The effects of a school-based nutrition program diffused throughout a large urban community on attitudes, beliefs, and behaviors related to fruit and vegetable consumption.

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Abstract:

BACKGROUND: Obesity among US children has increased in recent years. Although increased fruit and vegetable consumption has not been directly linked to obesity prevalence, it has been posited that more fruits and vegetables (FV) could reduce the consumption of high-fat, energy-dense foods and may protect against childhood illnesses including asthma and other respiratory diseases. The purpose of this current research was to assess the impact of a large public school district's hybrid approach to nutrition education programming on attitudes, beliefs, and behaviors related to fruit and vegetable consumption.

METHODS: A total of 12 elementary schools from the Los Angeles Unified School District (9 intervention schools, 3 control schools) were randomly selected to participate in a “hybrid” school-based nutrition education program. Data were collected at baseline (beginning of school year) and postintervention data (end of school year 9 months later). Linear mixed models were developed to assess the impact of the intervention.

RESULTS: The intervention resulted in a significant change in teacher influence on students' attitudes toward FV ($p < .05$) and students' attitudes toward vegetables ($p < .01$), even after adjusting for gender, grade, and race/ethnicity. Although not statistically significant, there was a slight increase in fruit and vegetable consumption from pretest to posttest for both the intervention and control schools.

CONCLUSION: The hybrid model reflects a more accurate representation of school-based interventions. More research is needed to identify the specific components of this model that are most successful in impacting fruit and vegetable consumption among US children.

Keywords: nutrition | diet | child health | adolescent health | childhood obesity | school health programs | school health instruction

Article:

Trends in obesity among US children have accelerated in recent years. Over the past 3 decades, the childhood obesity rate has more than doubled for children aged 2–5 years and adolescents aged 12–19 years, and it has more than tripled for children aged 6–11 years.1,2 Dietary habits greatly influence childhood obesity.3 Although increased fruit and vegetable consumption has not been directly linked to obesity prevalence, it has been posited that eating more fruits and vegetables (FV) could lead to a reduction in the consumption of high-fat, energy-dense foods.4,5 Furthermore, FV are important sources of a broad range of nutrients, and there is strong evidence that FV consumption can prevent chronic diseases including cardiovascular disease and some cancers.6 Research also suggests that FV consumption in children may protect against childhood illnesses including asthma and other respiratory diseases.7 Despite the mounting evidence about the positive effects of FV, children are not consuming the recommended amounts. The 2007 Youth Risk Behavior Surveillance System (YRBSS) survey reported only 1 in 5 high school students eat 5 or more FV each day.8 Among younger children, less than one fourth consume the recommended amounts.9

The school setting is known to influence students' eating patterns,10,11 and presents an effective vehicle through which to intervene with children, as over 53 million students attend school every day in the United States.12,13 A number of school-based interventions have been developed to modify the dietary habits of school-age children.4,14–16 These interventions vary in terms of intervention type, duration, outcome measures, and significance of the results. Many studies have used a variety of theories in the development and evaluation of school-based interventions targeting young children4,16–19 with the most common being Social Cognitive Theory as described by Bandura, which emphasizes a strong behavioral component as well as environmental and individual aspects, reinforcing self-efficacy and decision-making skills.20 Other theories used in nutrition education programs have included the Theory of Planned Behavior to examine beliefs, attitudes, and knowledge related to nutrition behavior;21 and Ecological Systems Theory to examine individual, family, and community factors influencing nutrition practices.22,23 However, there is still a lack of understanding of how nutrition programming is developed and implemented in large urban settings with multiethnic populations, especially when the main program components are developed at the district level and then implemented with some flexibility at the local school level to account for the varying needs, interests, and academic requirements of students, teachers, and schools.

In practice, many school-based interventions are designed and implemented using 1 of 2 approaches: (1) a theory-driven “deductive approach”; or (2) the use of observational techniques as the impetus for the development of theories “inductive approach.”24 The first approach is often considered stronger, as interventions are created using theory as a guide, and then implemented as designed, with expected differences related to program implementation in multiple settings. The limitation with this approach is that, often, these “best practices” have not been translated in an environment that is similar to the original test environment. The second approach is to home grow an intervention. In this approach, interventions are often organic in nature, stemming from the context and unique needs of the classroom or school. Little is known about an emergent third approach, a “hybrid” of these 2 approaches. In this third “hybrid” model, general program elements are designed at a district level and then the individual schools and the teachers decide what to use, how to use it, and when to use it. This type of approach is a more accurate reflection of the realities of school-based interventions, and is an example of translational applied research.

The Nutrition Friendly Schools and Communities (NFSC) Group at the UCLA School of Public of Health has been working with the Los Angeles Unified School District (LAUSD) to evaluate various components of their nutrition education efforts. For this study, the LAUSD and the NFSC Group identified an opportunity to evaluate a hybrid approach to nutrition education. The LAUSD includes over 850 schools and enrolls approximately 700,000 students each year, presenting an ideal environment for intervention.25 Typically around 275 schools participate in nutrition-focused District activities. The LAUSD administers its nutrition education programs through the Network for a Healthy California-LAUSD, which was established in 2000 to encourage FV consumption and physical activity among students. The Network-LAUSD views classroom teachers as agents to teach students about nutrition and physical activity. Early on, the District realized that nutrition education must be integrated into the existing curriculum to be accepted and successful in a large school system already overburdened with teaching mandates and a focus on standardized testing. The program model sought to embrace the teachers' creativity by providing flexible nutrition education content and programs that could be woven into required curricula. Through this approach, each school involved in the program could create its own nutrition education program that would be sensible for that particular school, using resources provided by the District.

The purpose of this current research was to assess the impact of a large public school district's hybrid approach to nutrition education programming during the 2005–2006 school year. This study aims to answer the following 2 research questions: (1) What is the impact of a hybrid

nutrition education program on (a) elementary students' FV consumption; (b) attitudes and beliefs regarding FV; and (c) perception of peer, parent, and teacher influence on FV attitudes? (2) Does a greater exposure to program activities have a greater impact on the above outcomes than a lower dose? Results from the study are presented, as well as the lessons learned in developing and implementing a hybrid nutrition education program in a large, multiethnic, urban school system.

METHODS

Subjects

Participants included a total of 1528 low-income, predominantly minority, third-, fourth-, and fifth-grade students. Participation was voluntary. Classrooms were selected based on teacher willingness and participation in Network-LAUSD programming. During the 2005–2006 school year, 12 elementary schools participated in the study. A random sample of 9 elementary schools out of 276 with program funding from the Network-LAUSD were selected as the intervention schools, and 3 of the 141 schools that were eligible but not participating in the district's nutrition program were randomly selected as control schools. Within each intervention and control school site, third-, fourth-, and fifth-grade classrooms were randomly selected to participate in the study. Approximately 5–7 classrooms were selected from each school for a total of 75 classrooms. All students from the selected classrooms were eligible and invited to participate in the study.

Instruments

The student survey instrument, based on constructs from Social Cognitive Theory and Theory of Planned Behavior, included 4 sections that assessed student's FV consumption; attitudes and beliefs regarding FV; peer, parent, and teacher influence on FV attitudes, and demographic characteristics.

The first section assessed FV consumption using the 23-item Day in the Life questionnaire, a validated instrument to assess FV frequencies in school-age children.26 Students were asked to describe the foods and beverages they consumed on the previous day. For analyses, we totaled the number of daily servings of fruit and vegetables.

The second section measured students' attitudes and beliefs about FV through 12 dichotomous (yes/no) items (see Table 1 for survey items). Questions were adapted from existing validated instruments,27,28 and from previous evaluation of the District's nutrition programs. For the analyses, we created 2 continuous scales (1 for attitude toward fruits and 1 for attitudes toward vegetables). Scales ranged from 0 (representing most negative attitudes toward fruits/vegetables) to 6 (representing most positive attitudes toward fruits/vegetables). Cronbach's alpha for the scales were .62 (fruit) and .68 (vegetables).

Table 1. Survey Questions on Student's Attitudes and Beliefs About FV and Student's Perception of Peer, Parent, and Teacher Influence on FV Attitudes

Questions

Attitudes and beliefs about fruit

1. The amount of fruit I eat each day is just right.
2. I think fruit tastes good.
3. I feel good when I eat fruit.
4. Fruit is healthy for me.
5. Fruit is important for me to eat.
6. I like to eat fruit.

Attitudes and beliefs about vegetables

1. The amount of vegetables I eat each day is just right.
2. I think vegetables taste good.
3. I feel good when I eat vegetables.
4. Vegetables are healthy for me.
5. Vegetables are important for me to eat.
6. I like to eat vegetables.

Peer influence

1. My friends tell me that I should eat vegetables every day.
2. Most of my friends like to eat vegetables.

3. Most of my friends eat vegetables every day.
4. I tell my friends they should eat vegetables every day.
5. My friends tell me that I should eat fruit every day.
6. Most of my friends like to eat fruit.
7. Most of my friends eat fruit every day.
8. I tell my friends that they should eat fruit every day.

Parent influence

1. Do your parents tell you that you should eat vegetables every day?
2. Do your parents like to eat vegetables?
3. Do your parents eat vegetables every day?
4. Do you tell your parents that they should eat vegetables every day?
5. Do your parents tell you that you should eat fruit every day?
6. Do your parents like to eat fruit?
7. Do your parents eat fruit every day?
8. Do you tell your parents that they should eat fruit every day?
9. Are there vegetables in your home every day?
10. Is there fruit in your home every day?

Teacher influence

1. Does your teacher tell you that vegetables are good for you?
2. Does your teacher tell you that vegetables are healthy?
3. Does your teacher tell you that vegetables taste good?
4. Does your teacher tell you that you should eat vegetables every day?
5. Does your teacher tell you that fruit is good for you?
6. Does your teacher tell you that fruit is healthy?
7. Does your teacher tell you that fruit tastes good?

8. Does your teacher tell you that you should eat fruit every day?

The third section contained 26 dichotomous (yes/no) items related to perceived peer, parental, and teacher influence and encouragement regarding FV attitudes (see Table 1 for survey items). Questions were adapted from a previously validated instrument.28 For analyses, we created 3 continuous scales (peer influence, parent influence, and teacher influence). For peer and teacher influence, scales ranged from 0 (lowest level of influence) to 8 (highest level of influence). For parent influence, the scale ranged from 0 (lowest level of influence) to 10 (highest level of influence). Cronbach's alpha for the 3 scales were .79 (peers), .73 (parents), and teachers (.91).

The fourth section assessed demographic characteristics, including gender, grade (third, fourth, fifth), and race/ethnicity (White, Hispanic/Latino, African American, Asian, Native Hawaiian, American Indian/Native American, and other). Due to the small number of responses in the "other" category, this group was omitted from the analyses.

The teacher activity logs consisted of a 1 page form in which teachers indicated how many hours they spent incorporating nutrition-related activities in the classroom and the type of activities presented each week. Hours for each week were tallied on the form.

Procedures

Recruitment. After schools were randomly selected to participate in the study, the research team sent a letter to the principal of each school to introduce the study and request time to present the study to the faculty. Once the principal agreed to allow the school to participate, the project director scheduled a meeting with the teachers to discuss the program. After the individual third-, fourth-, and fifth-grade classrooms were randomly selected, the respective teachers were asked for their permission for their classrooms to participate. Upon receiving this permission, the research staff visited each classroom to explain the study to the students and then parent consent forms were sent home with the children. Students were required to submit a signed parental consent form and child assent form to participate.

Intervention. Schools with 50% or more of their students eligible to receive free or reduced-priced meals from the National School Meal program were eligible to participate in the District's intervention. To participate, eligible schools had to identify teachers willing to integrate nutrition programming into their classroom activities. Once a school had agreed to participate in the program, the teachers involved in the program were then given the freedom to design their own

intervention by choosing from a variety of strategies and activities. Teachers were given the choice of using district-wide intervention strategies, choosing other existing nutrition education activities, or creating their own. This resulted in all schools creating their own hybrid intervention, one that was a combination of district strategies, local school defined strategies, and "home-made" strategies/activities created by teachers. For example, with funding from the District, each school could use this money for a variety of district defined activities as well as efforts created at the local school. District 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," a program introducing new produce to the students. Participating schools were also eligible for teacher training conducted by District staff. Additionally, the school could use funds to create their own nutrition activities or purchase resources to support nutrition-focused efforts. The District kept minimal data on the specific activities and kept less information concerning the classroom activities. The District did mandate, per their funding mandate, monitoring the number of hours of nutrition programs that each classroom received.

Data Collection

A cross-sectional pretest and posttest design was used to evaluate the impact of the intervention. Students completed questionnaires to assess attitudes, beliefs, and behaviors at the beginning of the school year (September and October 2005) for baseline data collection and again at the end of the school year (May and June 2006) for posttest data collection. Questionnaires were group administered and completed individually by students.

Activity Logs

Each participating teacher was required to complete an activity log as part of program participation regardless of the evaluation study. Each teacher completed 3 logs covering the approximate periods of the fall, winter, and spring seasons. These logs were given to supervising teachers at each school who compiled them and gave them to the District office. UCLA research staff collected the logs from the District office. These activity logs included information on school location, teacher, grade, number of hours of activity, and type of nutrition activity. These activity logs were used to determine level of exposure to Network-LAUSD programming.

Data Analysis

First, we examined the distributions of all independent and dependent variables. Second, we assessed demographic characteristics by intervention and control groups using Chi-square tests

(gender and grade) and Fisher's Exact (race/ethnicity). Third, using pretest and posttest data, we built linear mixed models for each of the dependent variables that accounted for the clustering of students within schools (fruit consumption, fruit juice consumption, vegetable consumption, attitudes toward FV, and peer/parent/teacher influence on students FV consumption). In these models, the treatment condition (intervention or control) and time (pretest and posttest) were included as fixed effects, and schools were included as a random effect. Covariates were added to these models to control for factors that may have been unbalanced between the intervention and control groups, despite randomization. Covariates include gender, grade, and race/ethnicity. We calculated adjusted means and standard errors using the coefficients from the linear mixed regression models. Finally, correlation analysis was used to test whether the amount of log time (hours) spent delivering nutrition education (dosage) was associated with FV Consumption. All analyses were conducted using Stata 10.0 (Stata Corp, College Station, TX).

Data collected from Network-LAUSD teacher activity logs included the number of hours teachers spent delivering nutrition education to students. The log times (in hours) were averaged for each intervention school. We then averaged these hours to arrive at a mean for all intervention schools.

RESULTS

Demographic Characteristics

Demographic information is presented in Table 2. There were no significant differences between intervention and control schools on gender, but there were significant differences in grade and race/ethnicity ($p < .001$ and $p < .001$, respectively). There were significantly more third graders in the intervention schools and more fifth graders in the control schools. For ethnicity, the intervention schools had significantly more African-American and Asian students while the control schools had significantly more Hispanic/Latino students.

Table 2. Demographic Characteristics of Participants at Baseline by Intervention and Control Groups*

Characteristics	Intervention Group Total N = 1532 N (%)	Control Group Total N = 493 N (%)	p-Value
Gender			.40
Male	626 (41)	189 (39)	
Female	883 (59)	293 (61)	
Grade			<.001
Third	605 (40)	125 (26)	
Fourth	391 (26)	149 (31)	
Fifth	511 (34)	208 (43)	
Race/ethnicity			<.001
White	107 (8)	34 (8)	
Hispanic/Latino	885 (62)	358 (84)	
African American	171 (12)	8 (2)	
Asian	164 (11)	16 (4)	
Native Hawaiian	23 (2)	3 (<1)	
American Indian	73 (5)	5 (1)	

*p-Value based on Chi-square test for gender and grade, and Fisher's Exact test for race/ethnicity (due to missing data, variables do not sum to the total N).

FV Consumption, Attitudes and Beliefs Toward FV, and Peer/Parent/Teacher Influence on Students FV Attitudes

Table 3 presents the mean values for FV consumption, attitudes toward FV, and peer/parent/teacher influence on students FV attitudes at pretest and posttest. These means were calculated from the linear mixed model for each variable and controlled for the clustering of

students within schools. The intervention resulted in a significant change in teacher influence on students' FV attitudes ($p < .05$). Teachers' influence on students' FV attitudes increased for students in the intervention schools from pretest to posttest (+0.23) and decreased for students in the control schools (−0.37); a difference of 0.60 between the intervention and control schools on a 0 to 8 point scale. There was also a significant effect in students' attitudes toward vegetables ($p < .01$). While there was a slight decrease in positive attitudes toward vegetables from pretest to posttest for students in the intervention group (−0.08), there was a significantly larger decrease from pretest to posttest for students in the control schools (−0.48); a difference of 0.40 between the intervention and control schools on a 0 to 6 point scale. The intervention did not have a significant effect on actual FV consumption; however, there was an increase in fruit consumption from pretest to posttest for both the intervention and control schools (+0.24 and +0.28, respectively) and a smaller increase for vegetable consumption for both the intervention and control schools (+0.06 and +0.12, respectively). Regardless, the FV consumption for this population was well below the then-recommended 5 servings of FV per day.

Table 3. FV Consumption, Attitude Toward FV, and Peer, Parent, and Teacher Influence on FV Attitudes at Pretest and Posttest by Intervention Condition*

Variable and Time	**N**	**Intervention**	**N**	**Control**	**p-Value**
Fruit consumption	1528		493		.83
Pretest, mean		0.91		0.84	
Posttest, mean		1.15		1.12	
Difference		+0.24		+0.28	
Vegetable consumption	1528		493		.60
Pretest, mean		0.80		0.74	
Posttest, mean		0.86		0.86	
Difference		+0.06		+0.12	
Attitudes toward fruits	1510		478		.20
Pretest, mean		4.75		4.69	

Variable and Time	N	Intervention	N	Control	p-Value
Posttest, mean		4.69		4.71	
Difference		−0.06		+0.02	
Attitudes toward vegetables	1499		479		.004
Pretest, mean		3.87		3.99	
Posttest, mean		3.79		3.51	
Difference		−0.08		−0.48	
Peer influence on FV attitudes	1509		477		.10
Pretest, mean		3.08		3.21	
Posttest, mean		2.99		2.71	
Difference		−0.09		−0.50	
Parent influence on FV attitudes	1505		473		.28
Pretest, mean		7.48		7.74	
Posttest, mean		7.57		7.59	
Difference		+0.09		−0.15	
Teacher influence on FV attitudes	1516		474		.02
Pretest, mean		6.16		5.16	
Posttest, mean		6.39		4.79	
Difference		+0.23		−0.37	

1. FV, fruit and vegetable.

*Scale range for beliefs and attitudes toward FV (0–6; negative to positive). Scale range for teacher and peer influence on FV attitudes (0–8; low to high); scale range for parent influence on FV consumption (0–10; low to high). Means are adjusted for the clustering of schools. p-Value is for the test of the interaction of intervention × time.

The means for FV consumption, attitudes toward FV, and peer/parent/teacher influence on students FV attitudes adjusted for gender, grade, and race/ethnicity are presented in Table 4. These adjusted means were calculated from the linear model for each dependent variable and controlled for the clustering of students within schools. Consistent with models presented in Table 3, the difference between intervention and control schools remained significant for teacher influence on FV attitudes ($p < .05$) and attitudes toward vegetables ($p < .01$).

Table 4. FV Consumption, Attitude Toward FV, and Peer, Parent, and Teacher Influence on FV Consumption at Pretest and Posttest by Intervention Condition Adjusted for Gender, School Grade, and Race/Ethnicity*

Variable and Time	N	Intervention	N	Control	p-Value
Fruit consumption	1528		492		.43
Pretest, mean (SE)		0.96 (0.09)		0.74 (0.16)	
Posttest, mean (SE)		1.19 (0.09)		1.08 (0.15)	
Difference		+0.23		+0.34	
Vegetable consumption	1528		492		.99
Pretest, mean (SE)		0.83 (0.05)		0.71 (0.09)	
Posttest, mean (SE)		0.87 (0.05)		0.75 (0.09)	
Difference		+0.04		+0.04	
Attitudes toward fruits	1508		477		.16
Pretest, mean (SE)		4.77 (0.02)		4.67 (0.05)	
Posttest, mean (SE)		4.68 (0.03)		4.68 (0.04)	
Difference		−0.09		+0.01	
Attitudes toward vegetables	1497		478		.004
Pretest, mean (SE)		3.83 (0.05)		4.01 (0.10)	

Posttest, mean (SE)		3.77 (0.06)		3.53 (0.10)	
Difference		−0.08		−0.48	
Peer influence on FV attitudes	1507		476		.13
Pretest, mean (SE)		2.99 (0.11)		3.27 (0.20)	
Posttest, mean (SE)		2.95 (0.11)		2.85 (0.19)	
Difference		−0.04		−0.42	
Parent influence on FV attitudes	1503		472		.25
Pretest, mean (SE)		7.53 (0.10)		7.73 (0.18)	
Posttest, mean (SE)		7.59 (0.10)		7.53 (0.18)	
Difference		+0.06		−0.20	
Teacher influence on FV attitudes	1514		473		.03
Pretest, mean (SE)		6.13 (0.15)		5.19 (0.27)	
Posttest, mean (SE)		6.36 (0.16)		4.87 (0.27)	
Difference		+0.23		−0.32	

1. FV, fruit and vegetable.

*Scale range for beliefs and attitudes toward FV (0–6; negative to positive). Scale range for teacher and peer influence on FV attitudes (0–8; low to high); scale range for parent influence on FV consumption (0–10; low to high). Means are adjusted for the clustering of schools. p-Value is for the test of the interaction of intervention × time.

Teacher Activity Logs

Data collected from the teacher activity logs were used to quantify the amount of nutrition education provided to students over the course of the school year. Average log time by school ranged from 30.19 hours to 60.47 hours (Table 5). The distribution of log time (in hours) was categorized by intensity (low, moderate, high). We found no differences in the intervention schools between categories of intensity thus indicating that a higher exposure to Network-LAUSD programs did not have a greater impact on student FV consumption, student attitudes

and beliefs regarding FV, and peer/parent/teacher influence on FV attitudes than did a low or moderate exposure.

Table 5. Total Log Time (Hours) Exposed in Intervention Classrooms

Category	Total Log Hours Exposure	Number of Classrooms*
Low	15–20	2
	21–30	11
Moderate	31–40	15
	41–50	25
High	51–60	5
	61–70	5
	71–80	3

*There were 3 outlier classrooms (reported more than 100 hours) that were not included.

DISCUSSION

The purpose of this study was to examine the impact of a hybrid nutrition education program on students' FV consumption; attitudes and beliefs regarding FV, perception of peer, parent, and teacher attitudes on FV attitudes; and to assess the effect of level of exposure to program activities on these outcomes.

Students in both the intervention and control groups had very positive attitudes toward the consumption of fruits at baseline, thus there was little room for change due to a potential ceiling effect. However, these positive attitudes did not translate favorably into behavior. While there was an increase in fruit consumption from pretest to posttest for both intervention and control groups, the change was not significant and was well below the daily recommendation. We observed a decrease in positive attitudes toward vegetables in both the intervention and control groups; however, the decrease was significantly greater for the control group. Vegetable consumption increased slightly for both the intervention and control groups, but the increase was not significant and was well below the daily recommendation. This is particularly noteworthy as one of the District's main intervention program components is its “Harvest of the Month”

program. The “Harvest of the Month” program is the 1 program that all intervention classrooms are exposed to, although there is variance in how the teachers implement the program. The aim of this program is to introduce students to new produce, and it gives them the opportunity to try new foods with the expectation that students will be more likely to consume more FV after the exposure. Although we did see a slight increase in consumption, greater efforts are needed to impact the desired food consumption behavior change.

Our study found that students in the intervention group were significantly more likely to receive positive messages about FV from their teachers than students in the control group. The District has always viewed its classroom teachers as the primary deliverers of their nutrition program. Thus, this study demonstrates that teachers, as recognized nutrition educators, may have an impact on students' attitudes and behaviors toward FV consumption.

We did not find a significant difference between intervention and control groups on perceptions regarding positive influences at home about consuming FV; however, there was a slight increase for the intervention group. Previous studies have documented similar findings and noted the challenge of involving parents in school-based nutrition projects and the difficulty of these projects on impacting home consumption practices.18,27 In our study, the District assumed an increase in students' awareness and positive attitudes would result in the students taking this knowledge and positive attitudes home to their families and this would result in increasing parental knowledge and attitudes toward the importance of consuming FV for themselves and their children. Thus, a more structured approach, eg, specific homework activities engaging students with their parents may have a greater impact on parental influence.

We observed a decrease in peer influence on students' attitudes toward FV in both the intervention and control groups over time with the decrease being much greater for the control group. The District expected peer influence to operate through modeling and shared activities and eating patterns. More research is needed to better understand the role of peers in influencing healthy eating behaviors in our population.

We explored whether exposure to higher log time (ie, hours) of nutrition education would lead to greater impact than exposure to low or moderate log time hours. We found that there was no difference in impact on students' consumption of FV; attitudes, beliefs, or behavior regarding FV; or perception of peer, parent, or teacher influence on FV attitudes regardless of level of exposure. While there may be a minimum threshold of log time (hours) to induce an intervention

effect in the classroom, we were not able to find it in this study. While logging hours for nutrition education activity is mandatory for the Network-LAUSD teachers, log time (hours) may not be indicative of teacher performance or input.

Limitations

There are limitations to this study that must be acknowledged. First, while the hybrid nutrition model is a more accurate reflection of the realities of school-based interventions, it creates some evaluation challenges such as lack of standardization in program implementation. Although the message to eat FV was delivered to students through nutrition education provided by teachers in the classrooms, the quality, the intensity, and the duration of program activities was not well documented. Teachers delivering the program were not given specific instructions of what to tell the students, when to tell them, and how often. Also due to staffing capacity issues, the District staff was able to provide teacher training to less than 10% of participating teachers. Second, since the inception of the Network for a Healthy California-LAUSD in 2000, teachers have been delivering nutrition education to their students, so the research team acknowledges that they were not evaluating a new program. Some students may have been exposed to the same or similar messages before this study, and we were not able to account for that. Third, the teacher activity logs collected in the study were part of a mandatory reporting for participating teachers. We have no reason to believe that teachers inflated the hours they recorded because of study participation. However, we cannot comment on the validity of the activity logs as recorded, an inherent limitation to any self-reported measure. We did not observe teachers in the classroom to measure the number of hours teachers actually spent delivering nutrition education. Fourth, although schools and classrooms were selected at random and a census of all students in selected schools and classrooms was used, the agreement to participate may have been impacted by selection bias. Fifth, as we did not use observations to assess students' FV consumption or 24-hour recall, there is the potential for recall bias. Finally, this study was conducted in one large urban school district and the results may not be generalizable to other schools districts.

Conclusion

We did not find a significant change in positive attitudes toward FV, but we did observe a slight increase in FV consumption for both intervention and control groups. For the students in the intervention group, the teachers were more likely to be viewed as influential nutrition messengers, indicating that they have an important potential role in affecting children's FV attitudes and behaviors. Teachers may play an invaluable role in imparting healthy eating messages to students; however, whether or not teachers understand that they play this role is a question worth investigating. Future school-based nutrition education studies should focus on involving not only students, but also teachers, parents, and peers equally so that interventions

carried out in one domain support those in another.10 Furthermore, the realities of implementation should be considered in program development and design. The hybrid model seems to be the most accurate representation of school-based interventions, and more research is needed in this area to identify the components of this model that are most successful in impacting behavior change.

IMPLICATIONS FOR SCHOOL HEALTH

Schools provide a unique opportunity for preventing childhood obesity. Children spend a large percentage of their time in schools, a setting in which children can receive information about proper nutrition.19 This study has highlighted one way in which a hybrid nutrition education program can be delivered in a large urban school district, and has provided lessons to be learned. In a school district of this size, feasibility often presents a challenge for more complex programs. The realities of serving more than 350 schools can limit the type and duration of the programming offered. The geographic spread of the district, which encompasses 710 square miles, may have also limited the type of programming the network could offer to participating schools. In essence, this will be one of the major challenges of the school-based community in embracing the practice of using programs that have been demonstrated to be effective in a relatively closed system. Large school districts such as LAUSD are unlikely to have the resources to devote to a labor-intensive program focusing on nutrition when there are so many academic issues competing for resources. Therefore, there is a continued need to learn how nutrition programs are implemented in such an impacted curriculum environment. Although a hybrid model may reflect the realities of nutrition programming in many school settings, this approach is not without its own challenges. For example, many teachers will take the time and utilize existing resources to create new programming for their schools, others will chose not to. It may be difficult for a district to provide the technical support to help teachers make these local school decisions. Also, in many school settings today, teachers are not accustomed to having the freedom to modify curriculum, as they are often required to follow strict district mandates. The findings from this study have led to the development of other program components in LAUSD, including a parent nutrition education component and a more structured training of teachers participating in Network-LAUSD programming.

This experience confirms behavior change is difficult to achieve and behavior is influenced by many factors and is not solely motivated by knowledge. In this study, a significant increase in students' FV consumption was not observed. If the ultimate aim is to increase FV consumption, then it is worth considering adopting new intervention strategies to further increase FV consumption. A second challenge is how to engage teachers who are overwhelmed with other

priorities focusing on the education mission. LAUSD chose to allow teachers considerable freedom in implementing their program with the hope that more teachers would participate if they did not feel overly burdened and controlled by a new program. Third, if a district is able to select appropriate program materials and recruit teachers, how will it adequately train the teachers to become nutrition educators. Most teachers have received minimal instruction in nutrition, let alone nutrition education, and often feel ill-prepared for the job.29

Currently, LAUSD is attempting to address these challenges. For example, in the upcoming academic year, the District will offer teacher training related to the nutrition program online. Through this mechanism, all participating teachers will have the option of training whereas now only about 10% have this opportunity. Considering the influence of parents and the home environment on child nutrition, the District has designed and implemented a parent intervention that has been shown to be successful in modifying parent knowledge, attitudes, personal behavior, and the home environment.30 Although the District wanted to give classroom teachers the freedom to do what they thought best for their class, this year, the District is implementing a new approach. In a pilot study of 4 schools, they are requiring that the participating classrooms use 1 of 2 standardized curricula demonstrated to be effective in behavior change, while at the same time giving the teacher the freedom to do other nutrition activities.

Human Subjects Approval Statement

The study was approved by the UCLA institutional review board and the LAUSD Research and Planning Division.

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