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Does Participation in the Nutrition Advisory Council Program Lead to Increased Knowledge of Nutrition Concepts?

Kelly Bowman

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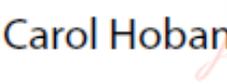
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DOES PARTICIPATION IN THE NUTRITION ADVISORY COUNCIL PROGRAM
LEAD TO INCREASED KNOWLEDGE OF NUTRITION CONCEPTS?

A Master Thesis

Submitted to the Faculty

of

American Public University

by

Kelly Nicole Bowman

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Public Health

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Charles Town, WV

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DEDICATION

I dedicate this thesis to my family. Without their patience, understanding, support, and, most of all, love, the completion of this work would not have been possible.

ABSTRACT OF THE THESIS

DOES PARTICIPATION IN THE NUTRITION ADVISORY COUNCIL PROGRAM LEAD
TO INCREASED KNOWLEDGE OF NUTRITION CONCEPTS?

by

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American Public University System, May 10, 2015

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Background: Since 1980, the prevalence of obesity in the United States has increased dramatically with the largest increases seen in children and adolescents. Although a number of school-based prevention programs have produced promising results, a consensus has yet to be reached as to which programs and/or program components are most effective. **Purpose:** To determine whether participation in a Nutrition Advisory Council Program lesson lead to increased knowledge of lesson-specific nutrition concepts **Methods:** Using a quasi-experimental design, a 9-item multiple choice pre/post-evaluation was administered to 255 elementary students in grades three through five who were participating in the Nutrition Advisory Council Program in one southern California school district. A paired samples t-test was conducted to determine whether total test scores increased significantly from pre to post and McNemar's exact tests were conducted to determine whether there were significant percentage increases in the number of correct responses provided for each question. The significance level was set at $p < 0.05$ for all analyses. **Results:** Significant increases in the percentage of correct responses from pre to

post were identified on eight of the nine test questions, $p < 0.05$. **Conclusion:** The Nutrition Advisory Council Program may be an effective component in school-based obesity interventions; however, further research is needed to determine the impact of the program on dietary intake behaviors and weight status of program participants.

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Does Participation in the Nutrition Advisory Council Program Lead to Increased Knowledge of Nutrition Concepts?

Overview

As of 2010, one-third of school-aged children in the United States (U.S.) were considered to be overweight or obese (Nihiser, Merlot, & Lee, 2013). Since the 1980's, obesity rates in the U.S. have increased dramatically in both children and adults; however, the largest increases have been seen in adolescents between the ages of 12 and 19. Between 1980 and 2008, obesity rates in this age group more than tripled, increasing from five to 18 percent. A similar trend has been found in younger children between the ages of six and 11 years-old with obesity rates increasing from seven to 20 percent during the same time period (Falter, Pignotti-Dumas, Popish, Petrelli, Best, & Wilkinson, 2011; Nihiser, Merlot, & Lee, 2013).

Currently, childhood obesity remains a significant public health issue across the U.S. and the globe. In the state of California, recent data suggests that two in five school-aged children are either overweight or obese with more than 50 percent of low-income children in one of these two categories (California Department of Public Health, 2013). Overweight and obesity pose a number of immediate and long-term threats to a child or adolescent's health. More immediate consequences for children and adolescents who are overweight or obese can include: sleep disturbances, high blood pressure, poor bone health, iron deficiency, type 2 diabetes, depression, and low self-esteem. In addition, youth who are overweight or obese are much more likely to become obese adults and/or develop one or more of the following conditions: cardiovascular disease, type 2 diabetes, certain cancers, osteoarthritis, sleep apnea, metabolic disease, and

numerous other complications (Fahlman, Dake, McCaughtry, & Martin, 2008; Nihiser, Merlot, & Lee, 2013).

Literature Review

The magnitude and severity of this problem have led to a variety of government initiatives and scientific research studies focused on childhood obesity prevention. While no single cause has been identified, two factors known to play integral roles in the development and prevention of obesity are dietary intake and physical activity (Dairy Council of California, 2013; Eliassen & Wilson, 2007; Greening, Harrell, Low, & Fielder, 2011; Nihiser, Merlot, & Lee, 2013). Thus, the vast majority of childhood obesity prevention programs have been based upon changing at least one of these behaviors. Additionally, because more than 95 percent of school-aged children in the U.S. are enrolled in school at any given point in time, a large percentage of prevention programs have been implemented within the school environment (Avery, Johnson, Cousins, & Hamilton, 2013; Eliassen & Wilson, 2007; Nihiser, Merlot, & Lee, 2013).

A number of studies that sought to determine the effectiveness of school-based obesity prevention programs focused on changes in knowledge of nutrition and/or physical activity concepts. For instance, in 2002 Morris, Koumjian, Briggs, and Zidenberg-Cherr investigated the effect of the *Nutrition to Grow On* program on knowledge of lesson-based concepts in 200 fourth-grade students. In this quasi-experimental study, one fourth-grade classroom from three different schools matched on demographic characteristics was selected to participate. These three classrooms were then randomly assigned to one of three conditions: 1) intervention with the *Nutrition to Grow On* curriculum, 2) intervention with an alternate nutrition education curriculum, or 3) control group.

Students who participated in the *Nutrition to Grow On* intervention received nine nutrition lessons each paired with a garden-based activity. Students who participated in the alternate intervention were exposed to nine nutrition education lessons only. To assess the impact of the interventions on knowledge, students in all three groups completed a knowledge assessment containing 30 multiple choice questions on three separate occasions: before the intervention period, after the intervention period, and six months after the intervention period (Morris et al., 2002). The results revealed that knowledge significantly improved in both intervention groups compared to the control group ($p < 0.0005$) (National Cancer Institute, 2013).

Another study performed by McGaffey, Hughes, Fidler, D'Amico, and Stalter (2010) investigated the effect of the *Fitwits* program on knowledge of lesson-based concepts in a group of fifth-grade students attending five low-income schools in Pittsburgh, Pennsylvania. The *Fitwits* program consisted of a one-hour classroom intervention including explanations of health-related definitions and portion control concepts as well as hands-on activities and physical activity. To determine the impact of the *Fitwits* program on knowledge of lesson concepts, participants completed a knowledge assessment that consisted of 14 multiple choice questions immediately before the intervention, just after the intervention, and one week following the intervention.

Answers provided on all three tests were coded as either correct or incorrect and the primary outcome measure was the percentage of correct responses to each test question at each point in time. Odds ratios were calculated to estimate the odds of a correct answer being given from baseline to each post-intervention point. The results revealed significant increases in knowledge on 11 of the 14 questions at both post-intervention points in time ($p < 0.01$). The three questions that did not indicate significant increases in knowledge were answered correctly by the majority of students at baseline. While these results were promising, the researchers noted the

short duration, narrow focus, and lack of generalizability of the intervention and acknowledged the need for validation of the program's effectiveness in other populations (McGaffey et al., 2010).

Falter et al. (2011) also focused on changes in knowledge of lesson-based concepts when they investigated the effectiveness of the *Kids Eat Healthy* program administered to elementary students in grades K-3 by pharmacy school students as part of their program requirements. The *Kids Eat Healthy* program consisted of one 30-minute classroom lesson taught once per week for a total of four weeks. Lesson topics included: food groups, serving sizes, nutrition facts labels, and portion sizes. To examine the effect of the program on knowledge of lesson concepts, participants completed a knowledge assessment focused on matching foods to the appropriate food group both before and after the intervention period.

Pretests and post-tests for each participant were matched using pre-assigned student numbers and differences between the two tests were evaluated using the Mann-Whitney rank sum test. A total of 468 students completed both assessments and were included in the final analysis. The results revealed that knowledge improved by at least 10 percent in more than half of the participants in each grade level. This study was limited, however, by a number of factors such as the use of pharmacy students to provide classroom lessons, an assessment instrument focused solely on food groups despite the fact that other topics were discussed, and the use of a convenience sample without a control group (Falter et al., 2011).

In addition to changes in knowledge, several studies have assessed the impact of school-based obesity interventions on attitudes, preferences, self-efficacy, and self-reported diet and physical activity behaviors. For instance, Powers, Struempfer, Guarino, and Parmer (2005)

investigated the effect of a nutrition education program on knowledge and dietary behavior in 1100 second and third-grade students attending 64 schools in the state of Alabama. The program consisted of six weekly classroom lessons conducted by state nutrition educators. Lessons were adapted from a variety of other nutrition education programs, such as those created by the Dairy Council and the American Heart Association, and included topics such as food groups, nutrient functions, and serving sizes. Participants from each school were assigned to either the intervention group, which was exposed to the curriculum, or to the control group.

To assess differences in knowledge and self-reported dietary behaviors, the Pizza Please assessment tool was completed by participants in both groups before and after the intervention period. The assessment consisted of 16 knowledge questions and 24 questions related to dietary behaviors. Knowledge-based questions were in both multiple choice and matching format and behavior questions asked for yes/no answers related to foods and beverages participants consumed regularly. Total scores on the pretest and post-test were calculated for each participant and specific gain was calculated by subtracting pretest scores from post-test scores. To determine differences among all factors measured, a 2x2 mixed analysis of variance (ANOVA) was performed. Finally, paired *t* tests were used to determine differences on each test question between pre and post (Powers et al., 2005).

To gain a more detailed understanding of dietary behaviors, test questions related to behaviors were further divided into categories for dairy consumption and fruit and vegetable consumption. The results revealed that both dairy and fruit/vegetable consumption improved significantly in the intervention group and actually decreased in the control group ($p < 0.001$). Knowledge of lesson concepts also improved significantly in the intervention group compared to the control group with significant improvements identified on all 16 questions ($p < 0.001$). In the

control group, knowledge improved significantly from pre to post on only one question. Based on these results, the researchers concluded that nutrition education was a key factor in changing dietary behaviors. That being said, the study was limited by the fact that only self-reported behaviors were measured (Powers et al., 2005).

Fahlman et al. (2008) conducted a similar study to evaluate the impact of the *What's Food Got to Do with It?* program, implemented in Michigan public schools, on knowledge, behaviors, and self-efficacy of middle school students. Also using a pre/post control group design with 407 participants assigned to the intervention group and 169 participants assigned to the control group, researchers collected data both before and after the intervention period. Participants in the intervention group were exposed to eight nutrition lessons conducted by volunteer graduate students and retired teachers that covered topics such as food groups, food labels, and the importance of consuming fruits, vegetables, and dairy foods.

Participants in both groups completed an assessment comprised of 33 dietary intake questions, 20 knowledge questions, and eight self-efficacy questions. The dietary intake questions were adapted from a previously validated instrument used in the Physical Activity and Nutrition project and prompted participants to indicate how frequently specific foods were consumed the previous day. The knowledge questions were created by the researchers according to lesson content and were reviewed by a panel of middle school teachers to establish content and face validity. Finally, the self-efficacy questions pertained to participants' confidence in making healthy choices (Fahlman et al., 2008).

To identify differences in each of the outcome variables between the pre and post assessments in both groups, a 2x2 repeated measures ANOVA was performed for each subscale.

When significant differences were identified, a Tukey's post hoc analysis was performed to identify the specific variable that influenced the differences. The results revealed that the intervention group reported consuming significantly greater amounts of fruits and vegetables compared to the control group. In addition, knowledge of lesson concepts improved significantly from pre to post in the intervention group and was significantly higher at post compared to the control group. Finally, the intervention group improved significantly in some areas of self-efficacy while no change was found from pre to post in the control group. This study was limited, however, by the use of a convenience sample and volunteer educators as well as a significant loss of participants between pre and post assessments (Fahlman et al., 2008).

Irwin, Irwin, Miller, Somes, and Richey (2010) also assessed changes in knowledge of lesson-based content and health-related behaviors in their investigation of the effectiveness of the *Get Fit with the Grizzlies* program. This program, implemented in all Memphis City schools during the 2006-2007 school-year, consisted of six nutrition lessons created and conducted by elementary physical education (PE) teachers, school assemblies attended by professional basketball players on the Memphis Grizzlies team, and sports workshops. All fourth and fifth-grade students attending 11 randomly selected Memphis City elementary schools during the intervention school-year were included in the study.

To assess the impact of the program on knowledge of lesson concepts, dietary behaviors, and physical activity levels, participants completed a questionnaire comprised of questions based on lesson content as well as questions obtained from the Youth Risk Behavior Survey (YRBS) both before and after the intervention. Questions from the YRBS focused on dietary intake and physical activity levels within the previous 24-hour period. Questions based on lesson content were created by the researchers and were evaluated by a panel of elementary PE teachers and

education specialists to establish content and face validity. A total of 888 participants completed both assessments and were included in the final analysis (Irwin et al., 2010).

Prior to analyzing the data, answers to knowledge questions were coded as either correct or incorrect and knowledge was treated as a dichotomous variable. In the same way, questions taken from the YRBS were coded and dietary intake and physical activity levels were also treated as dichotomous variables. To identify differences in knowledge and behaviors between pre and post assessments, McNemar's test was performed followed by the calculation of odds ratios to determine the meaningfulness of the results (Irwin et al., 2010).

The results revealed a significant increase in knowledge on seven of the eight knowledge-based questions ($p < 0.05$). Odds ratios between 1.5 and 3.2 indicated the associations between the intervention and improvements in knowledge were moderate to strong. Significant improvements were also identified on seven of the 10 behavior questions; however, odds ratios between 1.3 and 1.6 indicated a small association between the intervention and behavioral improvements. This study was limited by several factors including: lack of a control group, no long-term follow-up, and failure to test the reliability of the newly developed knowledge assessment scale (Irwin et al., 2010).

Another study that evaluated the impact of a nutrition education program on knowledge of lesson concepts and dietary intake behaviors was conducted by the Dairy Council of California (2013) in public schools across the state of California. The program, known as *Nutrition Pathfinders*, is comprised of a series of nutrition lessons that are aligned with the California Health Education Content Standards as well as the 2010 Dietary Guidelines for Americans. All resources are made available free of charge to all public schools participating in

federal school meal programs in the state of California. Lessons are implemented by classroom or physical education teachers at their convenience throughout the school year.

To evaluate the effectiveness of the program, 53 volunteer fourth-grade teachers serving a total of 862 students were asked to implement the program in their classrooms during the 2012-2013 school-year. Thirty-three of the teachers were assigned to the intervention group and the remaining teachers served as controls. Students in the intervention group were exposed to the *Nutrition Pathfinders* curriculum while students in the control group received the traditional health education curriculum offered at their schools. Students in both groups completed a 17-item survey before the intervention period, after the intervention period, and three months post intervention (Dairy Council of California, 2013).

Results from survey analyses revealed that knowledge of lesson concepts significantly increased in the intervention group compared to the control group between pre and post assessments and remained significant at the three month follow-up. In addition, the intervention group was more likely to consume grain and protein foods and less likely to consume foods of limited nutritional value compared to the control group. Further, participants in the intervention group were more likely to consume breakfast compared to participants in the control group. These findings were limited by several factors including: use of a convenience sample, lack of standardization in lesson implementation, no matching of intervention and control groups on demographic variables, and failure to test the validity or reliability of the survey instrument (Dairy Council of California, 2013).

Another study performed by Wall, Least, Gromis, and Lohse (2012) investigated the effects of a nutrition education program on mediators of vegetable consumption including

attitude, self-efficacy, preference, and knowledge related to vegetables. The program consisted of four classroom lessons that included instruction, hands-on student activities, and vegetable taste tests. Participants included fourth-grade students from a group of 200 randomly selected low-income elementary schools throughout 22 public school districts in Pennsylvania. Half of the schools selected were assigned to the intervention group while the remaining schools served as controls. One fourth-grade classroom was selected from each school to participate in the study resulting in a total of 2231 participants. Participants in the intervention group were exposed to monthly lessons conducted by state nutrition educators.

To assess the impact of the program on mediators of vegetable consumption, participants completed a modified version of a survey originally created for use within the Supplemental Nutrition Assistance Program (i.e. SNAP-Ed). Survey questions were modified to align with concepts discussed during the classroom lessons and assessed attitude, self-efficacy, preference, and knowledge related to vegetables. Reliability of the modified instrument was assessed using the test-retest method with 147 fourth-grade students completing the instrument on two separate occasions approximately two weeks apart. Associations between pre and post scores were evaluated using Pearson correlation coefficients. In addition, internal consistency was established via Cronbach's alpha coefficients (Wall et al., 2012).

To evaluate differences in the mediators of vegetable consumption from pre to post intervention in both groups, paired *t* tests were performed. Independent samples *t* tests were also performed to analyze differences between intervention and control groups. Cohen's *d* was calculated to determine the effect size and a linear model univariate ANOVA was performed to determine the effects of study group, gender, and family influences. The results revealed that there were no significant differences between the intervention and control groups at baseline;

however, only the intervention group demonstrated significant improvements in each of the mediators between pre and post evaluations ($p < 0.001$). This study was limited by the facts that only a weak correlation was found for test-retest reliability and only low-income schools were selected for participation (Wall et al., 2012).

Another study performed by Herbert, Lohrmann, Seo, Stright, and Kolbe (2013) was also designed to assess the impact of a school-based obesity intervention on knowledge and dietary intake behaviors as well as changes in physical activity levels. The intervention, known as *Energize*, was implemented in three Indiana public schools and included weekly nutrition lessons, classroom physical activity breaks, and changes within the school environment that encouraged healthy choices. Two volunteer classrooms from each school were included in the study, half of which were assigned to the intervention group ($n = 59$) and the other half designated as controls ($n = 45$).

Students in both groups completed weekly diet/physical activity logs as well as the Student Health Assessment Questionnaire at the beginning and end of the 12-week intervention period. Each week, participants were asked to complete their diet/physical activity log by recording the foods and beverages consumed as well as the physical activities completed within the previous 24-hour period. Dietary intake and physical activity behaviors were also assessed with the pre/post questionnaire that consisted of 33 questions in Likert scale format. A one-way analysis of co-variance (ANCOVA) was used to evaluate answers to the questionnaires and identify differences in dietary and physical activity practices between the two groups at both pretest and post-test. Hierarchical linear modeling was used to identify potential correlations among log entries submitted by each participant (Herbert et al., 2013).

The results revealed that the control group reported consuming significantly greater amounts of fried potato products, such as chips and French fries, compared to the intervention group on the post-test. Conversely, no significant differences in physical activity levels between the two groups were identified. In addition, no significant differences existed for grain or fruit consumption. Finally, differences in reported vegetable intake were marginally significant with the actual increase in consumption in the intervention group between pre and post equal to less than one vegetable serving per day ($p < .10$) (Herbert et al., 2013).

Based on the results, the researchers concluded that the *Energize* program likely contributed to a reduction in the consumption of foods of minimal nutritional value and slight increases in the consumption of vegetables. The researchers noted that even though the results did not reveal significant changes in all variables measured, the changes that were identified were extremely significant because they were identified in such a small sample of participants. The study was limited, however, due to the lack of random assignment to treatment or control groups, small sample size, use of a convenience sample, and lack of long-term follow-up (Herbert et al., 2013).

One other study conducted by Berger-Jenkins et al. (2014) served to identify changes in knowledge, attitudes, and behaviors related to dietary intake and physical activity levels following participation in a school-based obesity intervention known as the *Choosing Healthy & Active Lifestyles for Kids (CHALK)* program. In this particular study, the researchers sought to assess the impact of the CHALK program within a sample of fourth-grade students, most of whom were Hispanic and eligible for free or reduced-priced school meals. The program, which consisted of school-wide marketing campaigns, nutrition education lessons, incentive-based physical activity challenges, and classroom physical activity breaks, was implemented over the

course of two school-years in a total of seven elementary schools servicing more than 3,000 students. All fourth-grade students were invited to participate in the study.

To evaluate the impact of the program on knowledge of lesson concepts as well as attitudes and behaviors related to nutrition and physical activity, 184 participants completed surveys at the beginning and end of each school-year (four assessments total) and 293 participants completed surveys at the beginning and end of year two only (two assessments total). A control group consisting of fourth-grade students attending a school that did not implement the *CHALK* program also completed surveys at the beginning and end of year two. The survey consisted of seven multiple choice knowledge questions, six Likert scale attitude questions, and nine behavior questions in yes/no format. The behavior questions required participants to recall foods/beverages consumed and physical activities performed during the previous day (Berger-Jenkins et al., 2014).

To assess the longitudinal effects of the *CHALK* program, a repeated measures ANOVA was performed using the four sets of data obtained from participants over the course of the two-year intervention period. Paired samples *t* tests were also performed to compare behaviors during similar seasons (i.e. spring to spring). To identify differences between the intervention and control groups at baseline, independent samples *t* tests were performed using demographic, knowledge, attitude, and behavior variables. Multivariate linear regression models were used to assess the impact of the program on knowledge, attitudes, and behaviors in the two groups (Berger-Jenkins et al., 2014).

The results revealed that the intervention group had more knowledge of lesson topics and engaged in healthier behaviors compared to the control group at the beginning of the second

year. In addition, the intervention group showed significant increases in knowledge over the course of the two-year intervention period. However, there were no significant differences in knowledge between the two groups at the end of the second year. In addition, no significant improvements in attitudes were identified nor were there significant differences in attitudes between the intervention and control groups at the end of year two. Finally, a trend towards healthier behaviors was identified in the longitudinal analysis and the intervention group reported engaging in healthier behaviors compared to the control group (Berger-Jenkins et al., 2014).

In addition to mixed findings, this study was limited by several factors. First, the researchers noted the likelihood of comprehension issues in regard to some of the survey questions. Despite the fact that 84 percent of the participants were Hispanic, some of whom were still learning English, the researchers failed to create or administer a Spanish version of the survey. Because of this, the researchers excluded all bilingual participants from the final analyses. Second, the researchers noted that the New York City Board of Education banned all vending machines and unhealthy fundraising activities in public schools during the study, which may have impacted the results. Thus, while the *CHALK* program may have had a positive impact on knowledge, attitudes, and behaviors, confounding factors were present and the results cannot be generalized to other populations (Berger-Jenkins et al., 2014).

In addition to self-reported measures, some studies have sought to determine the impact of school-based obesity interventions on anthropometric measures, such as body mass index (BMI) and waist circumference, and/or on fitness levels. One such study performed by Katz et al. (2011) included a randomized controlled evaluation (RCE) of the *Nutrition Detectives* program implemented in five elementary schools that were matched on demographic characteristics and randomly assigned to either the intervention or control group. Participants

included all second, third, and fourth-grade students who were attending the five schools during the 2007-2008 school-year. Participants in the intervention group were exposed to five nutrition lessons centered on the following topics: selecting nutritious foods, link between diet and health, barriers to consuming nutritious foods, and understanding food labels and advertisements. Each 20-minute lesson was implemented by PE teachers during class time.

To assess the impact of the program, gender, age, grade, height, weight, BMI, dietary intake, and nutrition knowledge data was collected before and after the intervention. Dietary intake was assessed using the Youth and Adolescent Questionnaire (YAQ), a previously validated measure to be completed by youth between the ages of nine and 19 with the assistance of a parent. To assess knowledge, a 10-question test based on content discussed during the lessons was completed by participants. To assess differences between the intervention and control groups at baseline, a student's *t* test was performed. A repeated measures ANOVA was performed to assess differences in nutrition knowledge from pre to post in both groups. Finally, post hoc analyses were performed to assess the impact of gender, age, and grade on the results (Katz et al., 2011).

Results of these analyses identified significant increases in knowledge between pre and post evaluations in the intervention group with the greatest gains identified in third-grade participants. Conversely, no significant changes in dietary intake or BMI occurred between pre and post in either the intervention or the control group. Based on these results the researchers concluded that the *Nutrition Detectives* program effectively increased participants' abilities to distinguish healthier foods from less nutritious options. The researchers also noted that, due to the short duration of the study, the lack of impact on dietary intake and BMI were not surprising and that these two variables should be assessed again in future studies of longer durations. In

addition to short duration, the study was limited by the use of a knowledge test that had not been validated, an intervention focused solely on nutrition education, and lack of ability to generalize to other populations (Katz et al., 2011).

Another study that was performed by Greening, Harrell, Low, and Fielder (2011) included a RCE of a more comprehensive school-based obesity intervention known as the *TEAM Mississippi* program. This program consisted of weekly nutrition lessons, changes to school foodservice, two physical activity sessions per week, and physical activity events. To assess the effectiveness of the program, two schools within a single community and similar demographic characteristics were selected and randomly assigned to either the intervention or control group. Participants at the intervention school were exposed to the *TEAM Mississippi* program while participants at the control school completed assessments only.

Researchers collected the following data before and after the eight-month intervention period: height, weight, waist circumference, body fat percentage measured with bioelectrical impedance, fitness level, nutrition knowledge, and self-reported dietary intake and physical activity levels. Fitness level was assessed using the shuttle run, curl-up, and V-sit tests from the President's Challenge Physical Activity and Fitness Awards program. Knowledge was assessed via the Know Your Body Questionnaire that consisted of 12 multiple choice questions. Dietary intake was assessed with the Child Dietary Fat Questionnaire that consisted of 17 questions related to the frequency of consumption of certain foods. Finally, physical activity levels were assessed using a checklist consisting of 21 common physical activities.

To identify changes in adiposity measures (i.e. BMI, waist circumference, and body fat percentage), a linear regression analysis including standardized residuals was performed.

Changes in dietary intake, physical activity levels, and knowledge were assessed by calculating total scores for each measurement and comparing pretest scores with post-test scores for both groups. The results revealed that there were significant differences in waist circumference and fitness levels between the two groups at baseline. Between pre and post evaluations, significant changes in adiposity were identified only for body fat percentage with significant decreases found in the intervention group (Greening et al., 2011).

The intervention group also reported a significant increase in physical activity between pre and post whereas the control group reported a decrease in physical activity level. A significant decrease in dietary fat intake was also reported by the intervention group whereas the control group reported an increase. The intervention group also improved significantly on two of the three fitness tests whereas no changes in fitness level occurred in the control group. Finally, no differences in knowledge were identified in either the intervention or the control group. Although the researchers concluded that the *TEAM Mississippi* program likely had a positive impact on adiposity, knowledge, and behaviors, the true effects of the program could not be determined due to significant differences between the intervention and control groups at baseline (Greening et al., 2011).

One other study performed by Burke, Meyer, Kay, Allensworth, and Gazmararian (2014) sought to assess the impact of a school-based obesity intervention, known as the *HealthMPowers* program, on knowledge and behaviors as well as on anthropometric measures and fitness levels. Like the *TEAM Mississippi* program, the *HealthMPowers* program included several different intervention strategies including: nutrition education, increased opportunities for physical activity during the school day, environmental changes to support healthier choices, and yearly school events. To evaluate the impact of the program on nutrition knowledge, dietary intake,

physical activity behaviors, BMI, and fitness levels, surveys and fitness tests were completed by three cohorts of participants attending 40 different Georgia public schools over the course of three school-years. Each cohort was followed for one school-year and was asked to complete the survey and fitness test at the beginning and end of that year.

The survey, which was created by the research team, consisted of questions related to lesson content and dietary intake behaviors. BMI was calculated from height and weight measured by trained school staff members and then converted to age and sex-specific BMI-for-age Z scores. Fitness level was assessed using the Progressive Aerobic Cardiovascular Endurance Run (PACER) test with performance on the test measured by the number of laps completed within a specific time frame. For each cohort, paired two-sample *t* tests were performed to determine changes in each outcome variable between pre and post evaluations (Burke et al., 2014).

The results revealed significant increases in knowledge in all three cohorts with the greatest increases identified during the first and second years of implementation. All three cohorts also demonstrated significant improvements in dietary intake behaviors as well as significant decreases in BMI. Within each cohort, the groups that had the greatest reductions in BMI were fourth-grade participants and participants who were overweight or obese at baseline. Finally, significant improvements in fitness level as measured by the PACER test were also identified in all three cohorts (Burke et al., 2014).

Based on the results, the researchers concluded that multi-dimensional school-based obesity interventions may lead to significant improvements in knowledge, behaviors, anthropometric measures, and fitness levels. This study had several strengths, one of which was

the fact that data was collected over a period of three years, which allowed researchers to study changes over time. In addition, both subjective and objective forms of data were collected from a large, highly diverse sample of participants. The study was limited, however, by several factors including: no control group, cohorts followed for only one year, and lack of objective measures of dietary intake and physical activity levels (Burke et al., 2014).

Despite promising results obtained in a number of studies, several studies have had somewhat mixed results. In addition, questions remain as to the most effective components of successful school-based obesity prevention programs. Even more importantly, a number of programs currently utilized in schools throughout the U.S. have yet to be evaluated (Berlin, Norris, Kolodinsky, & Nelson, 2013; Budd & Volpe, 2006; Burke et al., 2014). One such program that was first administered by the School Nutrition Association (SNA) in 1973 and continues to be implemented in districts across the country is known as the Nutrition Advisory Council (NAC) Program (SNA, 2005; SNA of North Carolina, 2014). Other than general guidelines provided by the SNA (2005) related to the formation of NACs in schools, little to no research has been conducted to evaluate the effectiveness of the program. Therefore, the purpose of this quasi-experimental study is to determine whether participation in the NAC Program leads to increases in student knowledge of essential nutrition and physical activity concepts via a pretest/post-test method.

Methods

Participants

The participants invited to participate in this study included a convenience sample of 345 elementary students in grades three through five who were currently participating in the NAC Program offered at one public school district in southern California. For the 2014-15 school year, one teacher and his/her students at 10 of the elementary schools and two teachers and their students at the remaining elementary school in the district agreed to participate in the NAC Program. The study was approved by both the participating school district and the American Public University System Institutional Review Board. Parental consent forms were sent to all parents of students who were currently participating in the NAC Program. All students who received parental consent and were present in the classroom on the day of the lesson were invited to participate in the study. All students who were invited to participate provided verbal assent prior to the initiation of the pretest.

Procedures

Program overview. The NAC Program consists of seven, one-hour classroom lessons that are based on the Dietary Guidelines for Americans (United States Department of Health and Human Services [USDHHS], 2010) and are aligned with the California Health Education Content Standards (California State Board of Education, 2008). Lesson topics include: 1) make half your grains whole, 2) strong bones, calcium, and dairy, 3) fats and oils, 4) go lean with protein, 5) vary your veggies, 6) focus on fruit, and 7) understanding MyPlate. Each lesson is conducted by the Supervisor of Nutrition Education and Marketing for the district, which at the

time of the study was the principal investigator, and consists of a lecture/discussion, hands-on student activity, taste test, and marketing project assignment (Table 1).

One lesson is conducted each month except for the months of September, December, and June. All lessons are scheduled at the beginning of the school year based on teacher schedules and are conducted at each elementary school during the first two weeks of the month. On the last Tuesday of each month, the food item tested during that month's lesson is offered as a free sample to all elementary students in the district who receive a school lunch that day. On several of the sample days, NAC students are responsible for collecting data regarding the acceptance of the new food item by the student body. Based on that data, the Child Nutrition Services Department decides whether or not to offer the new item on future elementary lunch menus.

Table 1. Nutrition Advisory Council Program Overview

Lesson 1: Make at Least Half Your Grains Whole

- MyPlate introduction
- Grains group
 - Examples of grain foods
 - Difference between whole and enriched grains
 - Nutrients in grain foods
- Activity: Reading nutrition facts labels and ingredients lists
- Taste test: Whole grain food item
- Marketing project: Student presentation at school assembly or during daily announcements

Lesson 2: Strong Bones, Calcium and Dairy

- Dairy group
 - Examples of dairy foods
 - Nutrients found in dairy foods
 - Recommended servings per day of calcium
 - Non-dairy sources of calcium
- Activity: Comparing and contrasting types of milk
- Taste test: Dairy food item
- Marketing project: Student-led creation and implementation of marketing strategy

Lesson 3: Fats and Oils

- Discussion: Fats and oils: Important, yet not a food group
- Overview: Fats and oils
 - Sources: Plants versus animals
 - Types: Saturated, unsaturated and trans
 - Health benefits and risks
 - Servings per day
- The circulatory system
 - Video: Exploring the heart
 - Activity: Flow of blood through the heart
- Taste test: Food item containing heart-healthy oils
- Marketing project: Data collection

Lesson 4: Go Lean with Protein

- Meat and beans group
 - Food sources of protein
 - Plant versus animal proteins
 - Health benefits
- Importance of including daily physical activity
- Activity: Physical activity and heart rate
- Taste test: Lean protein food item
- Marketing project: Creation and presentation of poem, song, or skit
- Special assignment: Classroom physical activity challenge

Lesson 5: Vary Your Veggies

- Vegetable group
 - Examples of vegetables
 - Importance of color and variety
 - Parts of the plant
 - Health benefits
 - Recommended servings per day
- Activity: Bingo game
- Taste test: Vegetable food item
- Marketing project: Data collection in the cafeteria

Lesson 6: Focus on Fruit

- Fruit group
 - Definition of a fruit
 - Examples of fruits
 - Health benefits
- Activity: Comparing and contrasting fruits
- Taste test: Fruit food item
- Marketing project: Promotion designed to increase school lunch participation

Lesson 7: Building Healthy Meals Using MyPlate

- MyPlate review
 - Importance of including all food groups
 - Variety and balance
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- Activity: Review game
 - Taste test: Healthy food item
 - Marketing project: Creating and displaying healthy lunch tray examples
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Theoretical framework. In addition to government guidelines and educational content standards, NAC Program lessons and projects were also designed to align with constructs from several behavioral theories. According to the CDC (2011), effective health education programs incorporate evidence-based curricula and theories of behavior change. Specifically, programs should focus on increasing perceived health risks related to unhealthy behaviors and promoting behaviors known to protect against chronic disease. Based on such recommendations, a number of researchers have incorporated constructs from behavior change theories into health education programs and have observed positive changes in dietary and/or physical activity behaviors.

For example, Greening et al. (2011) applied constructs from social cognitive theory (SCT) to a school-based obesity intervention implemented in Mississippi public elementary schools. SCT is based on the notion that behaviors result from the interaction among personal, behavioral, and environmental influences. Thus, for changes in behavior to occur, all influencing factors must be addressed (McAlister, Perry, & Parcel, 2008). To address personal and behavioral factors related to dietary intake and physical activity levels of participating students, Greening et al. (2011) implemented weekly nutrition lessons and physical activity events within the school setting. To address environmental factors, changes in school foodservice as well as additional physical activity sessions were incorporated. The influence of family members was addressed by having parents attend nutrition education classes and participate in monthly wellness contests. Changes in behaviors were assessed with questionnaires, dietary intake records, and physical fitness evaluations. Analyses of these

assessments revealed significant improvements in dietary intake, physical activity levels, and fitness levels in the intervention group.

Irwin et al. (2010) also incorporated SCT constructs in their school-based obesity intervention known as *Get Fit with the Grizzlies*. To address personal influences on health behaviors, a six-lesson nutrition education curriculum was implemented in 4th and 5th grade physical education classes in participating Memphis City Schools. In addition, students were exposed to health-related school assemblies and sports workshops hosted by professional basketball players. Family influences were addressed via homework assignments that were sent home with students and were to be completed with their parents or caregivers. School-based incentives related to student progress within the program served to address environmental (i.e. school) influences on behavior. Based on the results obtained from pre/post questionnaires, participants demonstrated significant improvements in nutrition and physical activity knowledge and behaviors.

In addition to SCT, the United States Department of Agriculture (USDA) (2007) recommended the incorporation of prospect theory into school-based nutrition education programs. Prospect theory is based on the notion that the manner in which a health-related message is framed can influence its effectiveness in terms of changing behavior. To influence preventive behaviors, such as behaviors related to preventing obesity, gain-framed messages have been recommended. An example of a gain-framed message would be that which encourages higher consumption of fruits and vegetables for the purposes of maintaining a healthy body weight and obtaining greater amounts of disease-fighting antioxidants. Conversely, a loss-framed message might focus on increased risk for chronic diseases related to the failure to consume adequate amounts of fruits and vegetables.

Finally, the CDC (2013) recommended utilizing the social ecological model (SEM) when developing and implementing programs related to the obesity epidemic. Like SCT, this model is based on the idea that behaviors result from a variety of influences; however, the SEM goes beyond SCT by including a more detailed breakdown of environmental influences as well as the magnitude of those influences. Based on the SEM behaviors are influenced by the following factors with the first factor being the least influential: individual, interpersonal, institutional/organizational, community, and structures/policies/systems.

The CDC (2013) made several recommendations for incorporating the SEM into school-based obesity interventions. One, schools should seek to collaborate with other organizations and agencies that might be able to assist in the implementation and sustainability of the program in question. Two, program development should include community participation and input from a variety of individuals, such as school administrators, staff members, parents, and students. Three, changes or enhancements at the organizational and policy level should coincide with the overall mission of the program. Finally, methods of evaluating progress and ensuring program sustainability should be identified, developed, and implemented. The development and implementation of the NAC Program have been built upon a number of constructs taken from each of the above-mentioned theories as well as from the health belief model (HBM) (Champion & Skinner, 2008). The specific constructs and their application within the NAC Program may be found in Table 2.

Table 2. Theoretical Constructs within the Nutrition Advisory Council Program**Social Cognitive Theory**

Activity	Constructs	Ways in Which the Activity Carries Out the Construct
Classroom nutrition education	Positive reinforcement; outcome expectations; facilitation; self-efficacy	<ul style="list-style-type: none"> • Students learn about the benefits of consuming healthy foods and engaging in physical activity (reinforcement) • Students learn about the potential consequences of consuming an unhealthy diet and/or failing to engage in regular physical activity (expectations) • Students learn how to utilize tools and resources, such as the MyPlate diagram, food labels, and websites, that can increase the likelihood of consuming healthy foods and engaging in physical activity (facilitation) • Students have the opportunity to practice using such tools and resources, which serves to increase confidence in their abilities to do so (self-efficacy)
Hands-on learning activities	Collective efficacy; observational learning; incentive motivation	<ul style="list-style-type: none"> • Students work in small groups to complete activities, which demonstrates the ability of groups to accomplish difficult or time-consuming tasks (efficacy) • Students observe their fellow students solving problems and engaging in positive behaviors (observation)

Taste tests	Positive reinforcement; outcome expectations; observational learning	<ul style="list-style-type: none"> • Students often complete with one another in challenges where they are tasked with engaging in healthy behaviors to earn prizes (incentive) • The lesson instructor and teachers provide encouragement and positive feedback when students try new foods (reinforcement) • Students learn that healthy foods can be delicious and enjoyable (expectations) • Students observe the instructor, their teacher, and their fellow students enjoying healthy foods (observation)
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Prospect Theory

Classroom nutrition education	Gain-framed messaging	<ul style="list-style-type: none"> • During each lesson, students learn how each of the food groups contributes to proper body function, energy to play and learn, protection against illness and disease, and overall health and happiness
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Social Ecological Model

Classroom nutrition education	Individual; interpersonal	<ul style="list-style-type: none"> • Attitudes and behaviors related to nutrition and physical activity improve as students acquire knowledge of these topics (individual) • Friends and family members are informed of the importance of nutrition and physical activity via
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Monthly cafeteria tasting events	Institutions/Organizations	<p>homework assignments given during lessons (interpersonal)</p> <ul style="list-style-type: none"> • School food service is altered and enhanced to encourage students to make healthier choices
Student marketing projects	Community	<ul style="list-style-type: none"> • Monthly campaigns led by NAC students serve to change the culture of the school community by emphasizing the importance of healthy diet and physical activity

Health Belief Model

Classroom nutrition education	Perceived susceptibility; perceived benefits; cues to action	<ul style="list-style-type: none"> • Students learn about the risks related to poor diet and lack of physical activity, such as osteoporosis, heart disease, and obesity (susceptibility) • Students learn about the benefits of consuming a healthy diet and engaging in daily physical activity, such as increased energy, better concentration, and strength (benefits) • Students learn how to make healthy food choices and ways to increase physical activity throughout the day (cues to action)
Hands-on learning activities	Self-efficacy	<ul style="list-style-type: none"> • Students practice using resources and tools that aid in making healthy choices

Instrument. To determine whether participation in a NAC lesson led to increased knowledge of lesson-based nutrition concepts, a 9-item multiple choice test aligned with topics discussed during the *Focus on Fruit* lesson was developed by the principal investigator (see Appendix). To protect against an accidental mix up of tests from various school sites and to ensure that pretests could be matched to the appropriate post-tests, the following information was added to the top portion of each test: 1) randomly assigned student number (i.e. 1-55), 2) date of test, 3) time of test, and 4) title of the test indicating pre or post. By noting the date and time each test was given, the location where each test was administered could be identified by the principal investigator, but not by an outside party.

To establish content and face validity, a panel consisting of three elementary school teachers who were familiar with the NAC program was asked to review the test and note any changes they deemed necessary. The only change that was recommended and subsequently implemented included using all capital letters and bold type when the word “not” was used in a question. The purpose of this change was to allow the word “not” to stand out so that students would be less likely to misread the question. The panel unanimously agreed that the content and structure of the questions were acceptable.

To establish reliability, the test-retest method was implemented with a classroom of 35 fifth-grade students within the same school district as the participants, but who were not participating in the NAC program. Parental consent forms were sent home with each student and returned to the classroom teacher prior to the day of the pretest. Each student in the class was invited to take the test on two separate occasions spaced 18 days apart. Only one student failed to obtain consent and, therefore, did not participate in either the pretest or post-test. On the day of the pretest, verbal assent was obtained from all remaining students present in the classroom.

Since three students were absent from school that day, a total of 31 students completed the pretest. One additional student was absent on the day of the post-test, which resulted in a total of 30 students who successfully completed both tests.

Data collection. All data was collected over the course of a two-week period in April during regularly scheduled *Focus on Fruit* classroom lessons led by the principal investigator at all 11 elementary schools in one school district located in southern California. Prior to the start of each lesson, the students who did not receive parental consent were asked to work on other assignments during the testing periods. All other students were informed of the purpose of the study and invited to participate via an assent script read aloud by the principal investigator. All students who agreed to participate were randomly assigned a number between one and 55 and handed a pretest with their designated number. The participants were asked not to begin the test until directed to do so by the principal investigator.

Prior to beginning the pretest, the students were informed that the test consisted of nine, multiple choice questions and that only one answer should be provided for each question. The students were also told that each question and corresponding answer choices would be read aloud, after which they were to circle the answer they thought to be correct. In cases where students did not know the correct answer, they were directed to provide their best guess. The students were reminded that only they would know the specific answers they provided.

Following the instructions, each test question and corresponding answer choices were read aloud to the participants by the principal investigator. Participants were given approximately 15-20 seconds to select their answers to each question before moving on to the next question. Throughout this process, the principal investigator reminded the students that, if

needed, additional time would be provided for returning to unanswered questions after all test questions had been read aloud. In addition, participants had the opportunity to request that certain questions and/or answer choices be read aloud a second time.

When all participants were finished answering the questions, the pretests were collected by the principal investigator and the *Focus on Fruit* lesson was conducted. Immediately following the lesson, students were provided with an identical post-test that was labeled with their student number. Once again, each question and corresponding answer choices were read aloud to the participants by the principal investigator. Once all participants were finished with the post-test, the tests were collected and participants were thanked for their contribution to the study.

Data analysis. Prior to analyzing the data, all answers provided on pretests and post-tests were coded as either correct or incorrect by assigning incorrect answers a value of zero and correct answers a value of one. In addition, total test scores were calculated for all pretests and post-tests. To assess the reliability of the test instrument, Pearson's correlation coefficient was calculated using total test scores obtained during the test-retest procedure. To determine whether participation in the NAC Program lesson led to increases in student knowledge of lesson concepts, two statistical analyses were conducted. First, a paired samples t-test was conducted to determine whether total test scores increased significantly from pre to post. Second, McNemar's exact test was conducted for each test question to determine whether there were significant percentage increases in the number of correct responses provided by participants. All data was analyzed using Microsoft Excel and the significance level for all tests was set at $p=.05$, one-tailed.

Results

At the time the study was performed, there were a total of 345 students in grades three through five participating in the NAC Program. A total of 24 students failed to obtain parental consent and, therefore, did not participate in the study. An additional 13 students who were absent on the day of data collection plus one student who was unable to speak or write in English did not participate. Also, an unforeseen scheduling conflict prevented students at one school site from participating in the complete lesson and data collection activities. Thus, an additional 44 students who had obtained parental consent were unable to participate in the study. Finally, one participant was unable to complete the post-test and, therefore, was not included in final data analyses. The final sample included in the data analyses consisted of 255 participants from 10 of the 11 elementary schools in the district.

The results from the test-retest reliability assessment revealed a moderate relationship between pretest and post-test scores obtained from the sample of 30 fifth-grade students who were not participating in the NAC Program ($r = 0.46, p = 0.05$). Results obtained from the paired samples t test revealed no significant difference between pretest and post-test total scores (pre: $M = 5.74, SD = 1.36$, post: $M = 7.42, SD = 1.38, t(254) = -18.99, p = 5.64$). Conversely, results from McNemar's exact tests revealed significant increases in the percentage of correct answers provided between the pretest and the post-test on eight of the nine test questions (see Table 3).

The pretest answer percentages revealed that the large majority of participants were able to identify foods in the fruit group, understood that fruits contain seeds, and knew that whole fruits were a healthier choice compared to fruit juices or juice drinks prior to participating in the

lesson. In addition, the majority of participants correctly identified the nutrition facts label as the source for determining the quantities of sugar in foods and beverages. Conversely, the majority of participants were unable to identify the specific vitamin associated with healthy eyes/vision and had a limited understanding of portion sizes related to the fruit group prior to the lesson. Between the pretest and post-test, improvements in knowledge were found for all nine test questions; however, the fact that the percentage of correct responses on the sixth question only increased by two points precluded a finding of statistical significance.

Table 3. Pre/Posttest Results for Correctly Answered Test Items

Question	Pretest (%)	Posttest (%)	p	Odds Ratio
1. Which vitamin is good for our eyes?	31.4	82.0	<0.001	11.8
2. Which of these is the healthiest choice?	75.7	88.2	<0.001	4.2
3. Which nutrient is found in fruit?	51.4	79.2	<0.001	8.9
4. Which of these foods is in the fruit group?	76.9	81.6	<0.05	2.2
5. How many cups of fruit should we eat every day?	51.0	82.8	<0.001	5.1
6. Which of these is not in the fruit group?	95.7	97.7	0.113	2.7
7. Where can you look to find out how much sugar is in a food or drink?	71.0	79.2	<0.001	3.6
8. Fill in the blank: We know that a food is in the fruit group if it:	86.7	93.7	<0.001	4.6
9. How much dried fruit is equal to one cup of fresh fruit?	34.5	57.7	<0.001	3.2

Discussion

The results obtained from this study provided a great deal of insight into the effectiveness of the NAC Program. Although the mean total test score did not increase significantly, the fact that the percentage of correct answers provided by participants on eight out of nine test questions increased significantly from pre to post indicated that participation in the NAC Program lesson effectively enhanced student knowledge of lesson concepts. Knowledge of fundamental nutrition concepts has been noted as a key component in improving dietary intake behaviors and, subsequently, addressing the childhood obesity epidemic. Furthermore, knowledge of nutrition concepts has been shown to promote positive attitudes towards healthy lifestyle behaviors and impact decisions related to diet and physical activity (Centers for Disease Control and Prevention [CDC], 2011; Herbert et al., 2013; Powers et al., 2005).

Several previous studies have demonstrated the connection between increased knowledge of nutrition concepts and improved dietary intake behaviors. For example, Powers et al. (2005) assessed changes in knowledge and dietary intake in a sample of 1100 second and third-grade students following exposure to six weekly nutrition lessons. The results indicated significant improvements in knowledge of nutrition concepts as well as in the consumption of fruits, vegetables, and dairy foods between pre/post assessments. Similarly, Wall et al. (2012) found improvements in attitude, preference, and self-efficacy paired with increased knowledge related to vegetable consumption in a sample of more than 2,000 fourth-grade students exposed to a nutrition education curriculum.

In the current study, it was interesting to find that the large majority of participants were able to correctly answer five of the nine test questions prior to participating in the lesson. The

concepts addressed in these questions included: 1) whole foods are generally healthier than processed foods, 2) identification of foods in the fruit group, 3) understanding nutrition facts labels, and 4) parts of the plant. There are a few possible explanations for this finding. First, it is important to note that the Focus on Fruit lesson included in this study was the second to last lesson scheduled for the school-year. All other food groups had been discussed during previous lessons and all of the concepts addressed in the five above-mentioned questions had been touched on at least once prior to the Focus on Fruit lesson.

Another possible explanation is that participants had been exposed to some or all of the concepts covered in the Focus on Fruit lesson prior to their participation in the NAC Program. This exposure could have come from the family environment, the educational setting, the Internet and/or social media, or a combination of these sources. In terms of the educational setting, the fact that the NAC Program was developed to align with the California Health Education Content Standards makes it nearly impossible to avoid overlap among NAC Program concepts and concepts covered in the regular school curriculum (California State Board of Education, 2008). In fact, overlapping of concepts throughout the educational experience is encouraged since greater exposure to concepts increases the likelihood that students will fully comprehend those concepts (Powers et al., 2005).

Further, the fact that fruits are naturally sweeter than most vegetables and are consumed in greater quantities makes it likely that the participants were more familiar with this food group going into the lesson. A recent report published by the CDC (2014) noted that the amount of whole fruit consumed by children between the ages of one and 18 increased by 67% between 2003 and 2010. Conversely, nine in 10 children failed to consume the recommended quantities of vegetables as of 2010. Regardless of the specific factor(s) that led the majority of participants

to answer several of the questions correctly on the pretest, the fact that significant improvements in the percentage of correct answers provided were identified on all but one test question demonstrated the positive influence of the NAC Program on participants' knowledge of lesson-based concepts.

However, there were several limitations to this study. First, the use a convenience sample and lack of a control group prevents the results of this study from being generalized to other populations. That being said, there are no other school districts known to have implemented the specific version of the NAC Program evaluated for this study. Subsequently, the need for generalization may not exist at this point in time. Rather, the primary benefit of this study at present is the production of preliminary data related to the program's effectiveness, which may be used to strengthen and enhance the program moving forward. Perhaps with further study and consistent results related to this specific NAC Program other school districts might benefit from its use in the future.

Another limiting factor was the inclusion of a test instrument that had not been previously deemed valid or reliable. Since the results of the test-retest reliability analysis revealed only a moderate relationship between pretest and post-test scores, it is possible that specific test questions or the test as whole was not a reliable measure of knowledge. That being said, the fact that the program and specific lesson being evaluated were unique to one school district prevented the use of a previously validated and reliable measure. Should additional studies related to the effectiveness of this program be conducted in the future, additional time and resources should be allotted to the development and testing of a valid and reliable instrument.

The failure to collect demographic data posed another limitation to this study. Due to time constraints and strict rules related to the release of personally identifiable information of minors, only the grade level of the participants was known. It would have been interesting to determine whether age, gender, ethnicity, and/or socioeconomic status had any influence on knowledge levels both before and after the intervention. Any future investigations related to this program should include demographic information if at all possible.

Finally, this study was limited by the fact that knowledge was the only outcome variable assessed. Further limitations arose from the lack of long-term follow-up to determine whether improvements in knowledge were sustained over time. In addition, it was not possible to determine whether improvements in knowledge led to positive changes in dietary intake behavior and/or reductions in the prevalence of overweight or obesity in the sample of participants. Despite these limitations, an abundance of other preliminary investigations of nutrition education programs focused solely on knowledge gains. For example, studies conducted by the Dairy Council of California (2013) and Duffrin et al. (2010) focused solely on changes in knowledge of nutrition concepts following nutrition education program interventions.

Conclusion

Childhood obesity has increased dramatically over the last 30 years and continues to pose a significant threat to public health both in the U.S. and abroad. Although a number of research studies have shown promising results and steps are being taken to reverse the rising obesity trend, researchers and experts alike have yet to determine the most effective elements of school-based obesity prevention programs. The results of the current study added to the growing body of evidence demonstrating the effectiveness of nutrition education programs, like the NAC

Program, that serve to increase knowledge of essential nutrition concepts. While enhancing knowledge of nutrition concepts seems to play a vital role in enhancing dietary intake behaviors, further research is needed to determine the long-term impact of knowledge gains on the prevalence of childhood obesity.

Recommendations for Future Research

The findings from this preliminary study of the effectiveness of the NAC Program offered at one California school district not only added to the growing body of evidence in favor of school-based obesity interventions, but also presented several topics for further investigation. First, future investigations should assess the long-term impact of participation in the NAC Program. Whether gains in knowledge related to lesson participation remain six months or more following conclusion of each lesson has yet to be determined. The level of knowledge improvement that occurs over the course of the entire NAC Program has also not yet been determined. It would be beneficial to examine knowledge of lesson concepts both before and after program implementation as well as before and after each individual lesson.

In addition, it would be beneficial to include assessments of dietary intake behaviors, attitudes, self-efficacy, and anthropometric measures in future investigations. Although the notion that increased knowledge of nutrition concepts leads to positive changes in dietary behavior has been widely accepted, whether this is true for NAC Program participants has yet to be confirmed. Further, the fact that physical activity, an equally important factor in the obesity epidemic, is addressed in the NAC Program makes assessment of this factor a vital component of future investigations. The true test of the efficacy of the NAC Program will ultimately be the effect of the program on the behaviors and health of the participants.

References

- Avery, G., Johnson, T., Cousins, M., & Hamilton, B. The school wellness nurse: A model for bridging gaps in school wellness programs. *Pediatric Nursing*, 39(1), 13-17. Retrieved from Ebscohost.
- Berger-Jenkins, E., Rausch, J., Okah, E., Tsao, D., Nieto, A., Lyda, E., ..., McCord, M. (2014). Evaluation of a coordinated school-based obesity prevention program in a Hispanic community: Choosing healthy and active lifestyles for kids/healthy schools healthy families. *American Journal of Health Education*, 45, 261-270. Retrieved from Ebscohost.
- Berlin, L., Norris, K., Kolodinsky, J., & Nelson, A. (2013). The role of social cognitive theory in farm-to-school-related activities: Implications for child nutrition. *Journal of School Health*, 83, 589-595. Retrieved from Ebscohost.
- Budd, G. M., & Volpe, S. L. (2006). School-based obesity prevention: Research, challenges, and recommendations. *Journal of School Health*, 76(10), 485-495. Retrieved from Ebscohost.
- Burke, R. M., Meyer, A., Kay, C., Allensworth, D., & Gazmararian, J. A. (2014). A holistic school-based intervention for improving health-related knowledge, body composition, and fitness in elementary school students: An evaluation of the HealthMPowers program. *International Journal of Behavioral Nutrition and Physical Activity*, 11(78). Retrieved from PubMed.

- California Department of Public Health. (2013). Harvest of the month. Retrieved from <http://www.harvestofthemonth.cdph.ca.gov/download/HOTMOverviewFlyer.pdf>
- Centers for Disease Control and Prevention. (2011). School health guidelines to promote healthy eating and physical activity. *Morbidity and Mortality Weekly Report*, 60(5), 1-76. Retrieved from <http://www.cdc.gov/mmwr/pdf/rr/rr6005.pdf>
- Centers for Disease Control and Prevention. (2013). Health equity resource toolkit for state practitioners addressing obesity disparities. Retrieved from <http://www.cdc.gov/obesity/downloads/CDCHealthEquityObesityToolkit508.pdf>
- Centers for Disease Control and Prevention. (2014). Progress on children eating more fruit, not vegetables. Retrieved from <http://www.cdc.gov/vitalsigns/fruit-vegetables/>
- Champion, V. L., & Skinner, C. S. (2008). The health belief model. In K. Glanz, B. K. Rimer, & K. Viswanath (eds.) *Health behavior and health education: Theory, research, and practice* (pp. 45-65). San Francisco, CA: John Wiley & Sons, Inc.
- Dairy Council of California. (2013). Nutrition pathfinders: Formative evaluation results of fourth grade students participating in a nutrition education program. Retrieved from http://www.healthyeating.org/Portals/0/Documents/Schools/Evaluations/NP4_Evaluation.pdf
- Duffrin, M. W., Hovland, J., Carraway-Stage, V., McLeod, S., Duffrin, C., Phillips, S., ..., & Berryman, D. (2010). Using food as a tool to teach science to 3rd grade students in Appalachian Ohio. *Journal of Food Science Education*, 9, 41-46. Retrieved from Ebscohost.

- Eliassen, E. K., & Wilson, M. W. (2007). Selecting appropriate elementary school nutrition education resources. *American Journal of Health Studies, 22*(4), 224-227. Retrieved from Ebscohost.
- Fahlman, M. M., Dake, J. A., McCaughtry, N., & Martin, J. (2008). A pilot study to examine the effects of a nutrition intervention on nutrition knowledge, behaviors, and efficacy expectations in middle school children. *Journal of School Health, 78*, 216-222. Retrieved from Ebscohost.
- Falter, R. A., Pignotti-Dumas, K., Popish, S. J., Petrelli, H. M., Best, M. A., & Wilkinson, J. J. (2011). A service learning program in providing nutrition education to children. *American Journal of Pharmaceutical Education, 75*(5), 1-7. Retrieved from Ebscohost.
- Greening, L., Harrell, K. T., Low, A. K., & Fielder, C. E. (2011). Efficacy of a school-based childhood obesity intervention program in a rural southern community: TEAM Mississippi project. *Obesity, 19*, 1213-1219. Retrieved from Ebscohost.
- Herbert, P. C., Lohrmann, D. K., Seo, D. C., Stright, A. D., & Kolbe, L. J. (2013). Effectiveness of the Energize elementary school program to improve diet and exercise. *Journal of School Health, 83*, 780-786. Retrieved from Ebscohost.
- Irwin, C. C., Irwin, R. L., Miller, M. E., Somes, G. W., & Richey, P. A. (2010). Get fit with the grizzlies: A community-school-home initiative to fight childhood obesity. *Journal of School Health, 80*, 333-339. Retrieved from Ebscohost.

- Katz, D. L., Katz, C. S., Treu, J. A., Reynolds, J., Njike, V., Walker, J., . . . , & Michael, J. (2011). Teaching healthful food choices to elementary school students and their parents: The Nutrition Detectives Program. *Journal of School Health, 81*, 21-28. Retrieved from Ebscohost.
- McAlister, A. L., Perry, C. L., & Parcel, G. S. (2008). How individuals, environments, and health behaviors interact. In K. Glanz, B. K. Rimer, & K. Viswanath (eds.) *Health behavior and health education: Theory, research, and practice* (pp. 169-188). San Francisco, CA: John Wiley & Sons, Inc.
- McGaffey, A., Hughes, K., Fidler, S. K., D'Amico, F. J., & Stalter, M. N. (2010). Can Elvis Pretzley and the Fitwits improve knowledge of obesity, nutrition, exercise, and portions in fifth graders? *International Journal of Obesity, 34*, 1134-1142. Retrieved from Ebscohost.
- Morris, J. L., Koumjian, K. L., Briggs, M., & Zidenberg-Cherr, S. (2002). Nutrition to Grow On: A garden-enhanced nutrition education curriculum for upper-elementary schoolchildren. *Journal of Nutrition Education and Behavior, 34*(3), 175-176. Retrieved from Ebscohost.
- Nihiser, A., Merlo, C., & Lee, S. (2013). Preventing obesity through schools. *Journal of Law, Medicine, & Ethics, 41*, 27-34. Retrieved from Ebscohost.
- National Cancer Institute. (2013). Nutrition to Grow On. Retrieved from <http://rtips.cancer.gov/rtips/programDetails.do?programId=1073505>
- Nihiser, A., Merlo, C., & Lee, S. (2013). Preventing obesity through schools. *Journal of Law, Medicine, & Ethics, 41*, 27-34. Retrieved from Ebscohost.

- Powers, A. R., Struempler, B. J., Guarino, A., & Parmer, S. M. (2005). Effects of a nutrition education program on the dietary behavior and nutrition knowledge of second-grade and third-grade students. *Journal of School Health, 75*(4), 129-133. Retrieved from Ebscohost.
- School Nutrition Association. (2005). NAC handbook. Retrieved from <http://ww2.schoolnutrition.org/Content.aspx?id=1892>
- School Nutrition Association of North Carolina. (2014). Nutrition advisory council handbook "Getting Started". Retrieved from http://www.sna-nc.org/NC-NAC_Getting_Started-2014.pdf
- United States Department of Agriculture. (2007). Nutrition education research brief: Message framing, use of interactive technology to tailor messages, and intervention intensity. Retrieved from <http://www.fns/usda.gov/oane>
- United States Department of Health and Human Services. (2010). Dietary guidelines for Americans, 2010. Retrieved from <http://www.health.gov/dietaryguidelines/2010.asp>
- Wall, D. E., Least, C., Gromis, J., & Lohse, B. (2012). Nutrition education intervention improves vegetable-related attitude, self-efficacy, preference, and knowledge of fourth-grade students. *Journal of School Health, 82*, 37-43. Retrieved from Ebscohost.

Appendix

Data Collection Instrument

Student Number: _____ **Date:** _____ **Time:** _____

Instructions

Read each question carefully and circle the correct answer. **There will only be ONE CORRECT ANSWER for each question.**

- 1) _____ **Which vitamin is good for our eyes?**
 - a. Vitamin C
 - b. Vitamin A
 - c. Vitamin D

- 2) _____ **Which of these is the healthiest choice?**
 - a. 100% Orange Juice
 - b. Sunny Delight
 - c. A whole orange

- 3) _____ **Which nutrient is found in fruit?**
 - a. Fiber
 - b. Protein
 - c. Fat

- 4) _____ **Which of these foods is in the fruit group?**
 - a. Corn
 - b. Cucumber
 - c. Peanuts

- 5) _____ **How many cups of fruit should we eat every day?**
- 1 cup
 - 2 cups
 - 3 cups
- 6) _____ **Which of these is NOT in the fruit group?**
- Raisins
 - 100% orange juice
 - Orange flavored soda
- 7) _____ **Where can you look to find out HOW MUCH sugar is in a food or drink?**
- The front of the package
 - The nutrition facts label
 - The ingredients list
- 8) _____ **Fill in the Blank: We know that a food is in the fruit group if it _____.**
- Grows in a pod
 - Tastes sweet
 - Has seeds
- 9) _____ **How much dried fruit is equal to 1 cup of fresh fruit?**
- $\frac{1}{2}$ cup
 - 1 cup
 - 2 cups