HHS Public Access

Author manuscript

Acad Pediatr. Author manuscript; available in PMC 2017 April 01.

Published in final edited form as:

Acad Pediatr. 2016 April ; 16(3): 247–253. doi:10.1016/j.acap.2015.07.009.

Cost and Cost-effectiveness of Students for Nutrition and Exercise (SNaX)

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Abstract

Objective—To examine the cost and cost-effectiveness of implementing Students for Nutrition and eXercise (SNaX), a 5-week middle-school-based obesity-prevention intervention combining school-wide environmental changes, multimedia, encouragement to eat healthy school cafeteria foods, and peer-led education.

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Conflicts of Interest: The authors have no conflicts of interest to declare. Dr. Ladapo had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Contributors' Statement

Joseph A. Ladapo, MD, PhD - conceived and designed study, contributed to analyses and writing. Laura M. Bogart, PhD - conceived and designed study, contributed to interpretation of data and writing. David J. Klein, MS - contributed to analyses, interpretation of data, and writing. Burton O. Cowgill, PhD, MPH – contributed to interpretation of data and writing. Kimberly Uyeda, MD, MPH - contributed to interpretation of data and writing. David G. Binkle, PhD - contributed to interpretation of data and writing. Elizabeth R. Stevens, MPH - contributed to analyses, interpretation of data, and writing. Mark A. Schuster, MD, PhD - conceived study, contributed to interpretation of the data and writing. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Financial Disclosure: Dr. Ladapo's work is supported by a K23 Career Development Award (1 K23 HL116787) from the National Heart, Lung, and Blood Institute (NHLBI). There are no other financial disclosures to report.

Methods—Five intervention and five control middle schools (mean enrollment = 1,520 students) from the Los Angeles Unified School District participated in a randomized controlled trial of SNaX. Acquisition costs for materials and time and wage data for employees involved in implementing the program were used to estimate fixed and variable costs. Cost-effectiveness was determined using the ratio of variable costs to program efficacy outcomes.

Results—The costs of implementing the program over 5 weeks were $5,433.26 per school in fixed costs and $2.11 per student in variable costs, equaling a total cost of $8,637.17 per school, or $0.23 per student per day. This investment yielded significant increases in the proportion of students served fruit and lunch and a significant decrease in the proportion of students buying snacks. The cost-effectiveness of the program, per student over 5 weeks, was $1.20 per additional fruit served during meals, $8.43 per additional full-priced lunch served, $2.11 per additional reduced-price/free lunch served, and $1.69 per reduction in snacks sold.

Conclusions—SNaX demonstrated the feasibility and cost-effectiveness of a middle-school-based obesity-prevention intervention combining school-wide environmental changes, multimedia, encouragement to eat healthy school cafeteria foods, and peer-led education. Its cost is modest and unlikely to be a significant barrier to adoption for many schools considering its implementation.

Keywords

adolescents; cost; cost-effectiveness; schools; health promotion; nutrition; fruits; vegetables

Introduction

Reducing the prevalence of obesity in children is a major public health goal[1,2] with broad implications for future population health and healthcare costs.[3] Because children consume 35% to 50% of their daily calories at school,[4] attention has been focused on school nutrition policy changes—such as those spurred by the 2010 Healthy Hunger-Free Kids Act (S.3307)—and local school-environment programs.[1,2] In recent years, several local programs have proven effective in promoting healthier dietary choices such as reducing sugar-sweetened beverage (SSB) consumption and increasing children's fruit and vegetable consumption;[5–12] some have improved body mass index (BMI).[9–12] However, with few exceptions,[13–17] the cost and cost-effectiveness of implementing these programs are unknown.

The cost of school-based nutritional and exercise interventions is important information for school principals, superintendents, and other leaders.[4,18] These decision-makers often oversee policy and program adoption decisions for schools, and they frequently navigate challenging budget constraints.[19,20] Furthermore, a recent Institute of Medicine report on preventive interventions in children emphasized the role of economic evaluation in providing policymakers with guidance for decision-making.[21]

In this study, we present the cost and cost-effectiveness of Students for Nutrition and eXercise (SNaX), a five-week middle-school-based obesity-prevention program that combined school-wide environmental changes, multimedia, encouragement to eat healthy school cafeteria foods, and peer-led education.[22] SNaX was developed using principles of community-based participatory research and was assessed in a randomized controlled trial in

public Los Angeles middle-schools (grades 6–8) from 2009 – 2012. We found that SNaX significantly increased the proportion of students choosing fruit during meals and obtaining lunch from the cafeteria (a program goal because the cafeteria had redesigned its food offerings to exceed national nutritional standards), decreased the proportion of students buying snacks at school, enhanced students' knowledge about obesity-prevention behaviors, and increased tap water consumption.[22] Our cost and cost-effectiveness analysis of SNaX, focused on diet-related outcomes, aims to inform policymakers and other stakeholders seeking to improve student dietary choices and ultimately student health.

Methods

Participants

We selected ten schools from the Los Angeles Unified School District (LAUSD) with >50% National School Lunch Program (NSLP)-eligible students (a proxy for low-income) and <900 seventh-graders to participate in a randomized controlled trial evaluating the SNaX program. There were five schools in the intervention group and five in the control group. Of 4,022 eligible students, 2,809 (70%) had consent for height, weight, and NSLP data collection; data were obtained for 2,606 (93%) and 2,693 (96%), respectively.

Intervention

More details about the intervention are available elsewhere.[22] Seventh-graders were recruited through in-class presentations and informational tables to join a peer leader club, where they were trained by facilitators to promote and model healthy behaviors and engage other students in discussions to change eating and physical activity norms. Specifically, they were trained to discuss SNaX messages regarding cafeterias, water, SSBs, fruits/vegetables, and physical activity/inactivity with peers and family using a motivational interviewing style. Peer leaders also learned educational messages and conducted lunchtime giveaways (e.g., educational bookmarks, wristbands, pens, key chains, and pedometers) and cafeteria-food taste tests. A different group of peer leaders was recruited and trained each week by trained facilitators, and across schools, 454 peer leaders and partners participated. To control for seasonal variation in students' dietary patterns, we conducted SNaX only in spring semesters, when LAUSD cafeteria participation typically declines. In keeping with community-based participatory research principles, school district administrators from Student Health and Human Services, Food Services, and Physical education served on the study leadership team and were integral to the development and implementation of the intervention and analysis and interpretation of results.

As part of SNaX, the SNaX team developed signs and posters promoting water consumption, healthy foods, and physical activity; developed a promotional film for students; and in conjunction with the schools, installed water stations to expand students' access to drinking water. Cafeterias offered chilled, filtered water and a greater variety of healthier options (sliced/bite-sized fruits/vegetables), and posted SNaX-branded signs and banners promoting water consumption and healthy foods in the cafeteria area.

Overall program effects were measured across the entire school population using cafeteria and school store records, although peer leaders were recruited from seventh grade, and seventh-graders received a more intensive intervention (e.g., peer leader education). Thus, seventh-graders students completed surveys that assessed attitudes about the cafeteria, knowledge about obesity-prevention, tap water consumption, and other outcomes. Additional details about the program's design, content, and dietary and survey outcomes are reported elsewhere.[22] The institutional review boards of Boston Children's Hospital and RAND Corporation and the LAUSD Committee for External Research Review approved the study protocol.

Data Collection

We documented the cost of multimedia materials and promotional and marketing items, and program coordinators reported detailed information about water system maintenance costs, time spent training facilitators and peer leaders, teacher wages, and cafeteria employee wages. Multimedia materials and marketing products were procured from local vendors, including a graphic designer and film team; purchasing was centralized, so prices of program components were similar across schools. The cost of developing multimedia materials and marketing products was not included in our analysis, since these costs have already occurred and are not recoverable (i.e., "sunk" in economic terminology) from the perspective of program dissemination.

Schools provided data on cafeteria participation (number of students obtaining lunch by NSLP eligibility; number of fruits and vegetables served) and school store and vending machine sales (number of snacks sold) for each day of the intervention; we divided these totals by the number of students in attendance. Students eligible for the NSLP received free or reduced-price lunches based on family income. One school did not provide snack sale data because its store was closed due to structural damage.

Intervention Component Categories

We classified intervention components into three categories using detailed activity and product descriptions provided by the schools and research staff. The categories were (1) Peer Leader Activities, including peer leader training, social marketing, and giveaways; (2) School-wide Multimedia Marketing, including SNaX-branded cafeteria signs and banners and parent take-home activity sheets; and (3) School Food Environment Changes, including filtered water system set-up and maintenance, plastic cups for water, preparing fruits/vegetables, and cafeteria taste tests.

Fixed and Variable Cost Classification

Intervention components were further categorized as *fixed cost inputs* (costs that do not change with the number of students enrolled in the school) or *variable cost inputs* (costs that increase with the number of students enrolled in the school). For example, activities related to peer leadership training or school food environment changes were generally considered fixed costs. Activities related to student-level marketing or water consumption were generally considered variable costs, as the amount distributed or consumed generally increased proportionally with the number of students enrolled in the school. Some costs

associated with peer leaders, such as peer leader wristbands, varied with the number of peer educators involved in the program, but we categorized them as fixed from the perspective of students.

Fixed and Variable Cost Estimation

We estimated the cost of SNaX components from a school's perspective using acquisition costs for materials and time and wage data for employees involved in implementing the program. We did not assign any cost to cafeteria employees for food preparation because the food component of the program was associated with routine lunchtime preparation activities, and we assumed it would not replace other productive activities. Our base case analysis assumes that manualized training of the SNaX program would be used to teach program facilitators (teachers already employed by the school). For these reasons, we did not include the cost of external program trainers in our analysis; however, the teachers' training time contributed to overall program costs, as did the time teachers spent serving as program facilitators. Teacher wages were obtained from the LAUSD. In a sensitivity analysis, we substituted bulk purchasing prices from national vendors and used national estimates of median teacher and cafeteria worker wages from the United States Bureau of Labor Statistics. Detailed cost inputs for the primary analysis and the sensitivity analysis are provided in Appendix Table 1, and additional information about program materials are available at www.snaxinschools.org.

Program Cost-effectiveness

Cost-effectiveness analysis is a method for assessing the relative value of health programs.[23] We derived the cost-effectiveness of SNaX implementation using the ratio of variable costs to program efficacy outcomes [(change in cost)/(change in effectiveness)], as compared to schools in the control group. We used variable costs because variable costs reflect the marginal cost of providing SNaX to one additional student, although fixed costs also contribute to economic decision-making.[24] In particular, because our analysis targeted program implementation, it was economically appropriate to analyze fixed costs and variable costs separately.[25] However, we also present average cost per student per outcome using a combination of fixed and variable costs.

The efficacy outcomes, reported in detail elsewhere,[22] included (1) portions of fruits and vegetables served; (2) number of free/reduced-price lunches served; (3) number of full-priced lunches served; (4) number of all lunches served; and (5) number of snacks sold. We calculated the mean change relative to the control group, while adjusting for baseline outcome value, school indicators, sociodemographic characteristics, BMI category, and NSLP-eligibility. Details of our regression models for efficacy outcomes are reported elsewhere.[22]

Statistical Analysis

We estimated standard errors and constructed 95% confidence intervals for cost-effectiveness ratios using a method that approximates the probability distribution of a function.[26] We used a similar method to construct 95% confidence intervals for average cost-per-student estimates. The unit of analysis for cost-effectiveness estimates was the

student. Schools in the control group were ascribed a cost of 0. All costs were converted to 2014 US dollars using the consumer price index for the first two quarters of the year.

Results

Student Characteristics

A total of 2,997 seventh-graders (75% of the 4,022 eligible seventh-graders across schools) completed pre- and post-intervention surveys assessing psychosocial variables. The mean (standard deviation) seventh grade class size and overall school size were 494 (124) and 1,515 (323), respectively, in intervention schools and 498 (88) and 1,524 (266) in control schools; the mean pooled enrollment was 1,520 students. The distribution of race/ethnicity was similar across intervention and control schools; overall, 14.2% of the children were Black, 74.7% were Hispanic, 5.7% were White, and 5.5% were Asian/Pacific Islander. Among 2,439 students who responded to our baseline survey, 20.8% were overweight and 30.2% were obese.

Program Fixed and Variable Costs

Fixed and variable costs for intervention components are summarized in Table 1. Total fixed costs averaged $5,433.26 per school. Components requiring the greatest amount of investment included peer leader social marketing ($1,462.62 per school), school-wide multimedia marketing ($2,361.26 per school), and filtered water system maintenance ($1,504.95 per school, not including $359.94 in variable costs spent on disposable plastic cups).

Total variable costs were $3,203.91 for 1,520 students for the five intervention schools in the study, or $2.11 per student. Because some items, such as pens, key chains, and pedometers, were not given to each student, the variable costs attributable to these items were weighted by the percentage of students who were recipients. Components accounting for the largest share of the program's variable costs included parent take-home activity sheets ($0.83 per student), promotional wristbands ($0.44 per student), pen and key chain giveaways to students ($0.34 per student), and pedometer giveaways to students ($0.25 per student). Using the total cost, including fixed and variable costs, the program cost a total of $8,637.17, or $5.68 per student. This is equivalent to an average daily cost per student of $0.23 over the 5-week intervention.

Cost-effectiveness

We evaluated the cost-effectiveness of SNaX by calculating the ratio of incremental variable costs to incremental program efficacy outcomes at 5 weeks, per student, as compared to the control group (Table 2). Over the duration of the intervention, the investment of $2.11 per student (variable cost per student) resulted in simultaneous mean increases of 1.75 fruit servings being served, 1.25 lunches being served, and 1.25 fewer snacks sold, per student.

These simultaneous improvements in consumption behaviors were also analyzed on a per-outcome basis, with costs calculated for each outcome as if it were the only one achieved by the program. In this case, a given incremental cost was associated with a given improvement

in outcome; because there are multiple outcomes, that same incremental cost was associated with improvements in multiple outcomes. Over five weeks, the cost-effectiveness of the program, per student, was $1.20 per additional fruit served during meals, $8.43 per additional full priced lunch served, $2.11 per additional free/reduced-priced lunch served, and $1.69 per reduction in snacks sold. As an example for interpretive purposes, each student, on average, ate 1.75 more fruits over the five-week period; achieving this goal, per student, therefore cost $1.20 per fruit consumed. Cost-effectiveness ratios are summarized in Table 2, along with estimates of the average cost per student for different outcomes.

Sensitivity Analysis

In an analysis using national estimates for cost inputs, total fixed costs were $4,307.18 and total variable costs were $2,342.60 for 1,520 students, or $1.54 per student. Combining fixed and variable costs, the program cost a total of $6,649.78, or an average of $4.37 per student over five weeks. The cost-effectiveness of the program was comparable to our primary analysis (Appendix Tables 2 and 3).

Discussion

We found that implementing SNaX at a school for five weeks would cost $5,433.26 in fixed costs and $2.11 per-student in variable costs. This investment resulted in simultaneous improvements in fruit selection and school lunch participation, and a reduction in snack sales. On a per-outcome basis, with each outcome treated as if it were the only outcome of the program, the cost-effectiveness of the program ranged from $1.20 per additional fruit serving to $8.43 for each additional full priced lunch. These estimates may be considered to be reasonable fixed and variable costs for many medium-to-large schools considering implementing the program, and for government bodies or foundations considering subsidizing its cost. Although we implemented SNaX over five weeks for research purposes, the program can be extended through the school year with comparable variable costs and cost-effectiveness.

Recent data suggest that rates of childhood obesity are falling in some states in the US,[27] but nearly one-third of children aged between 6 and 19 years—approximately 24 million children total—remain obese or overweight.[28,29] These children are at higher risk of obesity-related illnesses as adults, including coronary heart disease, diabetes, and hypertension.[30–32] Moreover, because dietary choices during childhood track into adulthood, during which poor fruit and vegetable consumption is associated with obesity, early dietary habits have long-term consequences.[33] In addition to the morbidity and mortality of these illnesses, they have also been found to be responsible for an economic burden in the United States that currently exceeds $190 billion annually[34]; the international economic burden is also substantial.[35] For these reasons, tremendous public and private investment has targeted the development of effective obesity prevention programs. SNaX was designed to promote healthy lifestyles and reduce obesity rates through the consumption of healthy school cafeteria foods and greater awareness of healthy choices.

In the context of school-based health interventions, the findings of our economic evaluation of SNaX are comparable to findings from other economic evaluations of obesity prevention

interventions, though few have been performed. In a 2003 analysis of the cost-effectiveness of the school-based intervention *Planet Health*, the intervention cost was $33,677 or $14 per student per year using average costs (compared to our estimate of about $8,637.17 or $5.68 per student over five weeks).[17] Though SNaX was implemented over a shorter period of time, we assessed efficacy outcomes both during and after the completion of SNaX. These post-intervention outcomes, reported elsewhere,[22] were similar to our main findings, supporting the conclusion that the intervention yielded durable effects. In particular, post-intervention outcomes were measured approximately three weeks after program completion and showed persistent program effects on full-priced lunches served, free/reduced-priced lunches served, and snacks sold ($p<0.01$ for all). There was also a nonsignificant difference in fruits served ($p<0.10$).[22] These downstream effects would also tend to make the program more economically favorable, and could be incorporated in a more comprehensive analysis.

Recent data also suggest that programs and policies that limit sales of unhealthy snacks and beverages in schools may not only improve children's health but can also increase school food service revenues in some scenarios, such as when the purchase of lunch meals increases.[4,18] Though our intervention was not designed to limit access to unhealthy snacks and beverages, we considered cafeteria meals an outcome rather than a cost so did not estimate the impact of SNaX on overall school budgets. This calculation is also more complex for schools participating in our study because the portion of students eligible for NSLP free and reduced-price meals was high.

The principal limitations of our study are that the study included a small number of schools and it was conducted in a single school district. These limitations affect the generalizability of our cost estimates and the degree to which our efficacy outcomes are representative of schools in other areas. In addition, the cost of promotional and multimedia items in SNaX may not be representative of prices from large vendors or bulk purchases, which may reduce the program's cost. (We provided cost estimates based on more nationally representative sources in the appendix.) Another important limitation is that we were unable to incorporate the potential effect of SNaX on overweight and obesity incidence in adolescents. Although other studies suggest that the availability of healthy food choices in schools reduces the incidence of obesity,[9–12] we cannot estimate the magnitude of effect from our study.

In conclusion, SNaX demonstrated the feasibility and sustained efficacy of a middle-school-based obesity-prevention intervention combining school-wide environmental changes, multimedia, encouragement to eat healthy school cafeteria foods, and peer-led education. The fixed and variable costs of the intervention may not be prohibitive barriers to its adoption and diffusion for many schools considering its implementation. The program also appears to be cost-effective across several measures of behavior change.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

We are grateful for the contributions of the study participants, the study team, and members of the Healthy Living Advisory Board (the community advisory board for this study).

Funding source: The SNaX study was funded by the National Institute of Minority Health and Health Disparities (R24 MD001648; MA Schuster, PI).

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What's New

SNaX demonstrated the feasibility and cost-effectiveness of a middle-school-based obesity-prevention intervention combining school-wide environmental changes, multimedia, encouragement to eat healthy school cafeteria foods, and peer-led education. Program aims were achieved at a cost of $0.23 per student per day.

Table 1

SNaX Program Fixed And Variable Costs Over A Five Week Program Period

	Items per week	No. of weeks	Cost type[¶]	Cost per item (or per hour)	Total cost
Peer leader activities					**$4,316.76**
Facilitator training					**$677.28**
Training facilitator to deliver SNaX program[*]	15	1	Fixed	$45.01	$675.09
SNaX manual	1	1	Fixed	$2.19	$2.19
Peer leader training					**$601.18**
Weekly facilitator training[*]	2	5	Fixed	$45.01	$450.06
Trivia game quiz cards	8	5	Fixed	$0.42	$16.89
Role-playing scenario cards	10	5	Fixed	$0.42	$21.12
Peer leader tips/informational guides	18	5	Fixed[†]	$0.83	$75.10
Role-playing tips handouts	18	5	Fixed[†]	$0.42	$38.01
Peer leader social marketing					**$1,462.62**
Wristbands, key chains, pens, water bottles	72	5	Fixed[†]	$2.49	$894.67
Pedometers	18	1	Fixed[†]	$1.94	$34.86
T-shirts	18	5	Fixed[†]	$5.92	$533.09
Peer leader social marketing-giveaways					**$1,575.68**
Pens, key chains	100	5	Variable	$1.03	$515.06
Pedometers	200	1	Variable	$1.94	$387.33
Wristbands (red) for students	1520	1	Variable	$0.44	$673.29
School wide multimedia marketing					**$2,361.26**
Parent sheets					**$1,268.29**
Parent take-home activity brochure	1520	1	Variable	$0.83	$1,268.29
Media					**$1,092.97**
SNaX DVD (promotional film)	1	1	Fixed	$2.06	$2.06

	Items per week	No. of weeks	Cost type¶	Cost per item (or per hour)	Total cost
Bookmarks	4000	1	Fixed	$0.03	$123.62
Physical Activity posters	1	1	Fixed	$78.29	$78.29
Banners, signs, other posters	16	1	Fixed	$63.50	$889.00
School environment changes					**$1,959.15**
Water					**$1,864.89**
Water system maintenance (e.g., cleaning jugs)*	1.5	5	Fixed	$13.64	$102.29
Water testing for copper and lead	1	1	Fixed	$160.70	$160.70
Water filter	1	1	Fixed	$559.01	$559.01
Water jugs	5	1	Fixed	$35.77	$178.83
Rolling cart for jug transport	1	1	Fixed	$504.12	$504.12
Plastic cups for water	1900	5	Variable	$0.04	$359.94
Food taste tests					**$94.26**
Strawberries	100	1	Fixed	$0.38	$38.42
Celery with low-fat ranch dressing	100	1	Fixed	$0.32	$31.62
Breaded chicken nuggets	100	1	Fixed	$0.24	$24.21
Total fixed costs, not including peer leader costs					$3,857.53
Total peer leader costs					$1,575.72
Total variable costs					$3,203.91
Total cost					**$8,637.17**

*Hours/week, based on average teacher or cafeteria employee wages

¶Variable costs vary with number of students enrolled in the school

†Varies with number of peer leaders

‡Total costs calculated by multiplying Items per week x No. of weeks x Cost per item (e.g. Peer leader tips/informational guides: 18 items/week x 5 weeks x $0.83/item = $75.10)

Note: As an example, the first entry (“Training facilitator to deliver SNaX program*) is interpreted as follows: 15 hours were spent in one week to train the facilitator, at a cost of $45.01 per hour, for a total fixed cost of $675.09

Table 2

Cost-effectiveness And Average Cost Of SNaX Based On Fruit And Vegetable Servings, Cafeteria Participation, And Snack Sales Per Student Over Five Week Program Period

Outcomes	Incremental change (Mean)	CE ratio ($/outcome)	95% CI	Avg cost per outcome ($/outcome)	95% CI
Cafeteria Servings					
Fruit[§]	1.75	$1.20	0.19 to 2.22	$3.25	1.69 to 4.81
Vegetables[¶]	-	-	-	-	-
Free/reduced lunch[*]	1.00	$2.11	0.04 to 4.17	$5.68	0.11 to 11.25
Full-price lunch[*]	0.25	$8.43	1.82 to 15.04	$22.73	4.91 to 40.55
All lunches	1.25	$1.69	0.36 to 3.01	$4.55	1.69 to 7.4
Snack Sales[†]	−1.25	$1.69	1.03 to 2.35	$4.55	3.12 to 5.97

Abbreviations: CI, confidence interval; Avg., average; CE, cost-effectiveness

Note: Incremental change represents adjusted differences-in-differences estimate of pre-to-post change within and between control and intervention schools

[§]As an example for interpretive purposes, each student, on average, ate 1.75 more fruits over the five week period. Achieving this goal, per student, cost $1.20 per fruit consumed.

[¶]Vegetable outcomes were not included in economic evaluation because there was no statistically significant intervention effect

[*]Includes 5 schools only (2 intervention and 3 control schools); because of the high number of students who were eligible for the NSLP in 4 schools, LAUSD allowed all students to receive free meals at those schools. NSLP data were not collected for one intervention school.

[†]Excludes one control school; one school's store was closed due to structural damage.

Appendix Table 1

Detailed Los Angeles Unified School District and Nationally Representative Cost Inputs

Item*	Description	Unit cost		
		LAUSD	National	Source
Peer leader activities				
Training facilitator to deliver SNaX program	Median hourly wage for middle school teacher	$45.01	$39.27	*a*
Weekly facilitator training	Median hourly wage for middle school teacher	$45.01	$39.27	*a*
SNaX manual	B&W Photocopies, 20 pages double sided, booklet binding	$2.19	$1.48	*b*
Trivia game quiz cards	B&W Photocopies, 40 pages double sided	$0.42	$2.80	*b*
Role-playing scenario cards	B&W Photocopies, 30 pages double sided	$0.42	$2.10	*b*
Peer leader tips/informational guides	Color copies, 2 pages double sided	$0.83	$0.84	*b*
Role-playing tips handouts	B&W Photocopies, 1 page	$0.42	$0.07	*b*
Wristbands (red) for students	Silicone debossed wristband	$0.44	$0.34	*c*
Wristbands (white) for peer leaders	Silicone debossed wristband	$0.44	$0.62	*c*
Pens	Customized ballpoint pen	$1.25	$0.58	*d*
Key chains	Round Vinyl Keychain	$0.81	$0.34	*e*
SNaX water bottles	Bike Bottle, 20 oz.	$7.44	$0.79	*f*
Pedometers	Mini Digital LCD Pedometer	$1.94	$5.49	*g*
T-shirts	One color screening	$5.92	$5.25	*h*
School-wide multimedia marketing				
Parent take-home activity brochure	B&W Photocopies, 2 pages double sided	$0.83	$0.14	*b*
Know Your Facts Poster	Glossy Large Poster, 24″ × 36″	$23.69	$23.98	*i*
Lable Able Poster	Glossy Large Poster, 24″ × 36″	$23.69	$23.98	*i*
Drink Measures Up Poster	Glossy Large Poster, 24″ × 36″	$35.02	$23.98	*i*
H20 Way to Go Poster	Glossy Large Poster, 24″ × 36″	$35.02	$23.98	*i*
Physical Activity posters	Glossy Large Poster, 24″ × 36″	$78.29	$23.98	*i*
SNaX Table Banner	Medium Vinyl Banner, 4′ × 2.5′	$61.81	$22.49	*j*
SNaX Stage Banner	Extra Large Vinyl Banner, 8′ × 2.5′	$200.87	$34.99	*j*
Bookmarks	Custom bookmark, 2″ × 6″	$0.03	$0.05	*k*
Cafeteria sign	Large sign with nutrition information	$103.01	$95.92	*i*
Big lunch sign	Extra Large Vinyl Banner, 8′ × 2.5′	$45.33	$34.99	*j*
Wide lunch sign	Glossy Medium Poster, 18″ × 24″	$17.51	$19.98	*i*
Extra cards for big lunch sign	Color, cardstock, 8.5″ × 11″	$6.18	$6.70	*b*
Extra cards for wide lunch sign	Color, cardstock, 8.5″ × 11″	$5.15	$6.70	*b*
Extra cards for windows	Color, cardstock, 8.5″ × 11″	$12.36	$6.70	*b*
Cafeteria entrée information sign	Large Poster, five 24″ × 36″ posters for each entree	$123.62	$95.92	*i*
SNaX DVD (promotional film)	DVD-R	$2.06	$0.42	*l*
School environment changes				
Water system maintenance (e.g., cleaning jugs)	Fill and clean water jugs	$13.64	$13.64	N/A
Water testing for copper and lead	Test cafeteria sink for levels of copper and lead	$160.70	$160.70	N/A

Item*	Description	Unit cost		
		LAUSD	National	Source
Water filter	Installation and 12 months service for 1 water filter (filters for taste and clarity only)	$559.01	$559.01	N/A
Water jugs	5-gallon water jug with spigot	$35.77	$35.77	N/A
Rolling cart for jug transport	Rolling cart to store and transport water jugs	$504.12	$504.12	N/A
Plastic cups for water	Translucent Plastic Cold Cups, 7 oz.	$0.04	$0.03	*m*
Strawberries	Serving for taste testing	$0.38	$0.38	N/A
Celery with low-fat ranch dressing	Serving for taste testing	$0.32	$0.32	N/A
Breaded chicken nuggets	Serving for taste testing	$0.24	$0.24	N/A

N/A, Not applicable

B&W, Black and white

*Additional details about program materials are available at www.snaxinschools.org

*a*http://www.bls.gov/ncs/ncswage2010.htm

*b*http://www.staples.com/sbd/content/copyandprint/copiesanddocuments.html

*c*https://www.reminderband.com

*d*http://www.staplespromotionalproducts.com/product/Vista%20Pen/80560/

*e*http://www.staplespromotionalproducts.com/product/Round%20Vinyl%20Keychain/80RN5/

*f*http://www.staplespromotionalproducts.com/product/20%20oz%20Bike%20Bottle/803Z0/

*g*http://www.staples.com/Insten-Mini-Digital-LCD-Pedometer-Black/product_974229

*h*http://www.staplespromotionalproducts.com/product/Hanes%20Tagless%20T-Shirt/800RP/

*i*http://www.staples.com/sbd/content/copyandprint/posters.html

*j*http://print.staples.com/custom-banners.aspx?pfid=AEJ&GP=6%2f4%2f2014+10%3a03%3a17+AM&GPS=3201329369&GNF=0#here

*k*http://www.nextdayflyers.com/bookmark-printing/2x6-bookmarks.php

*l*http://www.staples.com/Staples-12-Pack-47GB-DVD-R-Spindle/product_676158

*m*http://www.staples.com/SOLO-Galaxy-Translucent-Plastic-Cold-Cups-7-oz-2-000-Case/product_861913

Appendix Table 2

SNaX Program Fixed And Variable Costs Over A Five Week Program Period

	Items per week	No. of weeks	Cost type[¶]	Cost per item (or per hour)	Total cost[‡]
Peer leader activities					**$3,908.06**
Facilitator training					**$590.60**
Training facilitator to deliver SNaX program [*]	15	1	Fixed	$39.27	$589.12
SNaX manual	1	1	Fixed	$1.48	$1.48
Peer leader training					**$691.64**
Weekly facilitator training [*]	2	5	Fixed	$39.27	$392.74
Trivia game quiz cards	8	5	Fixed	$2.80	$112.00
Role-playing scenario cards	10	5	Fixed	$2.10	$126.00
Peer leader tips/informational guides	18	5	Fixed[†]	$0.84	$75.60
Role-playing tips handouts	18	5	Fixed[†]	$0.07	$6.30
Peer leader social marketing					**$781.02**
Wristbands (white), key chains, pens, water bottles	72	5	Fixed[†]	$0.58	$209.70
Pedometers	18	1	Fixed[†]	$5.49	$98.82
T-shirts	18	5	Fixed[†]	$5.25	$472.50
Peer leader social marketing-giveaways					**$1,844.80**
Pens, key chains	100	5	Variable	$0.46	$230.00
Pedometers	200	1	Variable	$5.49	$1,098.00
Wristbands (red) for students	1520	1	Variable	$0.34	$516.80
School wide multimedia marketing					**$857.51**
Parent sheets					**$212.80**
Parent take-home activity brochure	1520	1	Variable	$0.14	$212.80
Media					**$644.71**
SNaX DVD	1	1	Fixed	$0.42	$0.42

	Items per week	No. of weeks	Cost type[¶]	Cost per item (or per hour)	Total cost[‡]
Bookmarks	4000	1	Fixed	$0.05	$200.00
Activity posters	1	1	Fixed	$23.98	$23.98
Banners, signs, other posters	16	1	Fixed	$30.02	$420.31
School environment changes					**$1,884.21**
Water					**$1,789.95**
Water system maintenance (e.g., cleaning jugs)*	1.5	5	Fixed	$13.64	$102.29
Water testing for copper and lead	1	1	Fixed	$160.70	$160.70
Water filter	1	1	Fixed	$559.01	$559.01
Water jugs	5	1	Fixed	$35.77	$178.83
Rolling cart for jug transport	1	1	Fixed	$504.12	$504.12
Plastic cups for water	1900	5	Variable	$0.03	$285.00
Food taste tests					**$94.26**
Strawberries	100	3	Fixed	$0.38	$38.42
Celery with low-fat ranch dressing	100	3	Fixed	$0.32	$31.62
Breaded chicken nuggets	100	3	Fixed	$0.24	$24.21
Total fixed costs, not including peer leader costs					$3,444.26
Total peer leader costs					$862.92
Total variable costs					$2,342.60
Total cost					**$6,649.78**

[¶]Variable costs vary with number of students enrolled in the school

[‡]Total costs calculated by multiplying Items per week x No. of weeks x Cost per item (e.g. Peer leader tips/informational guides: 18 items/week x 5 weeks x $0.84/item = $75.60)

*Hours/week, based on average teacher or cafeteria employee wages

†Varies with number of peer leaders

[‡]Total costs calculated by multiplying Items per week x No. of weeks x Cost per item (e.g. Peer leader tips/informational guides: 18 items/week x 5 weeks x $0.84/item = $75.60)

Note: As an example, the first entry (“Training facilitator to deliver SNaX program*) is interpreted as follows: 15 hours were spent in one week to train the facilitator, at a cost of $39.27 per hour, for a total fixed cost of $589.12

Appendix Table 3

Cost-effectiveness And Average Cost Of SNaX Based On Fruit And Vegetable Servings, Cafeteria Participation, And Snack Sales Per Student Over Five Week Program Period

Outcomes	Incremental change (Mean)	CE ratio ($/outcome)	95% CI	Avg cost per outcome ($/outcome)	95% CI
Cafeteria Servings					
Fruit[§]	1.75	$0.88	0.14 to 1.62	$2.50	1.3 to 3.7
Vegetables[¶]	-	-	-	-	-
Free/reduced lunch[*]	1.00	$1.54	0.03 to 3.05	$4.37	0.09 to 8.66
Full-price lunch[*]	0.25	$6.16	1.33 to 11	$17.50	3.78 to 31.22
All lunches	1.25	$1.23	0.27 to 2.2	$3.50	1.3 to 5.7
Snack Sales[†]	−1.25	$1.23	0.75 to 1.72	$3.50	2.4 to 4.6

Abbreviations: CI, confidence interval; Avg., average; CE, cost-effectiveness

Note: Incremental change represents adjusted differences-in-differences estimate of pre-to-post change within and between control and intervention schools

[§]As an example for interpretive purposes, each student, on average, ate 1.75 more fruits over the five week period. Achieving this goal, per student, cost $0.88 per fruit consumed.

[¶]Vegetable outcomes were not included in economic e valuation because there was no statistically significant intervention effect.

[*]Includes 5 schools only (2 intervention and 3 control schools); because of the high number of students who were eligible for the NSLP in 4 schools, LAUSD allowed all students to receive free meals at those schools. NSLP data were not collected for one intervention school.

[†]Excludes one control school; one school's store was closed due to structural damage.