Pilot Study: EatFit Impacts Sixth Graders' Academic Performance on Achievement of Mathematics and English Education Standards

Mical Kay Shilts, PhD[1]; Cathi Lamp, MS, MPH, RD[2]; Marcel Horowitz, MS, CHES[3]; Marilyn S. Townsend, PhD, RD[4]

ABSTRACT

Objective: Investigate the impact of a nutrition education program on student academic performance as measured by achievement of education standards.

Design: Quasi-experimental crossover-controlled study.

Setting: California Central Valley suburban elementary school (58% qualified for free or reduced-priced lunch).

Participants: All sixth-grade students (n = 84) in the elementary school clustered in 3 classrooms.

Intervention: 9-lesson intervention with an emphasis on guided goal setting and driven by the Social Cognitive Theory.

Main Outcome Measure: Multiple-choice survey assessing 5 education standards for sixth-grade mathematics and English at 3 time points: baseline (T1), 5 weeks (T2), and 10 weeks (T3).

Analysis: Repeated measures, paired t test, and analysis of covariance.

Results: Changes in total scores were statistically different ($P < .05$), with treatment scores (T3 - T2) generating more gains. The change scores for 1 English ($P < .01$) and 2 mathematics standards ($P < .05$; $P < .001$) were statistically greater for the treatment period (T3 - T2) compared to the control period (T2 - T1).

Conclusion and Implications: Using standardized tests, results of this pilot study suggest that *EatFit* can improve academic performance measured by achievement of specific mathematics and English education standards. Nutrition educators can show school administrators and wellness committee members that this program can positively impact academic performance, concomitant to its primary objective of promoting healthful eating and physical activity.

Key Words: content standards, nutrition education, physical activity, adolescents, academic performance

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INTRODUCTION

Schools are an excellent delivery vehicle for nutrition education for children.[1] However, public schools are under increased pressure to show improved academic performance in basic subjects such as mathematics and English.[2] With this increased pressure, there is less time for other programming such as nutrition education.[2] To increase access to schools, nutrition educators would benefit from proving their programs can impact academic performance as measured by education standards achievement, in addition to documenting improved health behaviors.

In California, the education standards, also called content standards, were adopted by the state board of education for 7 subject areas: (1) English, (2) mathematics, (3) history/social science, (4) physical education, (5) science, (6) visual and performing arts, and (7) career technical education.[3] Students are evaluated annually on achievement of some of these standards through the Standardized Testing and Reporting (STAR) program, also known as standardized achievement testing. Mathematics and English are tested every year from second to ninth grade.[2] The results are used to determine a school's Academic Performance Index (API), the cornerstone of California's Public Schools Accountability Act of 1999.[2]

A search of studies investigating nutrition education's impact on

[1]Family and Consumer Sciences Department, California State University, Sacramento, Sacramento, CA

[2]University of California Cooperative Extension, Tulare County, Tulare, CA

[3]University of California Cooperative Extension, Yolo County, Woodland, CA

[4]Nutrition Department, University of California, Davis, Davis, CA

Address for correspondence: Marilyn S. Townsend, Nutrition Department, University of California Davis, One Shields Ave, Davis, CA 95616-8669; Phone: (530) 754-9222; Fax: (530) 752-7588; E-mail: mstownsend@ucdavis.edu

achievement of education standards yielded no peer-reviewed studies or reports. In addition, the authors interviewed evaluation experts at the California Department of Education and education professors at 2 universities and found the same results.

The objective for this pilot study was to investigate the impact of a nutrition education program on student academic performance as measured by achievement of education standards.

DESCRIPTION OF INTERVENTION
Curriculum

The nutrition education program was *EatFit*, a primary prevention intervention designed to improve the dietary and physical activity skills and behaviors of adolescents 11-14 years old.[4,5] The program included 9 experiential lessons driven by the Social Cognitive Theory and used a Web-based assessment (http://www.eatfit.net) to assist participants in dietary analysis and goal setting.[6] A description of the school intervention is reported elsewhere.[4,5]

Curriculum Alignment to Content Standards

Content of the intervention was evaluated by an educational consultant and aligned with the sixth-grade California Content Standards. The authors compared the selected content standards with those that were assessed annually by the STAR program. Additional information is provided elsewhere.[7] The results of the STAR program are used to determine a school's API.[2] Consequently, mathematics and English content standards for sixth grade were targeted for this study.

Evaluation Tool

A 25-question, multiple-choice evaluation tool assessing 5 standards for sixth-grade mathematics and English was developed (Table 1) using an 8-step process.[7] The California Department of Education granted permission to include in the evaluation instrument the copyrighted test questions previously administered as a part of the STAR program.[8] The tool was cognitively tested with middle school students (n = 5), revised, and then pilot-tested (n = 26) and revised again.[7] The Flesch-Kincaid readability score[9] was 7.1 with a Flesch Reading Ease score of 68.0. This instrument is available from the first author.

DESCRIPTION OF STUDY
Subjects

All sixth-grade students (n = 95, 58% qualified for free or reduced-priced lunch) at a California Central Valley suburban elementary school in Tulare County were invited to participate in this study. The participants were clustered in 3 classrooms.

Procedure

A quasi-experimental crossover-controlled design, was used for this pilot study. Evaluation instruments were administered to all sixth-grade students at the study site, 3 times during the fall of 2005: baseline (T_1), 5 weeks (T_2), and 10 weeks (T_3). During the 5-week control period from T_1 to T_2, students received their usual classroom education. During the 5-week treatment period from T_2 to T_3, students participated in the 9-lesson *EatFit* program. To mitigate a teacher effect, the intervention was delivered by 1 community educator trained and certified to teach the intervention. The University of California–Davis Institutional Review Board approved the study. Parents and legal guardians gave written informed consent, and participants gave written assent.

Data Analyses

Using SAS 8.1 (SAS Institute Inc., Cary, NC), double data entry in 2 separate files was examined to compare for differences. Repeated measures analysis (which controls for individual characteristics of participants) investigated differences between the 3 testing periods, T_1, T_2, and T_3. Paired *t* tests, 1-tailed, compared mean change scores for the control and treatment periods. Additionally, analysis of covariance investigated results by individual characteristics (ie, class, age, gender, and ethnicity) to determine the presence of a characteristic by intervention interaction. Significance level was set at $P \le .05$.

FINDINGS

Of the 95 eligible participants, 84 were included in the analysis. Several participants did not return both consent and assent forms (n = 8), whereas several others withdrew from school during the study (n = 3). The mean age was 11.0 ± 0.5 years. Half (50%) were female. Participants self-reported as black (1%), Asian (5%), white (27%), Hispanic (32%), and multiethnic (35%).

The total change scores for the treatment and control periods were statistically different using repeated measures analysis ($P \le .001$), with the treatment scores generating more gains. The beginning (T_1) and ending (T_2) scores of the control period were not different ($P = .22$). The beginning (T_2) and ending (T_3) scores of the treatment period were different ($P \le .001$). The total change scores for the treatment period (1.56 ± 3.41) and the control period (0.29 ± 3.43) were also different ($P \le .05$) (Table 2).

Each content standard was analyzed (Table 2). Change scores for Listening and Speaking ($P \le .01$), Mathematical Reasoning ($P \le .05$), and Algebra and Functions 2.3 ($P \le .001$) were statistically greater for the intervention period compared to the control period. Change scores for Algebra and Functions 2.2 ($P = .23$) and Statistics ($P = .41$) were not different for the treatment and control periods (Table 2).

No differences in total change scores for the treatment period were found by age, gender, or ethnicity. There was a significant difference in change scores by class ($P \le .01$). Pretest scores were marginally different among the 3 classes ($P = .06$). As might be expected, the class with the highest pretest score generated the smallest change score, demonstrating regression to the mean.[1]

DISCUSSION

Results suggest that this behaviorally focused nutrition education program

Table 1. Content Standard Areas, Number of Questions, and Examples from the 25-item Evaluation Measure Used

Content Standard Area	Questions (no.)	Example
Algebra & Functions 2.2 *Standard set 2.0* – Students analyze and use tables, graphs, and rules to solve problems involving rates and proportions: 2.2 Demonstrate an understanding that rate is a measure of 1 quality per unit value of another.	3	Jessie reads in the newspaper that to remain healthy and fit, people should exercise for a total of 30 minutes every day. How would this amount of exercise be written as a rate? A. 30 minutes per week B. 160 minutes per week C. 7 days per week D. 30 minutes per day
Algebra & Functions 2.3 Solve problems involving rates, average speed, distance, and time.	7	Lisa counts the number of times her heart beats in 6 seconds. She counted 8. Lisa wants to know how many times her heart beats per minute. What is Lisa's heart rate per minute? A. 60 beats per minute B. 80 beats per minute C. 8 beats per minute D. 48 beats per minute
Statistics 1.1 *Standard Set 1.0* - Students compute and analyze statistical measurements for data sets: 1.1 Compute the range, mean, median, and mode of data sets.	4	What is the average fruit and vegetable intake for the following 4 students? <u>Students' fruit and vegetable servings</u> Lisa 4 Aaron 3 Tange 7 Mya 2 A. 4 B. 16 C. 5 D. 8
Mathematical Reasoning 1.1 *Standard set 1.0* – Students make decisions about how to approach problems: 1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, identifying missing information, sequencing, and prioritizing information, and observing patterns.	5	If Joanna eats 1 entire food item above* and consumes 275 calories total, which of the above food items/beverages did she choose to eat? A. Circus Animal Cookies B. Rold Gold Pretzels C. Hawaiian Punch * 3 different food labels provided
Listening & Speaking 1.9 *Standard Set 1.0* - Students deliver focused, coherent presentations that convey ideas clearly and relate to the background and interests of the audience. They evaluate the content of oral communication: 1.9 Analysis and evaluation of oral and media communications - Identify persuasive and propaganda techniques used in television and identify false and misleading information.	6	You see a famous basketball star on a soft drink commercial. This makes him: A. a mascot B. a slogan C. a logo D. a celebrity endorsement

no. indicates number of questions asked.

impacted academic performance for sixth-grade students at this Tulare County school. These results provided nutrition educators at this school with relevant impact data to influence decision makers such as school administrators and wellness committee members.

Although a multi-school, randomly controlled field trial is ultimately needed to say with confidence that this nutrition education program is linked to academic performance, evaluation research is possible in a small-scale study using a quasi-experimental research design, as has been demonstrated here. A possible strategy for the nutrition education profession might be for other researchers to duplicate this small study with a variety of nutrition education programs. An accumulation of evidence from many programs may synergistically provide broad support with wellness committees and school administrators for the inclusion of nutrition education in schools.

Lack of Studies to Compare Results

A body of evidence exists linking students' health (ie, nutrition status, obesity, and physical activity) and school performance as measured by improved school attendance, academic performance, or cognitive ability[11-14]; however, the link between nutrition

Table 2. Scores (mean ± SD) at Times 1, 2, and 3 and Change Scores (mean ± SD) for Control and Treatment Periods (n = 84) for 5 Content Standard Areas

Content Standard Area	Time 1 (T₁)	Time 2 (T₂)	Time 3 (T₃)	Differences (Change Scores)		
				Control Period $(T_2 - T_1)$	Intervention Period $(T_3 - T_2)$	Intervention Period - Control Period
Algebra Functions 2.2	1.96 ± 0.84	1.96 ± 0.99	2.10 ± 0.96	0.00 ± 0.93	0.13 ± 0.93	0.13 ± 0.18
Algebra Functions 2.3	4.05 ± 1.87	3.61 ± 1.56	4.37 ± 1.82	−0.44 ± 1.52**	0.76 ± 1.47***	1.2 ± 0.28***
Listening and Speaking 1.9	3.07 ± 1.44	3.30 ± 1.35	4.14 ± 1.60	0.23 ± 1.37	0.85 ± 1.58***	0.62 ± 0.27*
Mathematical Reasoning 1.1	3.33 ± 1.15	3.26 ± 1.04	3.54 ± 0.87	−0.07 ± 1.15	0.27 ± 1.08*	0.35 ± 0.21*
Statistics 1.1	1.77 ± 1.30	1.94 ± 1.22	1.89 ± 1.37	0.17 ± 1.32	−0.05 ± 1.34	−0.21 ± 0.26
Total score	14.19 ± 4.79	14.48 ± 4.51	16.04 ± 4.90	0.29 ± 3.43	1.56 ± 3.41***	1.27 ± 0.64*

SD indicates standard deviation.
*$P < .05$; **$P < .01$; ***$P < .001$.

education and academic performance measured by content standards achievement has not been previously reported.

It is feasible to contrast these results to studies linking nutritional status, overweight status, and levels of physical activity to general student achievement and school attendance. Substantial research exists supporting nutrition's effect on school academic performance. The 3 areas are (1) consumption of breakfast, (2) iron deficiency, and (3) overweight/obesity.[11-13] Adding a morning meal can result in further academic gains, and reducing iron deficiency can enhance cognitive function.[13] Overweight and obesity are associated with lower levels of academic performance.[12] In addition, physical activity has been found to promote concentration,[11] and devoting academic time to a physical education program does not interfere with academic performance.[14] Using a guided goal-setting strategy,[5] *EatFit* aims to increase the frequency and quality of morning meals consumed, promote behaviors to increase intake of iron-rich food, and teach skills and behaviors that encourage physical activity and possibly reduce the risk of overweight.[4] The intervention may have the dual effect of enhancing math and English skills through experiential activities while promoting dietary and physical activity behaviors[20] consistent with the United States (US) Dietary Guidelines[15] and the US Surgeon General's Report.[16]

Changes to Intervention Based on Research Results

The participants' overall test scores indicated that the nutrition education program had an impact on academic performance. The authors observed improvement in 3 of the 5 content areas assessed and used this information to make minor changes to the intervention to address the other 2 content standards differently and/or in more depth.

National Application

Federal legislation requires all states to adopt education standards in at least English and mathematics.[17] In 2001, the No Child Left Behind Act established requirements for state standards and assessment systems.[18] During the 2005-2006 school year, every state administered assessments for English and mathematics in third through eighth grades and in high school.[19] To comply with the federal legislation,[18,19] California public schools have developed or are in the process of developing their school wellness policies. These policies include setting goals for nutrition education and physical activity. The present research provides some evidence that teaching nutrition education concepts can enhance specific math and English content standards in this school as well as change health behaviors,[20] thus serving a dual purpose for public schools.

The results of this study will serve as a marketing tool for wellness committee members in this Tulare County school. However, the importance of addressing academic performance via content standards is not limited to nutrition educators wanting access to the public schools in Tulare County, California. The methods the authors developed for this study are applicable to other situations where nutrition educators are seeking to provide evidence of program impact on academic performance.

Limitations and Recommendations for Future Research

Because of school constraints, the authors used convenience sampling and a quasi-experimental design for this pilot study. Generalization of study results is limited to the sixth-grade students in the participating school.[10] The authors cannot say with certainty that background learning did not influence the results; however, the classroom teachers reported there was no crossover between the *EatFit* content and the other class content during the treatment period (ie, T₂ to T₃). A testing effect is another threat to validity for consideration.[10] However, the authors observed no

differences in test scores when students took the test the second time (T_2). In addition, students may have matured mentally and physically between the first 5-week period and the second. The differences found by class could also be attributed to the factors discussed above. This potential interaction deserves additional study. Further research should include a randomized, controlled field trial with a sufficient number of classrooms for analysis on the classroom level.[21] In the meantime, this study provides preliminary evidence of an effect.

IMPLICATIONS FOR RESEARCH AND PRACTICE

This pilot study provides evidence to document the academic value of including *EatFit* in the sixth-grade curriculum at this Tulare school. Nutrition educators can show school administrators and wellness committee members that *EatFit* can positively impact academic performance, concomitant to its primary objective of promoting healthful eating and physical activity. Researchers who wish to replicate this research process with other nutrition education programs may find these study procedures helpful.

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