Austin Journal of Pediatrics

Open Access

Austin Publishing Group

Research Article

Impact of Body Quest: Food of the Warrior on Key Indicators for Childhood Obesity Prevention

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Received: May 05, 2015; **Accepted:** September 08, 2015; **Published:** September 28, 2015

Abstract

Strategies to combat childhood obesity are a top public health priority as overweight and obesity rates in children have risen to alarming rates over the past two decades. Overweight and obese children are at greater risk for many adult on-set diseases such as cardiovascular disease, diabetes, and bone and joint problems, as well as adult obesity. Determining effective childhood obesity prevention initiatives is one step toward combating early on-set of disease and reversing these staggering statistics in children. Body Quest is an initiative developed to combat childhood obesity in a SNAP-Ed eligible, third-grade population. The purpose of this study was to evaluate the effect of the BQ curriculum on behaviors and intentions related to obesity prevention measures in 3,568 third-grade students. Students were randomized into treatment (BQ education) or control. Treatment students were exposed to vegetables bi-weekly during the 17-week BQ curriculum.Treatment students reported significant improvements,compared to control students ($p<0.001$), on five key indicators related to accepted obesity prevention initiatives: increasing fruit and vegetable intake, physical activity and breakfast consumption; as well as reducing screen time and sugar sweetened beverages. These outcomes add to the evidence that educationally appropriate, engaging programs, targeted to children can positively impact several key indicators to assist with obesity prevention efforts.

Keywords: Childhood obesity; Fruit and vegetable consumption; Low-income; Elementary; Obesity prevention

Abbreviations

FV: Fruits and Vegetables; PA: Physical Activity; SSB: Sugar Sweetened Beverages; SNAP: Supplemental Nutrition Assistance Program; SNAP-Ed: Supplemental Nutrition Assistance Program-Education; BQ: Body Quest; NEP: Alabama SNAP-Ed Nutrition Education Program; FRL: Free or Reduced Price Lunch; IRB: Institutional Review Board; W4L: What's for Lunch; BMI: Body Mass Index

Introduction

Obesity prevention is the paramount of public health and nutrition education initiatives in the United States. Obesity and obesity-related diseases plague 34.9% of American adults [1]. The increase in childhood obesity during the past two decades is even more alarming. Currently, more than one third of children and adolescents are overweight or obese, with obesity affecting 18% of children ages 6-11 years [2]. From 1980 to 2012, the percent of obese children age 6-11 years more than doubled (7% to 18%) [2]. Obese youth are at greater risk for cardiovascular disease, diabetes, bone and joint problems, as well as adult obesity [2].

School-age children represent an important target for nutrition education. Early lifestyle and behavior changes, such as increasing Fruit and Vegetable (FV) intake and Physical Activity (PA), reducing Sugar-Sweetened Beverage (SSB) intake and screen time, and eating breakfast may reduce, or prevent, the chronic disease burden associated with obesity in this vulnerable population. Limited-resource individuals, such as Supplemental Nutrition Assistance Program (SNAP) recipients, are also disproportionately affected by obesity and related chronic diseases. Reaching this population through SNAP-Education (SNAP-Ed) is a key strategy for tackling adult and childhood obesity and health issues. One promising strategy to reach the SNAP population is through *Body Quest: Food of the Warrior* (BQ) [3]. Body Quest is a school-based initiative of the Alabama SNAP-Ed Nutrition Education Program (NEP). Body Quest is a childhood obesity prevention program for elementary youth, particularly third graders in schools with 50% or more of students receiving free or reduced price lunches (FRL).

The purpose of this study was to evaluate the effect of the BQ initiative on behaviors and intentions related to accepted obesity prevention mediators (such as increasing FV intake, increasing PA, reducing screen time, reducing SSB and eating breakfast) in an elementary age population. Positive behaviors adopted during childhood are likely to continue into adulthood.

Methods

Study population and recruitment

In fall 2013, 3,568 third-grade students from 80 schools in 47 Alabama counties were recruited by SNAP-Ed Extension nutrition educators (n=24) to participate in BQ. Classes were taught in SNAP-Ed eligible schools. To be eligible for SNAP-Ed, a school must have ≥ 50% of students receiving FRL. Extension educators read standardized recruitment scripts aloud to students in the classroom. Parents of participants provided signed written consent prior to student

Citation: Parmer SM, Streumpler B, Griffin JB and Funderburk KM. Impact of Body Quest: Food of the Warrior on Key Indicators for Childhood Obesity Prevention. Austin J Pediatr. 2015; 2(1): 1019.

Table 1: Demographic characteristics of Body Quest participants.

Characteristic	Treatment (n=2,126)	Control (n=1,442)
Sex		
Male	52%	49%
Female	48%	51%
Ethnicity		
Hispanic	5%	4%
Non-Hispanic	95%	96%
Race		
African American	40%	33%
Caucasian/Other	58%	65%
Other	2%	2%

participation in any BQ activity. Auburn University's Institutional Review Board (IRB) approved this study.

Instrumentation

What's for Lunch, iChallenge and *All About Foods* assessments were created to document students' knowledge, intentions and behaviors for diet and PA between pre- and post-assessments. Participant ethnicity and racial background were provided by each school administrator (Table 1), and were reported using the following categories: Non-Hispanic or Hispanic; White, Black or African American, American Indian or Alaska Native, Asian, Hawaiian or Pacific Islander, and Multiracial.

Protocol

Body Quest classes were designated as either treatment (BQ education) or control group. Treatment students were in different schools from control students. Schools were randomly assigned with one to five classes per school. Nutrition educators provided 17 weekly, 45 minute BQ classes to treatment students. The BQ curriculum is described in detail elsewhere [3]. For treatment students only, vegetable tastings were provided at alternating classes and family members received weekly take-home activities. Tastings consisted of six raw vegetables: bell peppers, broccoli, carrots, cauliflower, spinach and tomatoes. A one-ounce cup of ranch dressing was distributed with vegetables. Delayed intervention was provided to control students after completion of all post-assessments.

The *Body Quest: 2013-2014 Protocol*, an internal tool, was developed to help Extension educators manage the activities in each BQ class. It provided weekly step-by-step instructions for implementing a BQ class.

Two assessments were conducted during BQ for treatment and control students. Assessments included a *What's for Lunch* (W4L) checklist and either an *iChallenge* (treatment) or *All About Foods* (control) assessment. *What's for Lunch* was administered at six time points using traditional pencil and paper. The *iChallenge* and *All About Foods* were administered at four time points using electronic clicker devices, with data reported for pre-and post-assessments only. Between these two assessments, changes in students' knowledge, intentions and behaviors for diet and PA were documented.

What's for Lunch has been used by Alabama SNAP-Ed for the past 9 years. The W4L checklist was used to assess FV consumption of students eating a school lunch at six time collections periods (weeks 1, 4, 6, 8, 10 and 17). Criteria for the checklist were to be easy-to-use and time-efficient for students and classroom teachers, yet monitor consumption change. Students' self-reported consumption was defined as eating the portion or serving of each food provided by the School Lunch Program. Students completed the W4L immediately after lunch for five consecutive days during each of the six assessment periods. Validity of the W4L tool has been reported elsewhere [3].

Before the first *iChallenge* and *All About Foods* assessment, all students received the *Learning to Use a Clicker* training. *Learning to Use a Clicker* consisted of 36 questions read aloud by educators; students answered questions electronically using a hand-held clicker device. The tool was developed to acclimate students to clicker technology, as well as how to answer assessment questions using the hand-held clicker device. Clicker technology has proven beneficial as a data collection tool; it is technologically forward, and relatively easy to use with this population [4].

The *iChallenge* (treatment) and *All About Foods* (control) were developed to assess knowledge, intention and behavior for dietary and PA characteristics of students at pre- and post-assessment. Assessments were given at weeks 1, 7, 12 and 17. Both assessments contained 36 questions developed to be easy-to-read with yes/no and multiple choice answers. Questions were read aloud by educators; students answered questions electronically using a hand-held clicker device. During *iChallenge* assessments, treatment students answered a preference question about each of the six vegetables offered during the corresponding "veggie tastings". Control students answered identical questions in *All About Foods*, though questions pertaining to the vegetable tasting were omitted. A place holder question was used instead.

Statistical analysis

Only information on FV intake from the W4L checklist was analyzed. Fruits were collapsed into one category, as were vegetables. Changes in student FV consumption were analyzed using a repeated measures Analysis of Covariance (ANCOVA). Changes were examined within and between treatment and control groups. *What's for Lunch* data were reported as a percentage using the number of self-reported FV consumed through the School Lunch Program for six, five-day periods. Effect size was determined using an eta-squared (η^2) test. The *iChallenge* and *All About Foods* data were analyzed using a series of Pearson independent-samples chi-square (χ^2) tests and reported as a percentage of student responses. A significance level (α) of $p< 0.001$ was used for the comparisons. All analyses were performed with Statistical Package for the Social Sciences (SPSS), version 21(Chicago, IL).

Results

During the 2013-2014 school year, a total of 3,568 third-grade students participated in BQ (Table 1). The retention rate was 94%. All students came from schools with 50% or more students receiving FRL.

Fruit and vegetable consumption

There was a significant interaction between the treatment type and the six W4L assessment time points, $F (4.83, 9293.6) = 22.14$, $p < 0.001$. At pre-assessment, the control group had a higher percent consumption than the treatment group, though not statistically significant (53.5% versus 49.3% respectively), $F(1,198.22)=5.90$, $p=0.016$; $\eta^2=0.03$. At post-assessment, the treatment group had a higher percent consumption than control (61.5% versus 54.3%

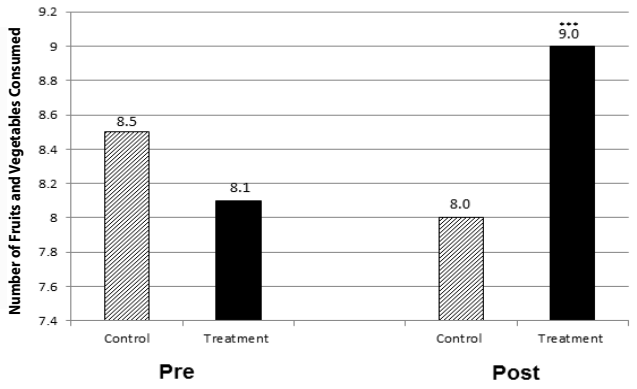

Figure 1: Number of Fruits and Vegetables consumed over a 5 days period through the School Lunch Program. At post-assessment the treatment group had a higher consumption than the control group (p<0.001).

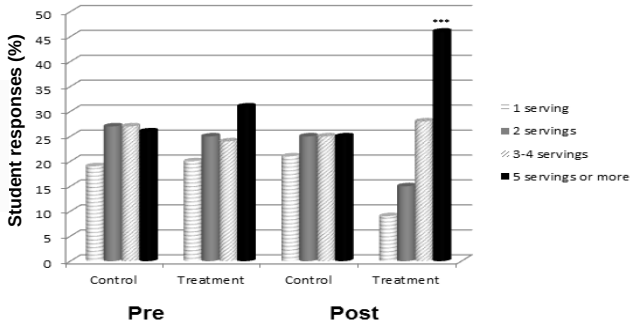

Figure 2: Student responses (%) to the question, "How many servings of fruits and vegetables do you think are healthy to eat each day?" At pre-and post-assessment, the treatment group demonstrated a higher percent of correct responses by students than the control group (p= 0.004: p <0.001).

respectively), F (1,193.74)= 13.46, $p < 0.001$; η_p^2=0.07. Figure 1 shows the number of FV consumed each week at pre- and post-assessment in control and treatment groups. In the treatment group, a within group analysis showed a significant increase in the percent of FV consumed across the six time points, with a medium effect size, F(4.77, 5398.17) = 76.35, $p < 0.001$.

Fruit and vegetable knowledge

During *iChallenge* and *All About Foods*, students were asked, "How many servings of fruits and vegetables do you think are healthy to eat each day?" Response options were "1 serving," "2 servings," "3-4 servings," or "5 servings or more." Figure 2 shows students responding correctly at pre- and post-assessment. A within group analysis showed the treatment condition was significantly higher at post-than pre-assessment, $\chi^2(1, N=1716) = 34.70$; $p < 0.001$.

Beverage consumption

During *iChallenge* and *All About Foods*, students were asked, "Will you drink water instead of soda in the future?" At pre-assessment, there was no statistical difference between control and treatment groups, $\chi^2(1, N = 3567) = 0.03$; not significant. At post-assessment, the treatment group demonstrated a higher percent of students planning to drink water in the future than the control condition (Figure 3). A within group analysis showed the treatment condition had a higher percentage of students reporting that they will

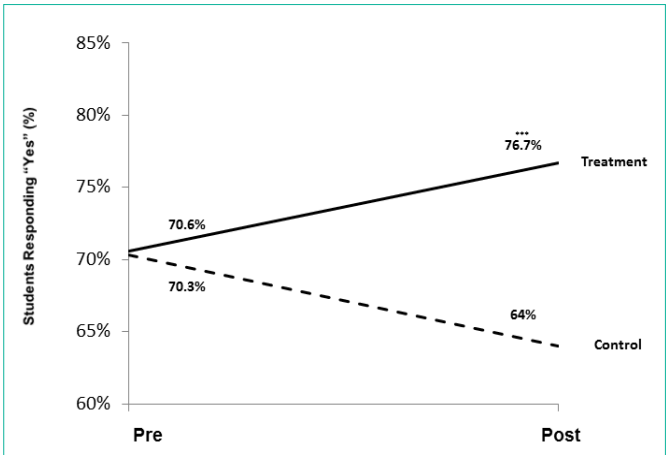

Figure 3: Student responses (%) to the question, "Will you drink water instead of soda in the future?" At post-assessment, the treatment condition demonstrated a higher percent of students planning to drink water in the future than the control condition (p<0.001).

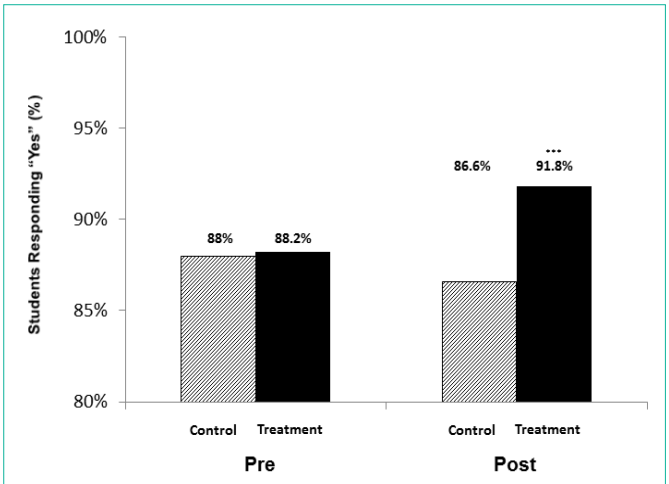

Figure 4: Student responses (%) to the question, "Are you physically active?" At post-assessment, the treatment condition demonstrated a higher percent of students being physically active than the control condition (p<0.001).

drink water instead of soda at the post-assessment than at the pre-assessment, $\chi^2(1, N = 1809) = 69.197$, $p < 0.001$.

Physical activity

During *iChallenge* and *All About Foods*, students were asked, "Are you physically active?" At pre-assessment, there was no statistical difference between control and treatment groups. Figure 4 shows students who reported engaging in PA. A within group analysis of the treatment group showed a higher percentage of students reported being physically active at post-assessment than at pre-assessment, $\chi^2(1, N=1801) = 34.67$; $p < 0.001$.

Family PA also was captured during *iChallenge* and *All About Foods*. Students were asked, "Did your family spend time together being physically active last week?" Figure 5 shows the percent change in family time spent being active from pre- to post-assessment. At pre-assessment, there was no statistical difference between control and treatment groups, $\chi^2(1, N = 3551) = 2.235$; not significant. At post-assessment, the treatment group demonstrated a higher percentage of

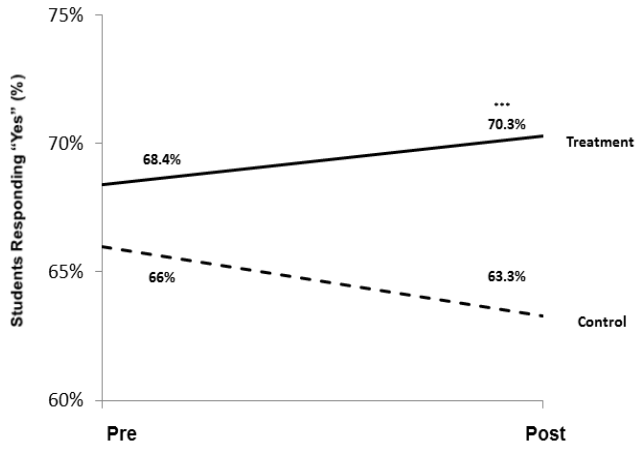

Figure 5: Student responses (%) to the question, "Did you and your family spend time together bring active last week?" At post-assessment, the treatment condition demonstrated a higher percent of students indicating that their family was active compared to control condition (p<0.001).

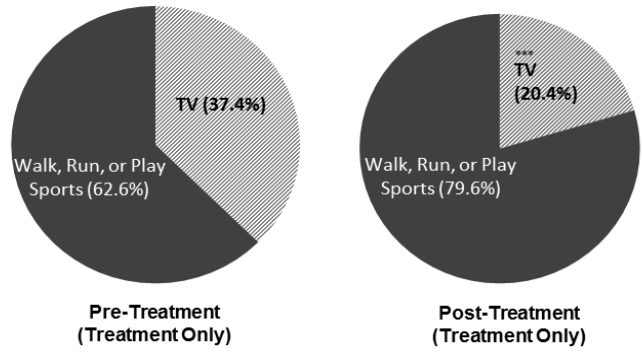

Figure 6: Student responses (%) to the question, "What activity do you do more often after you get home from school?" At post-assessment, the treatment condition demonstrated a lower percent of students watching TV than at pre-assessment (p<0.001). Treatment also demonstrated a lower percent of students watching TV at post than the control condition-not shown (p < 0.001).

students indicating their family was active compared to control, $\chi^2(1, N=3300) = 17.39$; $p < 0.001$.

Screen time

Students were asked about after school activity with the question, "What activity do you do more often when you get home from school?" At pre-assessment, there was no statistical difference between control and treatment groups, $\chi^2(1, N = 3557) = 1.419$; not significant. After treatment, students showed a significant reduction in time spent watching TV compared to control, $\chi^2(1, N=3323) = 99.07$; $p < 0.001$. Figure 6 shows change in screen time for treatment group only at pre- and post-assessment.

Breakfast consumption

Students were asked, "Do you eat breakfast?" At pre-assessment, there was no statistically significant difference between control and treatment groups, $\chi^2(1, N = 3564) = 0.033$; not significant. At post-assessment, the treatment group demonstrated an increase in students who reported consuming breakfast compared to control, $\chi^2(1, N=3342) = 17.54$; $p < 0.001$. Also at post-assessment, the percent of control students who reported eating breakfast slightly decreased

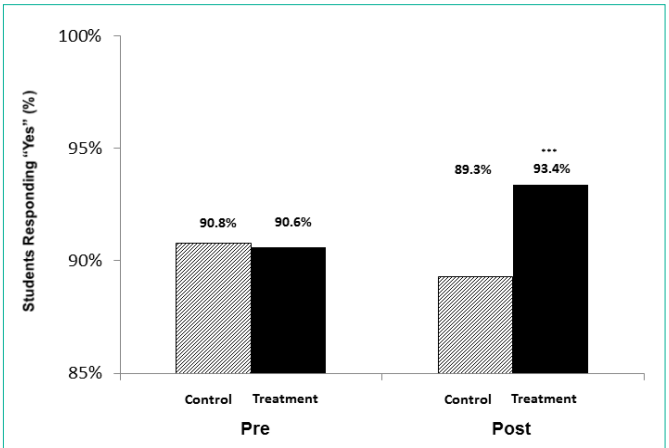

Figure 7: Student responses (%) to the question, "Do you eat breakfast?" At post-assessment, the treatment condition demonstrated a higher percent of students eating breakfast than the control condition (p<0.001).

from pre-assessment (Figure 7). A within group analysis showed that treatment students reported an increased percent eating breakfast at post-assessment compared to pre-assessment, $\chi^2(1, N=1810) = 45.77$; $p < 0.001$.

Discussion

Body Quest was a school-based obesity prevention intervention that resulted in six key findings that document success in a third-grade population. After intervention, several positive behaviors and intentions commonly linked to reduced BMI, reduced chronic disease risk and weight management emerged; 1.) Fruit and vegetable consumption, 2.) Water consumption, 3.) Physical activity, 4.) Physical activity with family members, 5.) Screen time, and 6.) Breakfast consumption.

Body Quest students ate more FV. From pre to post, FV consumption significantly increased in the treatment group. Body Quest treatment students ate 8.1 and 9 weekly FV servings through the School Lunch Program at pre and post, respectively. At post, treatment students ate an average 1.5 fruit and vegetable servings per school day. National School Meal Standards state a minimum of 2.5 total FV must be offered each day, totaling 12.5 FV per week [5]. Based on these guidelines, treatment students ate 75% of the FV offered during school lunch. Literature supports even moderate increases in FV can have a positive impact on chronic disease prevention [6,7]. Learning to eat FV early in life is an important dietary behavior to adopt for lifelong good health and body weight management [8,9].

In addition to behavior change, treatment students gained knowledge about the number of FV recommended each day for good health. After intervention, a significantly higher percentage of treatment students knew to eat 5 or more servings of FV every day for good health compared to control (46% versus 25%, respectively). Increasing knowledge of the benefit of a behavior is the initial step toward intention and action of the specified behavior.

Sugar-sweetened beverages are a leading contributor to excess calorie intake among youth; 76% of children (ages 2 to 19) consume SSB, with children ages 6 to 11 drinking an average of 212 ±4.1 calories per day from SSB [10]. Several entities recommend all Americans reduce SSB intake and replace them with non-calorie beverages such

as water [11-13]. At post, 76.6% of treatment students reported an intention to drink water instead of soda in the future, compared to 64% of control students. Replacing one 12-oz soda each day with a non-caloric beverage, such as water, can save 200 calories [14]. This positive dietary habit is beneficial for obesity prevention.

Good nutrition and physical activity go hand-in-hand. These two elements are needed for healthy body weight management. Current recommendations for children state they should engage in ≥ 60 minutes of moderate to vigorous PA each day [15]. At post, 91.8% of treatment students responded they were physically active, compared to 86.6% of control. Adequate PA helps reduce risk of developing obesity and chronic diseases such as diabetes, cardiovascular disease and colon cancer, as well as improves students' academic performance [16].

Parents who engage in PA are more likely to raise physically active children [16, 17]. The BQ curriculum promoted family physical activity. Body Quest students spread the message to be active to their families. Treatment students and their families were significantly more physically active at post compared to control (70.3% versus 63.3%, respectively). Parental self-efficacy, parental engagement, and parent PA levels are contributing factors for increased PA, reduced TV viewing, improved energy and macronutrient intake, and reduced rates of obesity in their children [17,18].

Screen time is one of the most important modifiable risk factors for sedentary behavior and childhood overweight/obesity, with each additional hour of TV/day increasing the prevalence of obesity by 2% [14,15,19]. As a result of BQ, treatment students watch less television after school, and replace this time with being physically active. Treatment students reduced the time spent watching TV by 17% from pre to post, while also increasing their time spent being physically active by 17%. Current recommendations state children should reduce screen time to ≤ 2 hours each day [15]. Reducing screen time could potentially reduce time spent being inactive as well as reduce intake of empty calories [15].

Less than daily breakfast consumption has been associated with increased likelihood for overweight/obesity [20]. At pre, 90.8% of control and 90.6% of treatment students ate breakfast (no significant difference). At post, the percentage of control students who ate breakfast declined (89.3%), while the percentage of treatment students who ate breakfast significantly increased (93.4%). Breakfast is an important meal for nutritional benefits to the body and mind [20], including improved academic performance [21].

There are several strengths with the current study. First, the sample size was large (n=3,568). Next, study participants were gender and racially diverse. Treatment students were 52% male, 40% black and 60% non-black, predominantly white. Control students were 49% male, 33% black and 67% non-black, predominantly white. Third, BQ encompassed a range of socioeconomic backgrounds. Though BQ was in schools with ≥50% FRL, schools with half of students being from low-income families also meant the remaining students were not. These characteristics are representative of the national population; allowing BQ results to be generalizable. Body Quest was a quasi-experimental design; classes were randomized, and included an experimental control. Lastly, treatment students were given repeated exposure to vegetables during "veggie tastings". Previous research shows repeated exposure to vegetables can overcome children's negative perceptions on the taste of vegetables [22,23].

This study is not without limitations. *What's for Lunch* data were self-reported by students, allowing for personal error. This was controlled for through immediate reporting. Body mass index (BMI), the gold-standard for obesity studies, was not captured during BQ. Body Quest assessments were not designed to capture BMI; nor did they quantitate the actual amount of time students spent being physically active, or time spent as a family being physically active. Furthermore, assessments did not capture data on FV intake in the home environment where limited accessibility and availability of FV can be a barrier for child consumption.

Young children are vastly influenced by their home environment. Future studies should focus on the home environment. Interventions focusing on the family food environment, and the primary food preparer, would be beneficial to determine children's availability and accessibility of healthful foods, such as FV, in the home. Assessments should also capture FV intake in the home environment. Lastly, assessments should be developed to quantitate the time children spent being physically active each day for comparison to the ≥60 minutes per day of moderate to PA.

Conclusion

These study findings highlight that BQ can motivate a younger population to adopt healthy behaviors that, when maintained into adulthood, will aid with weight management. Body Quest is beneficial to SNAP-Ed and the Cooperative Extension System. For SNAP-Ed, BQ effectively changed behaviors, intentions and knowledge of a young, at-risk audience. For Extension, BQ highlights a successful program that can be implemented in a real-world setting.

Acknowledgement

Funding for BQ was provided by the Alabama Cooperative Extension System and the US Department of Agriculture's SNAP. Appreciation is given to the SNAP-Ed educators who implemented the BQ program.

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Austin J Pediatr - Volume 2 Issue 1 - 2015
ISSN : 2381-8999 | www.austinpublishinggroup.com

Citation: Parmer SM, Streumpler B, Griffin JB and Funderburk KM. Impact of Body Quest: Food of the Warrior on Key Indicators for Childhood Obesity Prevention. Austin J Pediatr. 2015; 2(1): 1019.