Research Article

Changes in Fruit and Vegetable Consumption of Third-Grade Students in Body Quest: Food of the Warrior, a 17-Class Childhood Obesity Prevention Program

Barbara J. Struempler, PhD[1]; Sondra M. Parmer, PhD[1]; Lisa M. Mastropietro, MS[1]; Dilbur Arsiwalla, PhD[2]; Robert R. Bubb, MS[3]

ABSTRACT

Objective: To increase fruit and vegetable (FV) consumption of youth in Body Quest: Food of the Warrior (BQ), a childhood obesity prevention program.

Design: Quasi-experimental.

Setting: Supplemental Nutrition Assistance Program–Education eligible schools (n = 60).

Participants: Third-grade students (n = 2,477).

Intervention: Treatment groups (n = 1,674) self-reported foods consumed through the School Lunch Program for 17 weekly assessments; they participated in BQ curriculum, iPad app education, and weekly FV tastings. Control groups (n = 803) completed only pre- and post-assessments.

Main Outcome Measure: Weekly FV consumed through School Lunch Program.

Analysis: ANCOVA and growth modeling.

Results: From before to after the program, the treatment group demonstrated significant, moderate increases in fruit ($P < .01$) and vegetable ($P < .001$) consumptions, increasing from 7 to 8 weekly FV servings. After the program, the treatment group consumed significantly ($P < .001$) more FV than the control group. Fruit and vegetable consumption increased to class 10 and then stabilized. From before to after the program, all FV predictors were significantly higher and included gender (vegetables), race (FV), and free/reduced lunch (fruit).

Conclusions and Implications: Nutrition programs can increase FV intake. Even moderate increases in FV intake can be an initial step for the prevention of chronic disease.

Key Words: child, rural health, comparative effectiveness research, overweight, fruit, vegetable (*J Nutr Educ Behav*. 2014;46:286-292.)

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INTRODUCTION

Two health issues are common among today's youth. First, an alarming number of children are overweight and obese.[1] Second, consumption of fruits and vegetables (FV) among youth is less than ideal.[2–4] When eaten in place of high-calorie foods, foods of lower energy density, such as FV, can contribute to weight management.[5] People who live in states reporting higher FV intakes are less obese than those in states reporting lower FV intakes.[1]

For 2 decades, school-based nutrition intervention programs have attempted to increase children's FV intake.[6–11] The results are diverse, documenting only fruit consumption increases,[6,9,10] both fruit and vegetable increases,[7] or no FV increases.[8,11] Attributes of these studies include physical activity, gardening, tastings, parent education, school food service training, and classroom activities.[6,9,10] The duration of these programs and exposure to FV also have significant impacts on FV intake.[2,4]

This study used the rising obesity prevalence in youth as motivation to develop a childhood obesity prevention program, Body Quest: Food of the Warrior (BQ). Body Quest is a 17-class, elementary school–based program designed to increase FV consumption, increase physical activity, and promote family involvement. The purpose of this study was to report changes in FV consumption of third-grade students who participated in BQ and also the School Lunch Program.

METHODS

Design

Body Quest was an untreated control group, quasi-experimental design

[1]Expanded Food and Nutrition Education Program and Supplemental Nutrition Assistance Program–Education, Auburn University, Auburn, AL
[2]Department of Psychology, University of Northern Iowa, Cedar Falls, IA
[3]Department of Human Development and Family Studies, Auburn University, Auburn, AL
Address for correspondence: Barbara J. Struempler, PhD, EFNEP and SNAP-Ed Program, 207 Duncan Hall, Auburn University, Auburn, AL 36849; Phone: (334) 844-2217; Fax: (334) 844-2507; E-mail: struebj@auburn.edu

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program with dependent pre- and post-assessment samples. Participants were third-grade students in Alabama schools who were eligible for Supplemental Nutrition Assistance Program–Education (SNAP-Ed). This requires a school to have ≥ 50% students receiving free or reduced-price lunch (FRL). The Institutional Review Board at Auburn University approved this research. Informed consent was obtained from parents of participating students and standardized scripts were used to recruit students. Students were not required to give assent, and those students whose parents did not provide consent were given alternate activities with the classroom teacher. The number of nonparticipating students was < 1%.

The BQ curriculum, materials, and 7 iPad apps were developed by the Alabama Cooperative Extension System and are based on the Experiential Learning Theory.[12] This theory allows students to learn through reflection about their experiences. Body Quest materials (eg, card decks, vow cards, family discussion prompts) were focused and developmentally appropriate.

Each SNAP-Ed Extension, full-time, nutrition paraprofessional educator (n = 24) worked with 6 third-grade classes. Three classes were designated as either a treatment (iPad education) or control group. Treatment groups were in different schools from control groups. Schools were randomly assigned, with 1–3 classrooms per school.

Intervention

During the 2011–2012 school year, educators provided 17 weekly, 45-minute BQ classes to the treatment group. Classes consisted of pre-assessments (weeks 1–2), intervention (weeks 3–15), and post-assessments (weeks 16–17). During the intervention, 6 nutrition topics were sequentially taught: trying new foods, food groups, balanced meals, food nutrients, healthy snacks, and extending FV message to others. At every intervention class, FV were emphasized. During the 6 traditional, educator-led lessons, instruction included lecture and interactive activities using a BQ card deck. In the following week, a nontraditional reinforcement lesson was taught via 1 of 7 iPad apps. For the treatment group only, FV tastings were provided at each class and family members received weekly take-home activities. Control groups were given pre- and post-assessments, but no intervention, FV tastings, or family take-home messages.

> iPad apps engage young technology users.

Tastings were integral as they exposed students to FV and removed accessibility barriers students may face at home. Tastings consisted of 4 fresh FV that rotated weekly. Fruits and vegetables were chosen based on accessibility in local grocery stores, and also by frequency of use in the School Lunch Program. Fruits included blueberries, cantaloupe, strawberries, oranges, pears, pineapples, and peaches. Vegetables included tomatoes, squash, broccoli, cauliflower, pickled okra, carrots, bell peppers, spinach, and dark leafy lettuce. A 1-oz cup of ranch dressing was distributed with vegetables for dipping.

Instrumentation

The educators collected demographic data at the beginning of the study. Each school administrator provided students' genders and race. Free or reduced-price lunch data were provided by the Alabama Department of Education.[13] Each school's Child Nutrition program director reported on participation in the Fresh Fruit and Vegetable Program (FFVP).[14]

The researchers developed a What's for Lunch (W4L) checklist to assess FV consumption of students eating a school lunch. Criteria for the checklist were that it had to be easy to use and time-efficient for students and classroom teachers, yet monitor consumption change. Students' self-reported consumption was defined as the portion or serving of each food provided by the School Lunch Program that was eaten. Educators listed all available food items on the form; readability varied upon food items listed. Besides food items, only a few words were on the form (eg, name, day, date). Age-appropriate options for students to report were simple words such as "yes" and "no," "foods not served," and "did not eat a school lunch today."

Educators customized the W4L checklist based on each school's lunch menu for a 5-day period and then personalized the W4L checklist with the names of students. Forms were distributed before the corresponding 5-day period. Immediately after lunch, students reported on the W4L checklist whether they ate each food provided by the School Lunch Program. Classroom teachers assisted students with any questions about completing the W4L checklist. The educators collected completed forms. Treatment group students completed the W4L checklist each school day for the entirety of BQ. Control group students completed the W4L checklist during the 2 weeks of pre- and post-assessment.

Coding and Data Entry of Fruits and Vegetables

Although all foods from the school lunch menu were listed on the W4L checklist, only FV were analyzed. Educators entered FV data into a shared network site using codes for individual food items. For this study, fruits were collapsed into 1 category, as were vegetables.

Validity and Reliability of the W4L Checklist

For the past 8 years in Alabama SNAP-Ed, the W4L methodology was used in classrooms for students to self-report food items consumed through the School Lunch Program. For the current study, face validity of the W4L checklist was determined from a 6-week BQ pilot study that included 800 students in 40 classrooms in 40 Alabama counties. The W4L checklist was customized with appropriate foods, distributed to third graders, and collected by educators. Classroom teachers facilitated daily reporting of school lunch foods by students immediately after lunch. The evaluation allowed educators (n = 24) and teachers (n = 40) to provide input on strengths or weaknesses of the form. Written questions also probed for usefulness, ease of use, and readability. In addition, university faculty, school administrators, and parents reviewed materials and provided written feedback. The W4L checklist was revised to its final format after evaluating feedback. Intra-class correlations (ICCs) were analyzed as a measure of consistency and instrument stability for FV consumption. Reliability across the 17 classes was excellent for both fruit (ICC [3, 17] = 8.35; $P < .001$) and vegetable consumption (ICC [3, 17] = 0.908; $P < .001$).

Subjects

Third-grade students (n = 2,477) from 60 schools in 38 Alabama counties participated in BQ. Treatment group students (n = 1,674) were 51% male, 46% black, and 54% non-black, predominantly white. Student demographics in the control group (n = 803) paralleled those in the treatment group on gender ($\chi^2[1] = 0.197$; not significant) and race ($\chi^2[1] = 0.827$; not significant). All students came from schools with ≥ 50% students receiving FRL; 46% of students came from schools classified as high FRL (ie, 75% to 100% of students receiving FRL). One third of treatment and control students came from schools participating in the FFVP. However, students from schools with FFVP were more likely to be in the treatment condition ($\chi^2[1] = 9.82$; $P < .05$). To control for nonequivalence in sampling, FFVP was used as a covariate in all between-group analyses.

Statistical Analysis

Fruit and vegetable consumption was defined as self-reported intakes of FV eaten from those provided by the school lunch. The researchers calculated FV consumption based on 17 5-day periods. Data are reported based on this definition. In addition, analyses were conditional or unconditional when predictors were or not were included, respectively.

A post hoc power analysis with the program G*Power (version 3.1.7, Buchner, Erdfelder, Faul & Lang, Kiel, Germany, 2013) was used. Missing data for growth modeling were imputed using the full-information maximum likelihood feature in Mplus version 6.11 (Muthén & Muthén, Los Angeles, CA, 2010). Missing data were estimated based on present data for each student. ANCOVA data were analyzed using listwise deletion. Data collected across time points were normally distributed.[15] Because these data represented consumption habits, outliers were retained in the analyses.

Analyses were conducted using 2 data sets. Data set 1 analyzed treatment and control groups for differences in FV consumption within and between conditions of treatment. A repeated-measures ANCOVA measured changes from before to after the program, and an ANCOVA analysis was performed on postintervention data (Figure 1). Covariates included pre-intervention FV consumption, gender, race, FRL, and FFVP.

Data set 2 analyzed only treatment group students (n = 1,674) for changes in FV consumption across the program (Figure 2). Growth modeling examined overall change in FV consumption using Mplus. For analyses, the 17 classes, from pre1 to post2, were combined and averaged to 8 time points, each consisting of 2 classes, except for class 7, which consisted of 3 classes. This clustering was mid-intervention to prevent skewing end points.

For the growth modeling of data set 2, time was centered after the program. At the onset of analyses, a series of unconditional growth models were estimated to examine changes in FV consumption across the 17 classes. The first model tested in the series was an unconditional linear growth model. The next models tested were quadratic and latent basis, and estimated nonlinear change. The model with the better fit, the nonlinear latent basis model, was chosen.[16] Using the nonlinear latent basis model, the last time point was fixed at 0 and the first time point was fixed at –1. All other time points were freely estimated, allowing for an optimal shape. The intercept mean indicated the average FV consumption after the program. The nonlinear slope indicated change from the first (pre) to last classes (post).

In data set 2, the initial analysis of FV consumption was unconditional and did not include predictors (Figure 2: overall fruit and overall vegetable). However, all remaining analyses in this set were conditional and

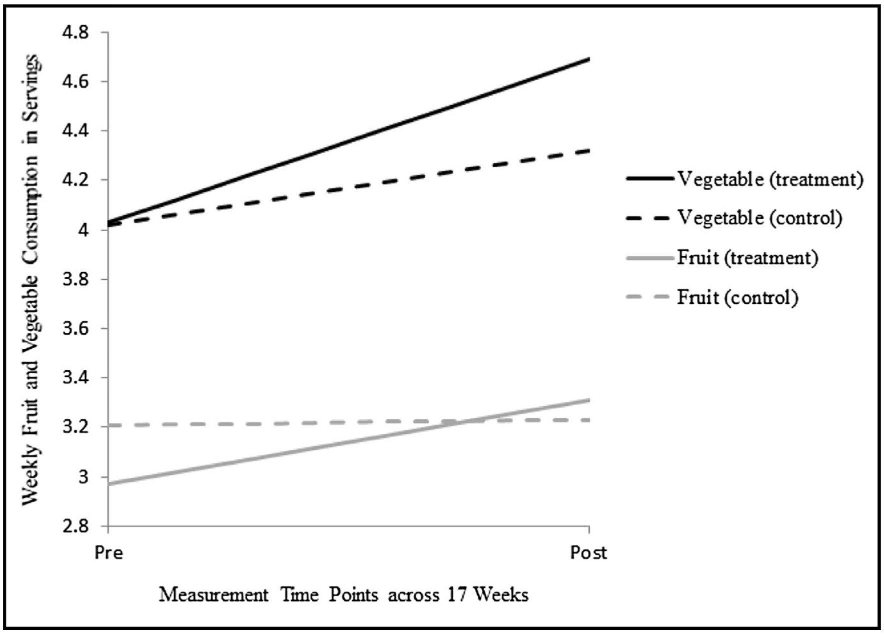

Figure 1. Changes in fruit and vegetable consumption of third-grade students in treatment (n = 1,674) and control (n = 803) groups, who participated in a 17-class Body Quest program. Students in the treatment group significantly increased consumption for both fruits ($P < .01$) and vegetables ($P < .001$) from pre- to post-intervention. Students in the treatment group consumed significantly higher fruits ($P < .001$) and vegetables ($P < .001$) than the control condition when pre-intervention consumption was controlled. Repeated measures ANCOVA used for statistical analysis.

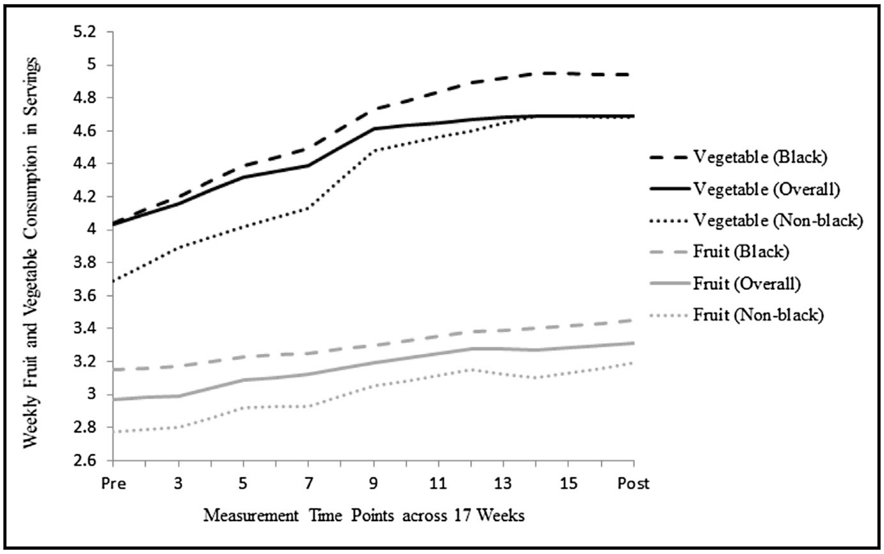

Figure 2. Changes observed at each class in overall fruit and vegetable consumption, using race as a predictor for third-grade students in the treatment group (n = 1,674), who participated in the 17-class Body Quest program. Overall fruit and vegetable consumptions significantly ($P < .001$) increased from pre- to post-intervention, with most of the change taking place by class 10. Using race as a predictor, black students in the treatment group consumed significantly higher fruit ($P < .001$) and vegetables ($P < .05$) than non-black students when pre-intervention consumption was controlled. Time points were collapsed for visual representation. Growth modeling used for statistical analysis.

included 4 demographic predictors: (1) gender, (2) race, (3) FRL, and (4) FFVP (see Figure 2 for race and the Table for all predictors). For data analyses, FRL was divided into 2 groups based on the percentage of students receiving FRL in schools: low = 50% to 74% and high = 75% to 100%.

RESULTS

Fruit and Vegetable Consumption Between Students in Treatment and Control Groups

A series of ANCOVA models examined FV consumption from pre-intervention to post-intervention and at post-intervention (Figure 1). A repeated-measures ANCOVA on fruit consumption indicated an interaction effect between pre and post time points and the control and treatment conditions ($F[1, 1{,}272] = 29.191$; $P < .001$; $\eta^2 = 0.021$). An ANCOVA performed on post data, while controlling for pre and demographic data, indicated a significant difference between control and treatment conditions ($F[1, 1{,}271] = 24.453$; $P < .001$; $\eta^2 = 0.019$).

As illustrated in Figure 1, a repeated-measures ANCOVA on vegetable consumption indicated an interaction effect between pre and post time points and the control and treatment conditions ($F[1, 1{,}322] = 23.958$; $P < .001$; $\eta^2 = 0.018$). An ANCOVA performed on post data, while controlling for pre and demographic data, indicated a significant difference between control and treatment conditions ($F[1, 1{,}321] = 15.899$; $P < .001$; $\eta^2 = 0.012$).

A post hoc power analysis determined that there was sufficient power to detect a difference in treatment conditions after the intervention. The power to detect an effect of the size obtained for fruit ($\eta^2 = 0.019$) was determined to be 0.95, $F[1, 1{,}271] = 24.453$, $P < .001$; vegetables ($\eta^2 = 0.012$) was determined to be 0.74, $F(1, 1{,}321) = 15.899$, $P < .001$ when controlling for pre and demographics. Although the size of the effects were modest (between a small and medium effect), they were positive. There are many influences on whether children eat FV, such as availability and healthy eating emphases at home, peer consumption and attitudes, and the portrayal of less healthy food alternatives.

Fruit and Vegetable Consumption of Students in Treatment Group

Unconditional model. A series of unconditional growth models examined

Table. Changes in Fruit and Vegetable Consumption Means From Pre-Intervention to Post-Intervention and Between-Group Differences Using 4 Predictors of Third-Grade Students in the Treatment Group (n = 1,674) of a 17-Class Body Quest Program

	Fruit		Vegetable	
	Pre	Post	Pre	Post
Gender				
Female	3.04	3.40	3.91	4.70*
Male	3.05	3.45	3.88	4.95
Race				
Black	3.15***	3.45***	4.04**	4.94*
Non-black	2.77	3.16	3.69	4.68
Free and reduced-price lunch				
Low	2.72***	3.12***	3.91**	4.65
High	3.20	3.53	4.21	4.83
Fresh Fruit and Vegetable Program				
With	3.16***	3.38	4.01	4.87
Without	2.75	3.26	4.06	4.64

*$P < .05$; **$P < .01$; ***$P < .001$.
Note: All within-group comparisons for each predictor demonstrated significant increases from pre to post ($P < .001$). Repeated measures ANCOVA used for statistical analysis.

FV consumption across the 17-class period. The first model tested was an unconditional linear growth model. For both FV, the model had good fit to data. An analysis of model fits indicated a nonlinear change across time points. The latent basis model for both conditional and unconditional analyses was chosen because it provided the best approximation to the pattern of FV change.

Overall, fruit consumption significantly ($P < .001$) increased by 0.35 weekly servings from pre (2.97) to post (3.31) (Figure 2). Results indicated the total amount of intra-individual change from pre to class 1 was 10%, with an increase of 45% at class 5. Most of the change (90%) had taken place by class 10 and 100% of change at post.

Overall vegetable consumption significantly ($P < .001$) increased by 0.66 weekly servings from pre (4.03) to post (4.69) (Figure 2). Results indicated the total amount of intra-individual change from pre to class 1 was 21%, with an increase of 55% at class 5. Most of the change (98%) had taken place by class 10, following a stable pattern with 100% of change at class 12 and thereafter.

Conditional model. A series of conditional nested growth models were fit to examine the role of 4 demographic predictors of students: (1) gender, (2) race, (3) FRL, and (4) FFVP. The prediction of the intercept indicating differences between groups (eg, female/male) at post in FV consumption also were examined (Table). For fruit consumption, predictors included race and FRL. For vegetable consumption, predictors included gender and race. When using the slope to examine FV consumption differences over time (pre/post), all within-group predictor comparisons demonstrated significant ($P < .001$) increases from pre to post (Table).

Race was the only predictor common to both FV consumptions, predicting the intercept (Figure 2 and Table). For fruits, black students reported significantly ($P < .001$) higher fruit consumption at the intercept (3.45) compared with non-black students (3.16). For vegetables, black students reported significantly ($P < .05$) higher vegetable consumption at the intercept (4.94) compared with non-black students (4.68).

Free or reduced-price lunch was another predictor of the intercept for fruit consumption (Table). Students attending schools with high FRL (75% to 100%) reported significantly ($P < .001$) higher fruit consumption at the intercept (3.53) compared with consumption of those attending schools with low FRL (50% to 74%; 3.12).

Gender was a predictor of the intercept and slope in vegetable consumption (Table). Males reported significantly ($P < .05$) higher vegetable consumption at post (4.95) compared with consumption at post (4.70) for females. Results showed females and males reported similar vegetable consumption at pre (3.91 and 3.88, respectively), but consumption by males increased at a significantly ($P < .05$) higher rate compared with consumption by females.

Finally, FFVP was a predictor of the slope in fruit consumption (Table). Students in nonparticipating FFVP schools reported lower fruit consumption at pre (2.75) compared with students attending schools that did participate (3.16). Student consumption at nonparticipating schools caught up with participating schools by post (3.26 and 3.38, respectively).

DISCUSSION

Body Quest was a school-based nutrition intervention successful in moderately increasing FV consumption in students. After the intervention, there were significant increases in both FV consumptions for treatment group students compared with control group students. From pre to post, the treatment group significantly increased both FV consumptions. When FV are combined, students consumed 7 and 8 weekly FV servings at pre and post, respectively. According to the 2011–2012 National School Meal Standards,[17] a minimum of 2.5 total FV must be offered each day, totaling 12.5 FV offered per week. Based on these guidelines, students increased weekly school lunch FV consumption from 56% to 64% from pre to post, respectively. The moderate FV increase of 1 serving/wk in this study is consistent with the literature. Moreover, authors in this study concur with other researchers that a moderate increase is an initial step for chronic disease prevention efforts.[18,19]

> Modest increases in children's fruit and vegetable consumptions can be achieved through nutrition education.

Although only a moderate FV increase was found, the BQ intervention resulted in more pronounced effects for vegetables than fruits. Previous studies reported difficulty in increasing children's vegetable intake owing to predisposition for sweet, rather than bitter, foods. Researchers suggested that repeated exposure to vegetables could overcome this obstacle.[2,20] Body Quest traversed this obstacle by repeatedly exposing students to vegetable tastings, resulting in an increase in vegetable consumption.

In BQ, both FV increases followed similar patterns of positive change. There were increases in FV consumption up to class 10 followed by a stable pattern to the end of the study. This finding adds to emerging literature to better quantitate the number of classes needed for nutrition behavior change. An understanding of the minimum nutrition education dosage needed to achieve measurable behavior change is evolving. Previous studies have shown inconsistent increases in FV consumption relative to the duration of education. Increases in both FV were seen in a study conducted for 12 weeks.[7] However, other studies showed no increases in FV when conducted for a longer duration of 2 years.[8,11]

For treatment group students, some characteristics were predictors for FV consumption. Race was a common predictor for both FV consumptions. Compared with white children, black children have a higher risk for obesity and have not always shared equally in obesity-related declines.[21] Fruit and vegetable increases were found in black students, which suggests that BQ can help reduce the disparity gap between black and nonblack students.

Gender was another FV intake predictor, but only for vegetable consumption. Males increased vegetable consumption at a higher rate and consumed significantly more vegetables than females at post. These results are inconsistent with the literature. Other studies have found higher vegetable consumption, as well as fruit consumption, among females.[20,22] Both males and females participating in BQ received identical education and tools, and were equal in number. Hence, the researchers are unsure why these results were inconsistent.

Another noteworthy predictor concerns BQ treatment group students whose schools participated in the FFVP. Although BQ students with FFVP consumed more fruits before the intervention, the change in fruit consumption from pre to post was greater for BQ students who did not receive FFVP. Although both programs promote intakes of FV, BQ students without FFVP were able to achieve similar fruit consumption after 17 BQ classes. This finding supports the positive impact of BQ.

The statistical analyses used in BQ were novel within the nutrition literature. Growth modeling examined the pattern of change in FV consumption across 17 classes. Some studies only examined absolute change by observing pre, post, and sometimes mid-time assessments.[6,7] These studies missed the opportunity provided by growth modeling to examine data patterns.

Body Quest was 1 of the first blended nutrition interventions to use self-directed, interactive teaching via iPads combined with educator-led classroom instruction. Students benefited by learning traditional nutrition concepts in a nontraditional pedagogy via the 7 iPad apps.

Limitations

A common measurement in obesity studies is body mass index. In this study, changes in FV intakes were not correlated with body mass index because this was not the study's intention. In addition, students self-reported their FV school lunch intake, which allowed for personal error, although this was controlled for as much as possible through immediate reporting. Students also could have been influenced by social desirability, which could alter reporting of foods. Another limitation was that socioeconomic status was recorded for each school, but not for each student. However, all schools were SNAP-Ed eligible. If individual socioeconomic status had been obtained, it could have been useful when comparing these results with other findings. Finally, the FV consumption increase was statistically significant, although actual consumption was not appreciably increased.

IMPLICATIONS FOR RESEARCH AND PRACTICE

These findings support school-based childhood obesity prevention programs as a means to moderately increase FV consumption through the School Lunch Program. Similar programs can aid in the prevention of childhood obesity by teaching children the importance of a healthy diet, engaging them in nutrition-related activities, and exposing them to FV. With regard to nutrition education dosage, a better understanding of the reasons for the leveling-off of consumption after 10 weeks is needed. Moreover, follow-up with the same students would be helpful to determine the lasting effects of BQ. Long-term behavior change to indicate an adoption of FV consumption and also predictors of FV consumption are needed.

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