

Original article

Exposure to a Comprehensive School Intervention Increases Vegetable Consumption

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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 2 years of a 3-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 3-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 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 (one standard serving), whereas 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. © 2010 Society for Adolescent Health and Medicine. All rights reserved.

Keywords: School food service; Gardening and cooking programs; Fruit and vegetable; Elementary school; Middle school; Child obesity prevention; Community-based

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

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prevention strategies [16], especially studies that involve the community in their development and implementation, larger sample sizes, and longer follow-up duration.

This article reports findings from the first 2 years of a 3-year evaluation of a comprehensive, multicomponent, 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 effect of the intervention on nutrition-related outcomes, academic performance, and physical fitness. This article will discuss only nutrition-related outcomes, namely, knowledge, attitudes, and behaviors. Specifically, we hypothesized that students most exposed to the intervention will be affected in the following ways:

- 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, and
- 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 2 years of a 3-year prospective study of 4th and 5th 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 (because of 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. Students of 4th and 5th graders were selected to allow for an assessment of the cumulative effect 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. Students' knowledge, attitudes, and behavior were assessed annually by questionnaire and 3-day food diary. 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. On the basis of past experiences, we anticipated an average yearly attrition rate of 22.5% and an exclusion rate of 10% (because of incomplete or poor quality data), giving a targeted sample size of 330.

Participants

Four elementary schools provided a potential pool of 414 4th and 5th 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 (79%) of all 4th and 5th 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 affected 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, six 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

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