Exposure to a Comprehensive School Intervention Increases Vegetable Consumption

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ABSTRACT

Purpose

The current epidemic of childhood overweight has launched a variety of school-based efforts to address the issue. This study reports on the first two years of a three year evaluation of one school district's comprehensive intervention to transform school foodservices and dining experiences, offer cooking and gardening programs, and integrate nutrition and food systems concepts into the academic curriculum.

Methods

This three-year prospective study, enrolled 327 4th and 5th graders in a mid-sized school district in California, and followed them into middle school. Intervention exposure was determined through interviews with school staff, and through student surveys. Student knowledge and attitudes were assessed annually by questionnaire, and student behavior was assessed annually by 3-day food diary. Household information was gathered by parent questionnaire. Changes in knowledge, attitudes and behavior were compared by level of intervention exposure using analysis of covariance; pairwise differences were evaluated using Bonferroni's test at a procedure-wise error rate of 5%.

Results

After controlling for family sociodemographic background, students most exposed to the intervention increased their consumption of fruits and vegetables by nearly 0.5 cups (1 standard serving) while students least exposed decreased their consumption by 0.3 cups ($p<.05$). Students

most exposed to the programming also showed a significantly greater increase in preference for fruit and green leafy vegetables, compared to students least exposed to the programming ($p<.05$).

Conclusions

Future research is needed to better understand the relative importance of the different components of such a program, and their cost-benefits as well as health impacts.

Keywords: school food service; gardening and cooking programs; fruit and vegetable; elementary school; middle school; child obesity prevention; community-based

INTRODUCTION

The school has been identified as a key setting for implementing nutrition-related obesity prevention programs in the United States [1-7]. Because fruits and vegetables are low energy dense foods that are high in essential micronutrients and can be expected to reduce obesity risk [8], such programs have often aimed at increasing fruit and vegetable (F&V) intake. The success of these programs varies widely; some have increased knowledge [9-10]; several have increased preference for fruits and/or vegetables [9,11]; and a few have increased consumption of fruit and/or vegetables [11-15]. When increases in F&V consumption are observed, the effect is more likely to be seen with fruits than with vegetables [13-15]. In the United States, garden-based programs have been of interest and appear to have potential for improving children's eating behaviors [16]. Regardless of the type of intervention, there is a need for more rigorous evidence-based studies to identify effective child obesity prevention strategies [16], especially studies that involve the community in their development and implementation, larger sample sizes and longer follow-up duration.

This paper reports findings from the first two years of a three-year evaluation of a comprehensive, multi-component school-based intervention designed to transform school lunch and offer education in nutrition, health and the environment. This effort, which began in 2004, was the result of a collaborative effort among a mid-sized school district in California, an organization dedicated to education for a sustainable living, and a private foundation based in the community. The vision of this community public/private partnership was to provide all students with healthy, appealing seasonal school meals made from locally grown and sustainable ingredients, along with experiential learning in instructional gardens, cooking classes and the school dining room, which connected to formal academic subjects.

Our evaluation aimed to examine the impact of the intervention on nutrition-related outcomes, academic performance and physical fitness. This report will discuss only nutrition-related outcomes, namely, knowledge, attitudes and behaviors. Specifically, we hypothesized that students most exposed to the intervention will

1) show greater increases in nutrition knowledge;
2) show positive changes in attitudes toward healthy eating behaviors (including preference for fruits and vegetables) and sustainable ways of procuring food;
3) consume more fruits and vegetables while in school;
4) consume more fruits and vegetables outside of school, after controlling for family sociodemographic characteristics (race/ethnicity and parent's education).

METHODS

Study design

The above hypotheses were tested using data collected during the first two years of a three-year prospective study of fourth and fifth graders. This prospective design was chosen (instead of a traditional randomized controlled trial) to take advantage of the wide variability in the implementation of the intervention among district schools. It compared changes in the outcomes of interest among students who were differentially exposed to the intervention (due to school differences in intervention development), thus allowing for evolution of the intervention to continue 'naturally' during the evaluation, and eliminating the need for a group of "control"

schools. Fourth and fifth graders were selected to allow for an assessment of the cumulative impact of exposure to the intervention for elementary students making the transition into middle school, a critical period in terms of changes in dietary behavior [17].

Student exposure to the intervention was determined by interviewing school staff, reviewing relevant curricula and programming, and observing school environments. Student knowledge and attitudes, and student behavior were assessed annually by questionnaire and 3-day food diary, respectively. Family and home information were gathered using a one-time questionnaire administered to parents to allow for the consideration of potential confounding factors in the analysis. The protocol for this project was approved by the University of California at Berkeley's Committee for the Protection of Human Subjects.

Sample size

It was estimated that a final sample of 174 participants would be needed to detect a difference of 0.5 servings in F&V consumption between two groups, assuming a standard deviation of 1.15, type I error of 0.05, and type II error of 0.20. Based on past experiences, we anticipated an average yearly attrition rate of 22.5% and an exclusion rate of 10% (due to incomplete or poor quality data), giving a targeted sample size of 330.

Participants

Four elementary schools provided a potential pool of 414 fourth and fifth graders for recruitment. These four schools were selected to provide the widest possible range in the degree of intervention development, with two schools having implemented the intervention to a greater degree than all other schools ('HIGH' intervention development), and the other two schools having implemented the intervention to a lesser degree than all other schools ('LOW' intervention development). As students entered middle school in the second year of the study, a

'MEDIUM' category of intervention development was added to reflect the range of programming offered at all of the district's middle schools.

Student recruitment involved presentations to school principals, classroom teachers, parents, and students. English and Spanish invitations to participate were addressed to parents and sent home with students; a coordinator at each school facilitated communication, providing language translations as needed. Parent consent was required for participation but students were also asked for their written assent. The students were free to decline to participate at any time.

A total of 327, or 79%, of all fourth and fifth graders in the four schools enrolled in the study. Approximately 13% of families declined the invitation to participate, 6% did not respond, and 2% left the school district mid-year, or had significant special learning needs that precluded their ability to participate in the study. In the second year of the study, 49 students had left the school district and three students were chronically absent from school. Of the remaining 275 students, 6 declined to participate in year 2, leaving 269 participating students in the second year.

Data Collection

Student exposure to the intervention:

Key informant interviews with 18 teaching and administrative staff were conducted to assess the degree of intervention development at each elementary and middle school in the district. Features indicating the degree of development of each intervention component were given points, which were summed to provide a ranking of the schools (Figure 1). School rankings were confirmed with district and partner staff. Schools selected for the evaluation were reassessed annually through interviews with 10-15 teaching and dining staff, conducted by the same researcher using an interview guide.

Student knowledge, attitudes, and preference:

Student knowledge about, and attitudes toward nutrition, food and the environment, and student preference for fruits and vegetables were evaluated using a questionnaire that was developed in collaboration with school staff and project partners responsible for the relevant curricula; this questionnaire was administered during class time. Curricular learning objectives provided the basis for developing the knowledge and attitude questions. Students' preferences for a list of 12 fruits and vegetables (used or introduced in cooking or gardening classes) were assessed using a 4-point scale (never tasted=0, don't like it=1; like it a little=2; like it a lot=3). The questionnaire was reviewed by school staff and pretested for wording among students of similar age as the participants.

Student food behavior:

Food behavior was assessed annually in spring using a 3-day food diary previously developed for similar aged children for the NHLBI Growth and Health Study [18]. To achieve quality food records and a high response rate, trained research staff met with participating students in the classroom for about 45 minutes on a Monday to train the students to record their food intakes for the following three days (Tuesday through Thursday); classroom teachers reminded the students daily to record their food intakes. The food diary was collected on the Friday of the same week during another 45-minute classroom session, by a research team of about 5-8 members who reviewed the food diary with each student individually. During this time, the participants also completed the questionnaire described above. To address language barriers, at least one bilingual assistant was present. To support the timely return of food records, participants received appropriate incentives each year, and reminders from their teachers (during class) and research staff (via phone).

Family characteristics:

Parents or guardians of students were asked to complete a questionnaire (English or Spanish) that sought information about sociodemographic characteristics, and home environment including family attitudes and behaviors with regard to food preparation and eating patterns. The questionnaire was reviewed for wording clarity and relevance by research and school staff, and a small convenience sample of parents.

Operationalizing variables

Student exposure to the various components of the intervention was assessed in two ways: (i) at the student level by summing years of exposure to school cooking and garden programs assessed by student questionnaire; and (ii) at the school level by interviewing school staff to determine the types of kitchen, garden and food-related programs available in each school for each year that the student participants were in school.

Student knowledge about and attitudes toward nutrition, food and the environment, and *student preference for fruits and vegetables* were operationalized by appropriately scoring relevant questions and summing the scores. The nutrition and food environment knowledge scores were derived by summing the number of correct answers to questions that were based on the curriculum, while attitude and F&V preference were assessed by summing Likert-scale responses. For the Likert-scales, Cronbach's alpha coefficients for the combined attitude (16 items) and F&V preference (12 items) scores were 0.7 and 0.8 respectively but were lower for the following sub-scales: food-related attitude (4 items) = 0.5; health-related attitude (4 items) = 0.3; environment-related attitude (5 items) = 0.5; and preference for fruit (3 items) = 0.3.

Student food behavior was quantified by the average number of standard 8-ounce cups of fruits, vegetables and dairy foods, and the average number of ounces of grains consumed per day, estimated from the food diaries.

Family sociodemographic and home environment characteristics were represented by categorical responses. Parent's education was represented by mother's (female guardian's) education except when only father's education was available.

Data management and analysis

All questionnaire data were double-entered using Epidata (v2.1, Denmark). Food diary data were entered into a relational database (Access, 2003; Microsoft Corporation, Redmond, WA) specifically designed for analyzing dimensions of foods not usually considered in standard nutrient analysis programs (e.g. snacks high in salt, sugar and/or fat). A registered dietitian was trained to enter the data and she in turn, trained and closely supervised nutrition students to enter the food diary data. Each year, at least 25 food diaries were randomly selected by the dietitian who checked the data entered against the food diaries. The number of food items recorded on any given day ranged from 3 to 26, with 95% of the participants recording 5 items or more. An additional layer of data quality control was imposed by visually inspecting box plots of F&V, dairy food, and grain intakes to detect outliers. These box plots were created using the statistical software, SAS, version 9.1 (SAS Institute, Cary, NC), which was also used to analyze the data. A total of 21 food diaries were re-examined. Of these, two diaries were incorrectly entered, and one (estimating 25 cups of vegetable intake) was considered questionable and dropped from analysis.

Food groups (fruits and vegetables, dairy foods and grains) were defined to be consistent with USDA's 'My Pyramid' food groupings; fruit juice was included in the estimation of fruit

servings. Controversial plant-based items such as potato chips and ketchup were not included in the vegetable estimates.

Characteristics of the students were summarized using means and standard deviations for continuous variables and frequency distributions for categorical variables. To compare changes in knowledge, attitudes, and behavior, and relate them to exposure to the intervention, two approaches were used. One approach employed multivariate procedures to examine the association of *cumulative years of exposure* with cooking or gardening programs, controlling for school history (same school from kindergarten vs. different schools). The second approach *grouped the students according to the schools they attended* (higher or lower developed schools), and used analysis of covariance to examine group differences in changes in knowledge and attitude scores, and food consumption. Both approaches controlled for baseline values and sociodemographic characteristics. Multiple comparisons were adjusted for using Bonferroni's test at a procedure-wise error rate of 5%.

RESULTS

Sociodemographic and relevant home characteristics

Sociodemographic and home environment characteristics of the participants are shown in Table 1. In addition, home environment characteristics differed by race/ethnicity ($p<.05$) but not by parent's education (data not shown in table). Students from non-Hispanic white families were more likely to eat out than other families (63 % vs. 38%) while African American families were less likely to eat dinner together (35% vs. 65%) and prepare dinner using fresh ingredients (33% vs. 56%).

Characteristics of student exposure to the intervention

The number of years of exposure to cooking and garden programs was estimated based on self-reports. More than one third of the students reported not ever having had a *cooking* class, while only 15% of the students reported not ever having had a *gardening* class. About 18% and 28% of the students reported having attended a cooking class and a gardening class *for 5 years or more*, respectively. Student exposure to the intervention was also assessed by grouping participants according to the level of intervention development at the schools they attended. For both study years, nearly 40% of the students were in schools that had the least level of intervention development, while 27% were in schools that were at the highest levels of intervention development. About 12% moved from a school at a high level of intervention development in the baseline year to a school at a lower level of intervention development in the following year. About 22% moved from a less developed school at baseline to a higher developed school in the following year.

Knowledge and attitudes

Mean knowledge scores in the nutrition domain were higher among students attending the highest developed schools (H→ H) in the baseline year after adjusting for student grade, race/ethnicity, parent/guardian education and household income (Table 2), compared to students attending the least developed schools (L→L) However, mean changes in knowledge scores from the first to the second year of the study did not differ by intervention exposure. Attitudes toward food, heath, environment and school did not show consistent patterns or significant differences (data not shown). Preference for fruit and green leafy vegetables increased the most among students in the highest developed schools (H→H), adjusting for baseline preferences (Table 2).

Food behavior

At baseline, consumption of fruits and vegetables did not differ between schools at different levels of intervention development (Table 3). In year two, there is a notable increase in intake of fruits and vegetables by 0.46 cups (0.9 standard servings) among the students in the H→H group, adjusting for baseline consumption, grade, race/ethnicity and parent's education. In comparison, students in the L→L group showed a decrease in F&V intake by 0.32 cups (0.6 standard servings) from baseline to year two. Much of the increased intake in the H→H group is attributable to an increase in vegetable consumption.

Comparisons were made for foods eaten during school hours and outside school hours. During school hours, students most exposed to the intervention (H→H) increased their consumption of fruits and vegetables by 0.2 cups while students least exposed to the intervention (L→L) showed a decrease of 0.3 cups ($p<.05$). Outside school hours, a similar trend was observed but was not significant (Figure 2).

DISCUSSION

Our findings support the hypothesis that garden- and cooking-based education, along with changes to the school food environment, has a positive behavioral impact on F&V consumption. Students most exposed to intervention activities demonstrated an increase of nearly 0.5 standard cups, while students least exposed showed a decrease of 0.3 cups. This increase was largely driven by vegetable consumption, and is particularly encouraging since several studies have demonstrated that school interventions increase fruit intake but not vegetable intake [13-15].

In the United States, there are few reports of successful multi-component school-based interventions addressing nutrition education and the school environment simultaneously. McAleese [12] reported that garden-based nutrition education had a positive impact on intakes of both fruits and vegetables. In Canada and Europe, recent reports of school interventions that distributed free fruits and vegetables reported increases in fruit and/or vegetable consumption in the amount of 0.4 servings and 0.2 portions respectively [19,20].

To our knowledge, this is one of the first evaluation studies of a comprehensive multi-component school-based intervention that involves the community; uses a prospective study design as well as rigorous dietary methodology to assess changes in the children's diets; and adjusts for family sociodemographic characteristics. Sociodemographic characteristics may confound positive findings with regard to interventions such as this. For example, race/ethnicity and parent's education may influence the home environment in ways that determine food-related behaviors. In our study, race/ethnicity was associated with various aspects of the home environment including frequency of eating family dinner together, eating out and using fresh ingredient to prepare dinner. However, family sociodemographic characteristics are unlikely to explain the observed increase in F&V consumption in our study. Not only did we control for

race/ethnicity and parent's education in our analysis, the elementary schools with the highest level of intervention development happened to be schools with the higher percentages of students qualifying for free or reduced-price school lunch (55% vs. 35%).

Several study limitations should be noted. First, schools were not randomized and control schools were not established. Some schools in the district had implemented their own food-related interventions over many years, and this gave them a distinct advantage over other schools in implementing the multi-component comprehensive intervention. Therefore, this evaluation took advantage of school differences in intervention development, and used a prospective study design that measured student exposure to the intervention. Second, the low Cronbach's alpha coefficients for the sub-attitudinal and fruit preference scales may reflect multi-dimensional constructs or the small number of items measured and partially explain the inconsistent findings with regard to food, health and environment attitudes. Third, while the food diary appears to be a more valid method for assessing diet in children aged 9 years and older [18], some students in the lower grades had difficulty completing the food diaries. Effort was made to mitigate this effect by promptly reviewing food diaries after completion. In addition, bilingual research staff assisted students whose primary language was not English. While the students' cognitive abilities in the younger grades may have limited their descriptions of foods, and biased their estimates of food amounts consumed [21], analysis of data collected from only the fourth graders resulted in the same inferences with regard to the effects of intervention development on change in F&V consumption. Fourth, to increase response rates, students were asked to record their food intakes on three weekdays instead of on weekdays and weekend days; dietary behaviors of the students on weekend days may vary considerably from what is reported here. Finally, the intervention did not target the home environment, and the greater increase in F&V

consumption observed among students most exposed to the intervention was statistically significant only for foods consumed during school hours. However, for foods consumed outside school hours, a similar trend was observed, as was a wide variance in consumption, suggesting that a larger sample size may be necessary to detect the effect of a school-based intervention on F&V consumption outside school hours.

CONCLUSION

Our findings strongly suggest that a comprehensive school district intervention that includes regular attendance and hands-on learning in garden and cooking classrooms, in conjunction with a changed school meal program matched to nutrition, environment, gardening and cooking lessons, can be effective in increasing preference for a variety of fresh produce, and F&V consumption among fourth to sixth grade children in public school. Whether these increases will continue or be maintained in higher grades as the children enter adolescence and peer influences assume a larger role in determining adolescent behaviors, remains to be investigated. While there is some evidence supporting the tracking of diet from childhood into young adulthood [22-24], there is also evidence that F&V consumption declines during adolescence [17,24]. One study of students from Minnesota reported that fruit consumption decreased by 41% and vegetable consumption by 25% between third and eighth grade [17].

It should be noted while the increases in F&V consumption in the most exposed group are encouraging, mean consumption levels fall below the current recommendation of 7-8 servings [25]. Students most exposed to intervention activities met about 70% of dietary recommendations, while students lest exposed to intervention activities met only 50% of dietary recommendations.

This study will conclude with a third year of data collection, allowing for the cohort to be followed as they progress to middle school. Schools can play an important role in promoting healthy eating behaviors and preventing obesity; the high societal costs of obesity, in terms of increased morbidity and mortality, and decreased economic productivity [26] provide a compelling reason to involve schools in the fight against obesity. Future research is needed to understand the relative importance of the different components of such a program, and their cost-benefits as well as health impacts.

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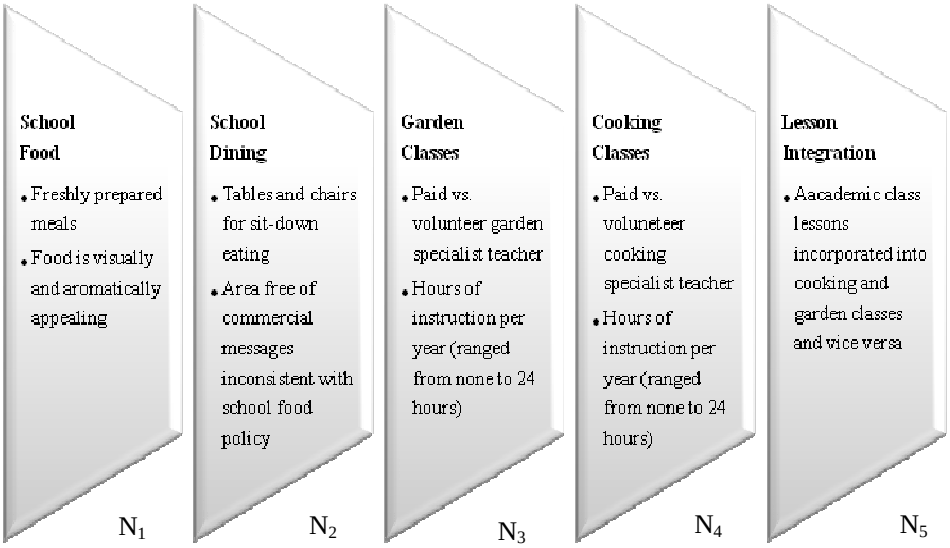
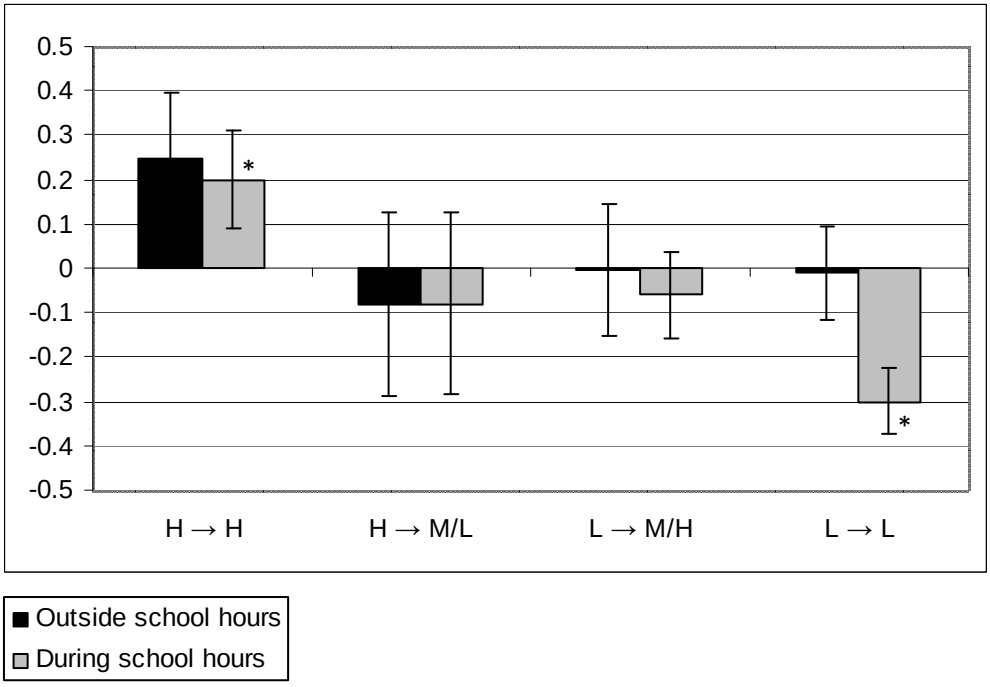
FIGURE 1: How degree of intervention development was assessed

Attributes of each intervention component were determined and then rated using a Likert scale. These ratings (for each attribute) were summed to provide a total score. Examples of attributes rated for each intervention component are shown below. The number of attributes rated varied from fourteen for School Food to six for Lesson Integration.



Degree of intervention development = $N_1 + N_2 + N_3 + N_4 + N_5$ where N_k is the sum of the ratings for all attributes for each intervention component.

Figure 2: Change in adjusted[1] mean fruit and vegetable consumption (cups) by timing of consumption[2] by intervention exposure[3,4] in Year 1 and Year 2



[1] Adjusted for baseline consumption, grade, race/ethnicity and parent's/guardian's education.

[2] "During school hours" defined by school bell schedules for a standard school day, and does not include any before or after school programming or sports. Food/beverage consumed at any other time was considered to be "Outside school hours".

[3] Each elementary school was rated as having high (H) or low (L) intervention development, and each middle school was rated as having high (H), medium (M) or low (L) intervention development. Participants were grouped based on the level of intervention development at the schools they attended in the baseline and follow-up year of the study.

[4] Four students without complete food diary records in both baseline and year 2, and one student with questionable food diary data were excluded from analysis. Sample sizes for each intervention exposure group: H→H (70), H → M/L (31), L → M/H (57) and L → L (106).

* Pairwise differences were evaluated using Bonferroni's test at $p<0.05$, and significant differences are indicated by matching superscripts. Error bars represent standard errors.

Table 1: Sociodemographic and home environment characteristics

		Baseline examination (2006-07) N=327[1]	Follow-up examination (2007-08) N=269[1]
Sociodemographic Characteristic (% distribution)			
Grade:	Fourth	52.9	
	Fifth	47.1	56.9
	Sixth	--	43.1
Gender:	Male	41.6	41.6
	Female	58.4	58.4
Race/ethnicity:	White	26.6	27.1
	African American	21.4	21.6
	Latino	13.5	14.1
	Asian	8.0	7.4
	Mixed/Other/Unknown	30.6	29.8
Mother's/female guardian's education:			
	High school or less	17.5	18.3
	Some college	27.6	27.4
	College degree	18.5	19.8
	Graduate school	36.4	34.5
Father's male guardian's education:			
	High school or less	23.9	24.1
	Some college	20.6	19.9
	College degree	21.9	20.8
	Graduate school	33.6	35.2
Household income:			
	< $40,000	39.1	39.4
	$40,000-$79,999	21.4	22.5
	≥ $80,000	39.5	38.1
Home environment characteristic (% of all students)[2]			
Eat out at least once a week		46.9	46.3
Eat family dinner together everyday		59.4	59.3
Use fresh ingredients to prepare dinner everyday		51.5	50.8

[1] Actual Ns vary due to missing values
[2] All home environment characteristics were associated with race/ethnicity at $p<.05$

Table 2: Adjusted mean knowledge and food preference scores by intervention exposure[1,2]

Intervention Exposure Group	All participants (N=269)[3]			
	H→H (N = 72)	H→M/L (N = 32)	L→M/H (N = 58)	L→L (N = 107)
Knowledge scores				
Nutrition (maximum possible score = 8)[4]				
Year 1	3.32[a]	3.20	2.67	2.72[a]
Year 2	3.85	3.42	3.33	3.36
Change	0.74	0.35	0.39	0.41
Food Environment (maximum possible score = 12)[5]				
Year 1	6.80	6.49	6.31	6.16
Year 2	7.91	7.57	7.75	7.05
Change	1.17	1.00	1.28	0.67
Combined Knowledge Score (maximum possible score = 20)				
Year 1	10.12	9.69	8.97	8.88
Year 2	11.76[a]	10.99	11.08	10.42[a]
Change	1.81	1.30	1.80	1.20
Preference scores				
Fruit Preference[6] (strawberries, persimmons, pears)				
Year 1	2.58[a]	2.58[b,c]	2.22[b]	2.16[a,c]
Year 2	2.76[d]	2.50	2.42	2.31[d]
Change	0.29[e]	0.04	0.13	0.05[e]
Green Leafy Vegetable Preference (chard, spinach, kale)				
Year 1	1.28	1.58[a,b]	0.94[a]	0.96[b]
Year 2	1.82[c,d]	1.40	1.11[c]	1.18[d]
Change	0.60[e,f,g]	0.01[e]	0.06[f]	0.10[g]
Other Vegetables Preference (beets, winter squash, peas, bell peppers, radishes, green beans)				
Year 1	1.89	1.80	1.45	1.66
Year 2	2.10[a,b]	1.71	1.62[a]	1.77[b]
Change	0.26	-0.02	0.05	0.08
Total Food Preference Score				
Year 1	1.94[a,b]	1.92[c]	1.48[a,c]	1.62[b]
Year 2	2.19[d,e]	1.83	1.69[d]	1.76[e]
Change	0.32[f]	-0.01	0.10	0.09[f]

[1] Each elementary school was rated as having high (H) or low (L) intervention development, and each middle school was rated as having high (H), medium (M) or low (L) intervention development. Participants were grouped based on the level of intervention development at the schools they attended in the baseline and follow-up year of the study.

[2] Adjusted for grade, race/ethnicity and parent's/guardian's education, and where change is the outcome of interest, for baseline value (relevant knowledge or food preference variables).

[3] Actual Ns may vary slightly due to non-response to some questions.

[4] Derived from responses to the following questions: How many servings of fruits and vegetables do you think are healthy to eat each day; which food has the most sugar; which food has the most fat; which food has the most fiber; which lunch has the most variety of healthy foods; which statements are true about high fiber food; which statements are true about trans fats; which food would be the healthiest to give you energy you need to exercise for a long time.

[5] Derived from responses to the following questions: Where does corn in a corn tortilla come from; how do fresh tomatoes become canned tomato soup; which food is the best for the environment; which food is least "processed"; what does a plant use to capture energy from the sun; apples and pumpkins are ripe in CA in which season; peas and asparagus are ripe in CA in which season; lemons and oranges are ripe in CA in which season; peaches and zucchini are ripe in CA in which season; what do plants need to survive; what is the first thing you should do to make a salad; how do you think people can help make less trash and waste.

[6] Maximum possible average score in each produce category = 3 (like a lot); lowest score possible = 0 (never tasted)

[a,b,c,d, e,f,g] Pairwise differences were evaluated using Bonferroni's test at $p<0.05$, and significant differences within each knowledge or food preference score category are indicated by matching superscripts.

Table 3: Consumption of fruit, vegetable, dairy foods, and grains[1] by intervention exposure[2,3]

Intervention Exposure Group	All participants (N=264)[4]			
	H→H (N = 70)	H→M/L (N = 31)	L→M/H (N = 57)	L→L (N = 106)
Daily fruit servings (cups)				
Year 1	1.32	1.02	1.27	1.30
Year 2	1.34	0.90	1.24	0.96
Change	0.04	-0.29	-0.03	-0.31
Daily vegetable servings (cups)				
Year 1	0.83	1.01	0.86	0.93
Year 2	1.30[a]	1.10	0.87	0.94[a]
Change	0.41[b]	0.13	-0.04	-0.002[b]
Daily fruit and vegetable servings (cups)				
Year 1	2.15	2.04	2.13	2.23
Year 2	2.64[a]	2.00	2.12	1.91[a]
Change	0.46[b]	-0.16	-0.06	-0.32[b]
Daily dairy[5] servings (cups)				
Year 1	1.47	1.69	2.02	1.49
Year 2	1.78	1.39	1.96	2.01
Change	0.21	-0.28	0.10	0.41
Daily grain servings (ounces)				
Year 1	6.11	6.57	6.86	6.84
Year 2	6.44	5.71	6.86	7.00
Change	-0.32	-1.12	-0.04	0.11

[1] Defined by consumption of fruit, vegetable, dairy foods, and grains, measured in cups or ounces.

[2] Each elementary school was rated as having high (H) or low (L) intervention development, and each middle school was rated as having high (H), medium (M) or low (L) intervention development. Participants were grouped based on the level of intervention development at the schools they attended in the baseline and follow-up year of the study.

[3] Adjusted for grade, race/ethnicity, and parent's/guardian's education., and where change is the outcome of interest, for baseline consumption.

[4] Four students without complete food diary records in both baseline and year 2, and one student with questionable food diary data were excluded from analysis

[5] Dairy group includes: dairy milks, enriched/fortified soy and rice milks, yogurt, cheese, milkshakes and ice cream

[a,b] Pairwise differences were evaluated using Bonferroni's test at $p<0.05$, and significant differences are indicated by matching superscripts.