12)	4.19 (0.13)	
Posttest, mean (SE)	4.17 (0.24)	4.17 (0.13)	3.83 (0.13)	
Difference	+0.42	+0.05	-0.36	
Attitudes and beliefs toward FVs				< .05
Pretest, mean (SE)	8.82 (0.35)	9.44 (0.18)	8.80 (0.19)	
Posttest, mean (SE)	9.36 (0.36)	9.41 (0.19)	8.70 (0.19)	
Difference	+0.54	-0.03	-0.10	
Parent influence on FV attitudes				.95
Pretest, mean (SE)	7.20 (0.23)	7.07 (0.12)	7.17 (0.13)	
Posttest, mean (SE)	7.28 (0.25)	7.39 (0.13)	7.24 (0.13)	
Difference	+0.08	+0.32	+0.07	
Teacher influence on FV attitudes				.17
Pretest, mean (SE)	5.56 (0.36)	6.08 (0.19)	5.63 (0.20)	
Posttest, mean (SE)	5.63 (0.38)	6.16 (0.20)	5.51 (0.20)	
Difference	+0.07	+0.08	-0.12	

FV indicates fruit and vegetable; SE, standard error. Note: Knowledge of food groups and FVs (mean number correct based on 8 items, scale range 0-8). Attitude toward FVs (scale range 0-12, negative to positive). Scale range for parent and teacher influence on student's FV attitudes (0-8, low to high). Linear mixed regression models for main effect of intervention condition (Intervention+, Intervention, Comparison groups) from pretest to posttest.

There was a significant effect on students' attitudes and beliefs toward the consumption of vegetables ($P < .01$) for students in the Intervention+ condition from pretest to posttest (+0.73) compared with students in the Intervention and Comparison conditions (-0.02 and -0.07 , respectively). There was also a significant effect of teacher influence on students' FV attitudes ($P < .05$). Teacher influence on students' FV attitudes increased for students in both the Intervention+ and Intervention conditions from pretest to posttest (+0.23 and +0.12, respectively) and decreased for students in the Comparison condition (-0.02). The intervention did not have a significant effect on parent influence on students' FV attitudes.

In the adjusted model (Table 4), the difference between the Intervention and Comparison conditions remained significant for knowledge about food groups and the health benefits of FVs ($P < .01$) and students' attitudes and beliefs toward the consumption of FVs ($P < .05$). Teacher influence on students' FV attitudes was no longer significant after adjusting for demographic characteristics.

Discussion

The purpose of this study was to examine the impact of a multicomponent nutrition education program on students' FV consumption, availability of FVs in the home, attitudes and beliefs regarding the consumption of FVs, and perception of parent and teacher influence on students' FV attitudes by study condition (Intervention+, Intervention, or Comparison).

Although students in the Intervention+ condition had positive attitudes toward the consumption of FVs, these positive attitudes did not translate into behavior change. A significant increase in the consumption of FVs was not found for any of the 3 study conditions. Additionally, FV consumption was well below national recommendations for all 3 study conditions. These findings were consistent with findings from the Network-LAUSD's previous nutrition education efforts.¹² It is possible that the lack of significant findings could be explained by the small number of students in the Intervention+ condition and/or the amount of time it takes to change behaviors. Following children longer than 1 school year may be required to capture the full benefit of the intervention on behavior change. Literature reviews have identified interventions in the "school food environment" as critical to the success of nutrition education programs.^{19, 31} and 32 Environmental interventions such as changes in food supply, collaboration with private sector food vendors, and incentives to change nutrition policies in schools may have greater success in influencing students' consumption behaviors.³³ For example, a study in Los Angeles found that introducing a salad bar as a lunch menu option resulted in an increase in FV consumption among elementary school children living in low-income neighborhoods.³⁴

A significant difference between the Intervention and Comparison conditions on the availability of FVs in the home was not found, although baseline levels of fruit were fairly high for the Intervention+ and Intervention conditions. Significant intervention effects in the availability of both fruits and vegetables for the Intervention+ condition were expected, since the parents had participated in the parent nutrition education workshops. There may be many reasons this effect did not occur, such as lack of access to fresh FVs, lack of money to purchase fresh FVs, or lack of time, as documented in previous studies.^{3, 35 and 36}

There was a statistically significant increase in student's knowledge of food groups and the health benefits of FVs for both the Intervention+ and Intervention condition compared to a decrease in the Comparison condition. To the extent that knowledge gains are an indication of program effectiveness, the data suggest the messages are reaching the students. However, because of the low Cronbach α of the knowledge scale, these results should be viewed with caution. Although no change in the Comparison condition would have been expected, there was a substantial decrease. It is possible this decrease in the Comparison condition was a result of natural fluctuation. However, it may also have been a result of the low reliability of the knowledge scale.

There was a significant increase in positive attitudes toward the consumption of FVs for the Intervention+ condition compared with the Intervention and Comparison conditions, both of which had slight decreases in positive attitudes toward the consumption of FVs. Given attitude shifting is related to behavior change, this finding is promising.

No significant difference was found between the Intervention and Comparison conditions on students' perceptions regarding the influence parents have on their FV attitudes. However, the average was high for all 3 study conditions at baseline, thus there was little room for change. Previous studies have documented the challenge of involving parents in school-based nutrition projects and the difficulty these projects have in influencing home consumption practices.²⁹ In this study, parents of students in the Intervention+ condition had attended the parent nutrition workshops, thus a significant effect for this group was expected. Future parent nutrition workshops may require strategies that place a greater emphasis on the importance of FV consumption and the correct required daily servings. Workshops with a more structured approach (eg, specific homework activities engaging parents with their children) may also have a greater impact on parental influence. It is also possible that the instrument used in this study to assess this concept did not capture significant differences between households in the Intervention

conditions as compared with the Comparison condition. Although parents may tell their children that FVs are healthful and good for them, doing so may not necessarily translate into greater consumption of FVs. In future studies, it might be useful to develop questions that focus specifically on the influence parents have on their children's actual consumption of FVs.

There was a significant increase in teachers' influence on students' attitudes toward FVs for both the Intervention+ and Intervention conditions compared with a slight decrease in the Comparison condition for the unadjusted regression model. Thus, teachers as recognized nutrition educators appear to have an impact on students' attitudes toward FVs.

There are limitations to this study that must be acknowledged. First, this study was based on a convenience sample; thus, there is the potential for selection bias, especially among the parent training sample, in which parents might have been more motivated or interested in nutrition compared to the other groups. Second, data were collected by self-report, and these data may be subject to a number of biases such as desirability or poor recall.

Third, low Cronbach α for the knowledge scale may reflect the lack of use of a validated instrument or the small number of items measured. Measuring general nutrition knowledge continues to be a challenge in this type of work. When using other instruments, knowledge measures may be either high or low depending on the program components. The dilemma is "Does one use standardized measures or measures that address the intervention more specifically?" A combination of the 2 was used in this study, and the result was a scale with low reliability.

Fourth, the small sample size for the Intervention+ study condition may have limited the ability to detect statistical significance in study outcomes. The number of students recruited for the Intervention+ condition was restricted by the number of parents willing to participate in the parent nutrition education program. Finally, this study was conducted in 1 large urban school district, and the results may not be generalizable to other school districts.

Implications for Research and Practice

This study has highlighted that a multicomponent nutrition education program can be successfully delivered in a large urban school district with positive outcomes such as improving attitudes and knowledge, although the change in knowledge should be interpreted with caution

because of the low Cronbach α for the knowledge scale. A number of lessons can be learned from this study. First, in a school district of this size, feasibility often presents a challenge for more complex programs. For example, large school districts such as LAUSD are unlikely to have the resources to devote to a labor-intensive nutrition program when there are so many competing academic issues. Therefore, there is a continued need to learn how nutrition programs are implemented in such an impacted curriculum environment.

Second, although this study had an impact on key outcome variables, this approach is not without its own challenges. For example, although the intervention was more defined for this evaluation study than in previous years, it was not clear whether all classrooms were receiving the required amount of nutrition education because a process evaluation was not conducted. Evaluation of teacher training and process evaluation of the delivery of the intervention should be included in future evaluation efforts. Process evaluation is an important component of evaluating the impact of health promotion interventions.²³ Process evaluation analyzes such areas as teacher training, fidelity to the program curriculum, curriculum delivery, use of program materials, and program attendance.¹⁹ and ³⁷ The findings from this study will lead to the development of more structured teacher training programs that will include both teacher training evaluation and process evaluation.

Third, this study confirms that behavior change is difficult to achieve and that behavior is influenced by many factors and not motivated solely by knowledge and attitudes. In this study, a significant increase in students' FV consumption was not observed. Given that the ultimate aim of the LAUSD nutrition efforts is to increase FV consumption, it is worth considering the adoption of new intervention strategies to further increase FV consumption, such as focusing on changing the school food environment.

Fourth, a major challenge is how to engage more parents in the intervention process. Only a few parents were willing to participate in the parent nutrition workshops. Greater efforts are needed to involve more parents. Perhaps schools could offer various incentives to parents who participate.

Finally, buy-in from more LAUSD schools and greater involvement by school administrators are needed in future studies. Implementing this multicomponent intervention in more schools will allow for better understanding of how these programs work at different schools and may serve to streamline and improve the intervention components.

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Supplementary Data is omitted from this format of the document.

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