Examining Associations between Parental and Peer Social Support and Positive Health Behaviors in Adolescents

Presented by Amier Haissam Haidar

in partial fulfillment of the requirements for completion of the Health Science Scholars honors program in the College of Natural Sciences at The University of Texas at Austin

Spring 2018

Deanna M. Hoelscher, Ph.D., RDN, LD, CNS
Supervising Professor
Department of Nutritional Sciences
Department of Health Promotion and Behavioral Sciences
UTHealth School of Public Health

Date

Nalini Ranjit, Ph.D.
Second Reader
Department of Nutritional Sciences
Department of Health Promotion and Behavioral Sciences
UTHealth School of Public Health

Date

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

I would like to give my greatest appreciation to my mentor, Dr. Deanna Hoelscher. Having Dr. Hoelscher as a mentor was the greatest opportunity I have received during my time at UT. She, personally has opened my eyes to the world of public health and she truly has made it a joy to come to conduct public health research. Being able to learn from her and work with her has been the greatest experience I could have asked for. Thank you for continually supporting me and allowing me to independently conduct research at the UT School of Public Health. Thank you for providing invaluable mentorship, and introducing me to the field I plan to contribute to for the rest of my life.

Thank you to Carolyn Smith and the research team of the School Physical Activity and Nutrition project (SPAN) for providing data for this study and allowing me to contribute to the completion of this project. I would also like to thank Dr. Nalini Ranjit, for spending time teaching me how to use STATA, and conduct data analysis using it, and for reviewing my work and providing valuable feedback throughout this process. Lastly, I would like to thank Dr. Leanne Field, for providing valuable support during the writing process and for helping hone my writing skills. I am much better and more confident writer because of you.

List of Tables

List of Figures

ABSTRACT

Parental and peer support has been shown to have an influence on adolescent dietary and physical activity behaviors. However, these associations have not been fully elucidated in multi-ethnic populations in early and late adolescence, and few studies have examined parental/peer support in school-based interventions that include a parental component in adolescent populations. The objective of this article is to present the results of two studies that examine the relationships between parental and peer support and adolescent diet and physical activity behaviors.

The aim of the first study was to investigate associations between parental/peer social support, and adolescent's physical activity and dietary behaviors, utilizing the School Physical Activity and Nutrition (SPAN) survey data, collected from 8th and 11th graders in 2009-2011. The SPAN survey is a cross-sectional statewide probability-based survey, used to assess obesity-related behaviors. Results from this study revealed that parental and peer support is associated with healthier dietary and physical activity behaviors in adolescents.

The objective of the second study was to understand the dietary, physical activity, and weight-related effects of a school-based intervention with a parental support component on adolescents using the CATCH Middle School Project. The CATCH Middle School Project is a school-based health program to promote obesity prevention and related behaviors (diet, physical activity) among middle school 8th grade students living in central Texas. A group-randomized serial cross-sectional design was used to evaluate the effect of three program conditions. Adolescents in the intervention condition with a parental support component experienced the greatest significant increases in fruit, vegetable, and water consumption, as well as reporting an increase in overall support from parents.

Data from these studies show: (1) parental/peer support is associated with healthier obesity-related behaviors, and (2) including parents in a school-based intervention program was shown to increase the healthfulness of adolescents' diets. Future research should focus on strategies to increase parental/peer support for healthy eating and physical activity behaviors that could potentially be integrated into school health programs for adolescents.

BACKGROUND

Public Health Significance

Obesity is a serious public health issue in the United States and has been on the rise among adolescents for the past 25 years [1,2]. From 1988 to 2014, obesity more than quadrupled in adolescents, with 8% of 12-19 year olds being classified as extreme obesity (BMI at or above 120% of the 95th percentile) and 20.5% being classified as having obesity (BMI at or above the 95th percentile) [1]. In 2014, nearly 6.3% of adolescents met the criteria for Class II obesity (BMI at or above 120% of the 95th percentile) and 2.4% met the criteria for Class III obesity (BMI at or above 140% of the 95th percentile) [2]. Specifically, Texas ranks 15th among states with the highest rates of 10-17 year old children with obesity, with 33% of adolescents in Texas being classified as having overweight or obesity [3,4]. These statistics for the US and Texas are of great concern because obesity can have adverse effects such as increased cardiometabolic risk, diabetes, asthma, and the later development of cancers, as well as the fact that obesity has been shown to persist into adulthood and lead to physical morbidity and premature mortality [5,6].

Factors that Impact Childhood Obesity

A multitude of factors have been shown to influence childhood obesity, such as physical activity, and dietary behaviors. The USDHHS Physical Activity Guidelines recommend that children exercise for at least 60 minutes a day [7]. This requirement is largely unmet by adolescents in Texas, with only 30% of adolescents engaging in physical activity for at least 60 minutes every day [3]. This is important to note because obesity has been correlated with decreases in physical activity and increases in sedentary activity [8,9]. A meta-analysis conducted by Zhang et al. found that increased sedentary behaviors such as TV watching was associated with

increased risk of childhood obesity and that restricting TV watching and other sedentary behaviors allowed children to engage in physical activity and to decrease their energy intake [8].

An important factor in the development of obesity in adolescents is dietary intake. It is well known that a healthy diet is rich in fruits and vegetables, and low in sugary foods and drinks [10]. Diets rich in fruits and vegetables, and low in sugary foods and drinks have been found to be associated with lower body mass index (BMI) [11-14]. However, research has shown that adolescents in the US still do not consume enough fruits and vegetables, and do not meet the requirements of around 2-3 cups per day [15,16]. This is significant because fruit and vegetable consumption has long been known to reduce the risks of many diseases and cancers and to help manage body weight, by either reducing weight gain or leading to a reduction in body weight [11,17]. The consumption of sugary beverages and added sugars is still highly prevalent among children and adults in the US, with added sugars intake still above the recommended level of 10% of total energy intake [18]. This is despite the fact that numerous studies have associated higher consumption of sugary beverages, and a diet abundant in added sugars, with weight gain [19-22].

Home food availability of healthy and unhealthy foods is another factor that has been demonstrated to impact childhood obesity [23,24]. A study conducted by Campbell and colleagues, on 12-13 year old adolescents in Australia, showed that the availability of unhealthy foods in the home environment was a strong predictor of the consumption of obesity promoting foods [24]. Another study conducted by Arcan and researchers, on kindergarten children in South Dakota revealed that families with a greater availability of vegetables and healthful foods had children with a higher probability of being at a normal weight and a lower probability of being obese [23]. The availability of obesity-promoting foods in the home promotes the consumption of those

foods, so by removing them or limiting their availability, and increasing the availability of healthful foods, the diet of children and adolescents is shaped into a healthier one [24].

Social Support for Adolescents

Social support can be classified into emotional support, esteem support, informational support, and instrumental support [25]. There are many different ways in which parents and peers can engage in and exhibit social support for physical activity or a healthy diet. They can support adolescents by modeling healthy behaviors, encouraging healthy dieting behaviors, discouraging unhealthy dieting behaviors, and ensuring healthy foods are available in the home. They can also provide support for physical activity by exercising together, encouraging physical activity, and promoting physical activities over sedentary activities.

Parents play an important role in the lives of their children. Parental behavior influences what children learn, how they respond to the external environment, and what they expect of themselves [26]. As such, parents are the gatekeepers to what their children eat and can influence the dietary behaviors that they develop over time [27]. Adolescents, in particular, are a difficult age group for parents because children age 12 to 19 feel a greater sense of autonomy and begin to make their own decisions, especially in regards to lifestyle choices for diet and physical activity [28,29]. This is a normal part of growing up and only becomes problematic when adolescents start making bad decisions, especially in terms of diet [28]. However, parents still have an important role to play in supporting their children by ensuring that healthy foods are available in the home and by modeling and encouraging healthy behaviors for their children [27]. The objective of this article is to present the results of two studies that examine the relationships between parental and peer support and adolescent diet and physical activity behaviors, through associational analyses as well as intervention effects.

STUDY ONE

INTRODUCTION

Parental Influence on Adolescent Physical Activity and Diet

Parents have been shown to have a strong influence on adolescent physical activity. A study conducted in 2007 by Ornelas et al. showed that parental engagement and support significantly predicted adolescent physical activity and that family cohesion, parent-child communication, and parental engagement were factors that determined whether adolescents met the recommended physical activity guidelines one year later [30]. A meta-analysis carried out by Gustafson and Rhodes, which examined 34 studies conducted from 1992 to 2003, revealed a strong association between parental support and child physical activity level, and that effective support can manifest in the form of encouragement, involvement, or facilitation [31]. A more recent meta-analysis conducted in 2015 by Yao and Rhodes encompassed 112 studies and found only a small association between parent physical activity and child physical activity, with greater physical activity in parents associated with greater physical activity in children [32]. A noteworthy finding in that meta-analysis was that parental support had a moderate effect size on child physical activity, and that parental encouragement had the greatest effect [32]. A study conducted by Jago et al. in 2010 indicated that the overall sedentary time of parents was associated with the sedentary time of daughters, and that high parental TV viewing increased the risk that children spent more than 4 hours per day watching TV [33]. These studies demonstrate the effects parents can have on either the sedentary activity or physical activity levels of their children.

Parents can help their children develop healthful dietary behaviors by supporting them in eating healthy and by modeling healthful eating. A study conducted by Lopez et al. in 2012,

found that parent-mediated behaviors, such as visits to fast-food restaurants and total screen time were associated with greater consumption of sugary beverages [34]. This study also found that greater parent support for healthful eating was associated with less consumption of sugary beverages [34]. Parents were also shown to have an effect on unhealthy food consumption. Parents who modeled healthy behaviors such as portion control and controlled access to unhealthy foods had children who consumed less fat in their diets [35]. Several studies have found a positive association between parental fruit and vegetable consumption and child fruit and vegetable consumption [36-38]. A study conducted by Rodenburg et al. found that parent fruit consumption and parental education were positively associated with child fruit consumption, and parental fruit consumption partially mediated the association between parental education and child fruit consumption [38]. This study is significant in that it showed the importance of parental involvement related to how healthy the child ate. The results of a study conducted by Miller et al. in 2011, showed that children's daily consumption of fruits and vegetables was closely related to their mothers' consumption patterns, reiterating the importance of parental modeling of healthful behaviors towards their children.

Home food availability of healthy and unhealthy foods, also controlled typically by parents, is another factor that has been demonstrated to impact childhood obesity [23,24]. A study conducted by Harris and Ramsey in 2015, suggested that increased availability of healthy foods and decreased availability of unhealthy foods at home may lower the likelihood of children consuming sugary beverages and increases the healthfulness of their diets [39]. A 2007 study conducted by Campbell et al. showed that the primary caregiver provides the food available for the adolescent to eat and that the availability of unhealthy foods at the home was a significant predictor of the consumption of unhealthy foods and beverages [24]. Parental eating attitudes have

also been shown to predict the healthfulness of the available foods at the home [40]. Mothers that had high levels of concern for healthy eating were more likely to have home environments that supported healthy eating [40].

Peer Influence on Adolescent Physical Activity and Diet

Adolescents spend much of their time with their peers. Peers can have a strong influence on many of the decisions that adolescents make. Adolescents are also significantly influenced by their peers in many ways, but there is limited information about the effects peers have influencing each other with respect to diet, and these studies generally focus on a limited age range or homogeneous populations [41]. A systematic review of peer influence on diet in adolescents found that dietary behaviors of adolescents were positively related to those of their peers [41]. Peer support by encouraging healthy eating was also associated with healthy eating intentions and healthy eating behaviors among adolescents [42]. One study found that peers had no significant effect on dietary intake [43]. Another study conducted on African American adolescents found that boys received more support from their peers to eat healthy foods than did girls, and girls actually received no peer support for healthy eating [44]. These findings are also similar to a study conducted by Bruening et al. which found that positive dietary behaviors by peers were associated with positive dietary behaviors in adolescents and that friends exhibited similarities in their healthy eating patterns [45]. A study conducted by Finnerty and coworkers found that peers did not have a significant effect on dietary intake [43]. Overall, more research is needed to determine the associations between peer support for a healthy diet and adolescent dietary behaviors.

Many studies have also examined whether peers can influence adolescent physical activity behaviors [41]. One study found that peers had a significant effect on each other's physical

activity levels [43]. Another study conducted among African American adolescents found that boys received more support from their peers to engage in physical activity than did girls, and girls reported receiving no peer support for physical activity [44]. A study conducted by Ling et al. in 2014 showed that among 5th-7th grade girls, parents (especially mothers), rather than peers, were the primary means of social support for physical activity [46]. A review of the literature of peer influence on physical activity, conducted in 2012, revealed that peer support and the presence of peers during physical activity were associated with increased physical activity, and that the power of this association may be greater for overweight adolescents [47].

Review of the School Physical Activity and Nutrition Project

The SPAN project was established in 2000, as a surveillance system to monitor the prevalence of overweight/obese school-aged children in Texas. SPAN includes administration of a survey to 2nd, 4th, 8th, and 11th grade students throughout a randomly selected sample of schools in Texas. This survey allows researchers to identify and track trends in childhood obesity, as well as to identify factors that may underlie obesity, including dietary behaviors, physical activity, nutrition knowledge and attitudes, and other behaviors. To date, four SPAN surveys have been conducted, in 2000-2002, 2004-2005, 2009-2011, and 2015-2016. To date, 24 peer-reviewed articles summarizing the SPAN project have been published. Many of the more recent studies have examined trends and associations with physical activity behaviors. Case and colleagues found that obese and overweight boys and girls who were bullied had higher odds of not meeting physical activity recommendations [48]. Another study revealed that girls who participated in less than three days of exercise per week had higher odds of being obese than girls who participated in exercise three or more days a week [49]. Many of the SPAN studies have also found associations with certain dietary behaviors. Ranjit et al. revealed that soda consumption and sports beverage

consumption was positively associated with a multitude of unhealthy dietary practices and sedentary behaviors, as well as soda consumption being negatively associated with consumption of healthy items, while sports beverage consumption was positively associated with consumption of healthy items [50]. Dortch et al. found that sports participation was associated with greater consumption of fruits and vegetables and lower consumption of soda [51]. Results of studies stemming from SPAN project can inform the design and implementation of new programs and interventions for children and adolescents to help achieve the goal of healthy children in a healthy world.

Objective

Despite the studies that have elucidated the effects of parental and peer support on physical activity and dietary behaviors, no studies have included diverse populations at two distinct developmental levels – middle and high school adolescents. Examining two distinct age groups in an ethnically diverse population will allow for further understanding of the associations between parental/peer support for physical activity and healthy diet, parental disapproval for unhealthy eating and not exercising, and dietary and physical activity behaviors in adolescents. This will allow for the development of strategies and programs that can effectively target parents and peers, to improve diets, increase physical activity, and decrease sedentary activity in adolescents. The objective of this project was to investigate associations between perceived parental/peer social support, perceived parental disapproval for unhealthy behaviors, and adolescents' dietary and physical activity behaviors, utilizing SPAN data collected from 8th and 11th grade students in 2009-2011.

METHODS

Study Design

SPAN is a cross-sectional statewide survey administered to school-aged children and adolescents throughout Texas. It is used to monitor the prevalence of child and adolescent overweight status, as well as health behaviors such as diet and physical activity [52]. The SPAN study provides data both at the state level and for each of the Texas Department of State Health Services public health regions [52]. SPAN uses a stratified, multistage sampling plan to obtain state representative data when stratified by race/ethnicity (African American, Hispanic and White/Other), gender, school grade (4th, 8th, and 11th), and by Texas Health Service Region [52]. Approval for the SPAN study was obtained from the Committee for the Protection of Human Subjects at the University of Texas Health Science Center at Houston (UTHealth) and the Texas Department of State Health Services Institutional Review Board. Participating school districts also reviewed study protocols for compliance with school district human subjects and research regulations. Further descriptions of the SPAN study and methods are presented elsewhere [52-54].

Participants

The SPAN 2009-2011 study included measurement of 6,716 8th and 11th grade students, with the aim of capturing distinct developmental stages of early and late adolescence. Data obtained from the Texas Education Agency (TEA) for public school enrollment during the 2009–2010 school year were used as the reference base for the sampling plan. The sampling frame for SPAN 2009–2011 included 3,931 8th graders and 2,785 11th graders, representing 310,045 8th grade and 272,122 11th grade students, respectively, in the state of Texas.

Data Collection

Study participants completed a self-administered questionnaire that was tailored to 8th/11th grade students. The questionnaires were adapted from the School-Based Nutrition Monitoring (SBNM) survey, which is an elementary-level and secondary-level surveillance instrument, designed to assess nutrition and physical activity behaviors and nutrition knowledge and attitudes [55-57]. The SPAN survey and protocols were developed, pilot tested, and assessed for reproducibility as part of the SBNM project [55-57].

Trained and certified project staff conducted data collection at both state and county levels, with assistance from state and county personnel. Height and weight were objectively measured by study staff using standard protocols to determine body mass index (BMI). BMI was used to categorize weight status (e.g., overweight, obesity) for adolescents of the same age and sex using the CDC growth charts.

Demographic data for the students were self-reported on the survey, and included gender and grade (8^{th} or 11^{th}). Self-reported race/ethnicity was collapsed, for analytic purposes, into 3 categories: African American, Hispanic/Latino, or White/Other. White/Other included non-Hispanic white, Native American, Asian, Pacific Islander, or "other" [52]. Other race/ethnicity accounted for only 3% of the total Texas population.

Parents' education level was measured based on two survey items, which asked students about the highest level of education their mother and father had completed. Mother's and father's education level was combined into a single variable and dichotomized as "at least some college" if at least one parent had completed some college, a college degree, or a graduate or professional degree versus "high school or less" if both parents had only completed high school/a GED or had completed less than high school. Socioeconomic status was assessed at the school level, not the

individual level, and was measured based on the percentage of students who received free and reduced price lunches within the adolescents' schools.

Measures for Diet Variables

Measures in this study included parental and peer support for a healthy diet, perceived parental disapproval for unhealthy eating, sugary beverage consumption, fruit and vegetable consumption, home food availability, and an overall SPAN healthy eating score. In the SPAN survey, parental support and peer support measures were adapted from validated questions [58,59]. Parental support for a healthy diet was measured with three questions: I have parents or guardians who… "eat lots of fruits and vegetables with me", "drink water instead of a soft drink with me", and "want me to eat breakfast every morning". Peer support for a healthy diet was measured with the same questions only starting with "I have friends who…" The responses were never, almost never, sometimes, almost always, and always. These responses were numbered from 0-4 for each of the three questions and an overall scale was created that ranged from 0 (least support) to 12 (most support). Perceived parental disapproval for unhealthy eating was assessed with "How upset would your parents feel if they found out you were eating a lot of junk food?" The response options were 1) not at all upset, 2) a little upset, 3) pretty upset, and 4) very upset. Cronbach's alpha for this scale was 0.55. The responses were then dichotomized into pretty upset or very upset, and a little upset or not upset [60].

Items assessing consumption of various index foods were evaluated for reliability and validity [55]. To assess sugary beverage consumption, the responses to two questions were combined to create a scale, "Yesterday, how many times did you drink any punch, Kool-Aid®, sports drinks, or other fruit-flavored drinks? Do not count 100% fruit juice." and "Yesterday, how many times did you drink any regular (not diet) sodas or soft drinks?". The responses for

sugary beverage consumption ranged from 0 to 5 or more times per day and the responses were collapsed into two categories: 1) those that consumed 0 or 1 sugary beverages the previous day and 2) those that consumed 2 or more sugary beverages the previous day. To determine how often the students consumed fruits and vegetables, five questions were used: “Yesterday, how many times did you eat any starchy vegetables like potatoes, corn, or peas?”, “Yesterday, how many times did you eat any orange vegetables like carrots, squash, or sweet potatoes?”, “Yesterday, how many times did you eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?”, “Yesterday, how many times did you eat any other vegetables like peppers, tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery or artichokes?”, and “Yesterday, how many times did you eat fruit? Fruits are all fresh, frozen, canned, or dried fruits. Do not count fruit juice.”. The responses to these questions ranged from 0 to 5 or more times per day and the responses were summed and collapsed into two groups: 1) those that consumed no fruits and vegetables the previous day, and 2) those that consumed 1 or more fruits and vegetables the previous day. Converting to binary variables was done in order to reduce potential bias from over-reporting.

Home food availability was assessed by asking how often 100% fruit juice, fresh fruit, and fresh vegetables were available in the home. As before, conversion to a binary measure was done in order to reduce potential bias from over-reporting, so the responses to these questions were summed and collapsed into two groups: 1) some of the time/never, and 2) most of the time/all of the time.

A healthy eating score was used to determine the healthfulness of the overall diet of the adolescent, based on the SPAN Healthy Eating Index [61]. The SPAN Healthy Eating Index created summary scores for unhealthy and healthy food indices, based on sum of the responses

from food items from the survey; this calculation is done separately for healthy and unhealthy foods. Each question began with "Yesterday, how many times did you…" and the possible answer choices were "0 times, 1 time, 2 times, 3 times, 4 times, and 5 or more times." To calculate this score, the responses to each question were dichotomized into "0=No" or "1=Yes", as in the adolescent did eat at least one serving of a food the previous day or did not eat it. Then certain questions were grouped based on whether or not they were describing a healthy item or unhealthy item. Healthy foods consisted of 13 items: nuts, milk, yogurt, whole wheat (or brown) rice or pasta, whole grain cereal, any type of vegetable, beans, fruit, 100% fruit juice, and water. Unhealthy foods consisted of 12 items: red meat, cheese, white bread, French fries, fruit flavored drinks, soda, diet soda, caffeine, frozen desserts, cakes, candy, and restaurant food. The scores were then scaled so each ranged from 0 to 100 points and unhealthy food scores were subtracted from the healthy food scores to create an overall healthy eating score, with possible range from −100 to 100. Earlier studies using the SPAN Healthy Eating Index suggest that the measure has good predictive validity, and varies reliably with a number of home food- environment measures [61]. Percent missing for the diet variables ranged from 0-0.5%, with 0, 0, 0, and 32 participants with missing data for fruits and vegetables, sugary beverages, home food availability, and healthy foods score, respectively.

Measures for Physical Activity Variables

Measurements analyzed in this study included parental and peer physical activity support, perceived parental disapproval for not exercising, and adolescent physical activity measures, including: amount of moderate physical activity, amount of vigorous physical activity, amount of sedentary activity, and an overall physical activity score. In the SPAN survey, two types of physical activity social support were examined: parental support and peer support. Parental and

peer support for physical activity were validated measures [62,63]. Parental support was measured with three questions: I have parents or guardians who… "want me to exercise or be physically active", "exercise with me", and "spend time teaching me to play a sport or do a physical activity". Peer support was measured with the same questions, only with a stem of "I have friends who…" The answer choices to each of the three questions were never, almost never, sometimes, almost always, and always. Each question had responses ranging from 0-4, which were then summed to create a total overall range from 0 (least support) to 12 (most support). Perceived parental disapproval for not exercising was assessed with the question, "How upset would your parents feel if they found out you were not exercising?" The answer choices were 1) not at all upset, 2) a little upset, 3) pretty upset, and 4) very upset. The responses were then dichotomized into pretty upset or very upset, and a little upset or not upset.

Physical activity was measured by two questions: "During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?" and "On how many of the past 7 days did you exercise or take part in physical activity that made your heart beat fast and made you breathe hard for at least 20 minutes?". The responses to these questions were collapsed based on physical activity recommendations by the USDHHS Physical Activity Guidelines [7]. Moderate physical activity was collapsed into five or more days and less than five. Vigorous physical activity was collapsed into three or more days and less than three. Sedentary activity was measured by three questions: "How many hours per day do you usually watch TV, DVDs, or movies away from school?", "How many hours per day do you usually spend on a computer away from school?", and "How many hours per day do you usually spend playing video games like Nintendo® Wii or DS, Sega®, PlayStation®, Xbox®, GameBoy®, or arcade games away from school?". The responses to these questions were combined to create a scale

and collapsed into two groups: 1) those that spent three hours or less per day, and 2) those that spent more than 3 hours per day engaging in sedentary activity.

A SPAN Physical Activity Index was also created based on the SPAN Healthy Eating Index, which earlier studies have determined has a good predictive validity, and varies reliably with other measures [55,61]. Physical activity behaviors consisted of moderate physical activity for at least 60 minutes, vigorous physical activity for at least 20 minutes, and strength training. Sedentary behaviors included hours watching TV, spent on the computer, and playing video games. To calculate this score, the responses to each question were dichotomized into "0=No" or "1=Yes", as in the adolescent did partake in physical/sedentary activity or they did not partake in a certain activity. Then certain questions were grouped based on whether or not they were describing physical activity or sedentary activity. Summary scores for sedentary activity and physical activity indices were created and scaled to range from 0 to 100 points. The sedentary activity index was subtracted from the physical activity index to create an overall physical activity score, with a range from -100 to 100, where higher scores indicated a combination of more physical activity and less sedentary activity.

Statistical Analysis

Statistical analyses were performed using Stata 13.0, incorporating survey weights [64]. Sampling weights and adjustments for the SPAN survey have been previously reported elsewhere [54]. First, weighted descriptive statistics were calculated, and differences in the frequency or mean of parental and peer support, dietary intake variables, and physical activity variables were examined by gender, grade, ethnicity, weight status, parent education level, and socioeconomic status, using Pearson chi-square tests and t-tests. Multiple logistic regression was used to determine the relationship between perceived parental disapproval of unhealthy

eating/not exercising, and the dependent variables. Linear regression was used to determine the relationship between parental/peer support for a healthy diet/physical activity, and dependent variables. All analyses were adjusted for grade, gender, ethnicity, weight status, socioeconomic status, and parents' education level. Significance of results was based on a p-value < 0.05.

RESULTS

Demographic Characteristics of the Study Population

The demographics of the study population are presented in Table 1. The mean age for 8th grade adolescents was 13.4 years and 16.5 years for 11th grade adolescents. The sample was split fairly evenly by grade, and consisted of 40% White/Other, 15% African American, and 45% Hispanic students. The majority (62%) of the adolescents were at a healthy weight, while nearly 16% were overweight and 22% were obese. Approximately 40% of the sample had parents with at least some college education, while 60% had parents whose highest educational level was high school or less. The preponderance of students in the sample went to schools with a socioeconomic status in either the lowest (37%) or middle tertile (38%), with only 25% of the sample coming from schools in the highest tertile. Data were also stratified by gender and demographic findings were similar between boys and girls.

Frequencies

The frequencies of parent and peer dietary support across different demographic groups are shown in Table 2. Overall, 35% of adolescents reported having parents that disapproved of the consumption of unhealthy foods. Forty-three percent of adolescents in the 8th grade reported having parents that disapproved of the consumption of unhealthy foods compared to 25.5% of 11th graders ($p<0.001$). Adolescents classified as healthy weight reported having parents that

disapproved of the consumption of unhealthy foods significantly less than overweight and obese adolescents, with 28% of healthy weight adolescents reporting parental disapproval of unhealthy eating compared to 42% and 49% of adolescents with overweight and obesity, respectively ($p<0.001$). Accordingly, weight status was included as a potential confounder in all regressions.

Significant differences in the frequency of fruit and vegetable consumption were evident across categories of race/ethnicity, parent education, and socioeconomic status. Eighty-eight percent of adolescents classified as White/Other reported consuming one or more fruits and vegetables per day compared to 81% and 78% in African-American and Hispanic adolescents ($p<0.001$). Boys reported consuming two or more sugary beverages a day 54% of the time compared to only 40% of the time in girls ($p<0.001$). Adolescents with parents with some college education or more reported consuming 2 or more sugary beverages per day 43% of the time compared to 53% of the time in adolescents with parent education levels of high school or less ($p<0.01$).

Frequencies of parent and peer physical activity support are shown in Table 3. Overall, 47% of adolescents reported having parents that disapproved of them not exercising. Only 38% of eleventh graders reported having parents that disapproved of them not exercising, compared with 54% of 8^{th} graders ($p<0.001$). A lower proportion of adolescents classified as healthy weight indicated having parents that disapproved of them not exercising (41%), compared with both overweight and obese adolescents (56% for both, $p<0.001$), with no gender differences.

Significant differences in sedentary and physical activity were evident by gender. Over two-thirds of males (69%) reported engaging in three or more hours of sedentary activity per day, compared with 53.4% of females ($p<0.001$). A greater proportion of males than females also reported engaging in five or more days of moderate physical activity (62% vs 49%, $p<0.01$) and

three or more days of vigorous physical activity per week (79% vs. 67%, p<0.001). Just over half of all White/Other adolescents (54%) engaged in three or more hours of sedentary activity per day, compared with 76.2% and 63.1% of African-American and Hispanic adolescents, respectively (p<0.001).

Regressions

Parental disapproval of not exercising and unhealthy eating was a strong predictor of parental support for physical activity and healthy eating, respectively. Adolescents who reported having parents that disapproved of them not exercising had a higher parental support for physical activity score (p<0.001), while adolescents who reported having parents who disapproved of unhealthy eating had a higher parental support for healthy eating score (P<0.001).

Table 4 presents odds ratios derived from logistic regressions comparing demographics of the study population to three survey responses related to parental disapproval of unhealthy eating and parental and peer support for a healthy diet. Overall, adolescents who reported having parents who disapproved of unhealthy eating had a higher perceived parental support score (P<0.001). Eighth grade adolescents had 2.1 times higher odds of having parents who disapproved of unhealthy eating compared to eleventh graders (p<0.001). Adolescents that had overweight or obesity had significantly higher odds of having parents who disapproved of unhealthy eating compared to healthy adolescents (OR=1.85, p=0.001; OR=2.66, p<0.001). Adolescents that had parents with some college education or more, had parental diet support that was 0.78 points higher than adolescents with parents that had education levels of high school or less (p<0.01).

Table 5 presents odds ratios comparing parental and peer dietary support and demographic characteristics to the dietary response variables. Eighth and eleventh grade adolescents who had parents who disapproved of unhealthy eating had 1.67 times higher odds of consuming one or more fruits and vegetables per day ($p=0.001$) and had a healthy foods score that was 10 points higher than those who reported not having parents who disapproved of unhealthy eating ($p<0.001$). Adolescents who reported having parents who disapproved of unhealthy eating also had 1.8 times higher odds of having healthy foods available in the home ($p<0.001$) while for every 1-point increase in parental support for a healthy diet, there was 1.12 times higher odds of having healthy foods available in the home ($p<0.001$) (data not shown). For every 1-point increase in parental support for a healthy diet, adolescents had 1.19 times higher odds of consuming one or more fruits or vegetables a day ($p<0.001$), 1.1 times lower odds of consuming two or more sugary beverages a day ($p<0.05$), and had a healthy foods score that was 1.6 points higher ($p<0.001$). For every 1-point increase in peer support for a healthy diet, adolescents had 1.14 time higher odds of consuming 1 or more fruits and vegetables a day ($p<0.001$), and had a healthy foods score that increased by 1.2 ($p<0.01$).

Table 6 presents logistic regression odds ratios and linear regression beta coefficients comparing associations between demographics of the study population and perceived parental/peer support for physical activity, as well as perceived parental disapproval for not exercising. Eleventh grade students had 1.9 times lower odds of having parents that disapproved of them not, compared to eighth grade students ($p<0.001$). In addition, eleventh graders had a lower mean parental physical activity support score than eighth graders (0.84 points lower; $p<0.01$). Adolescents classified as overweight or obese both had 1.8 times higher odds of having parents that disapproved of them not exercising, compared with adolescents classified as healthy

(p=0.004, p<0.001). Adolescents who had overweight or obesity also had parental physical activity support scores that were 0.67 and 0.71 points higher than adolescents classified as healthy, respectively (p<0.05). Parental and peer physical activity support scores were 0.84 and 0.85 points higher among African-American adolescents than among White/Other adolescents, respectively (p<0.01). Adolescents whose parents had some college education or more had a mean parental physical activity support score that was 0.89 points higher than among adolescents whose parents had a high school education or less (p=0.001). Lastly, the mean peer physical activity support score among girls was -0.74 points lower than among boys (p<0.05).

Table 7 presents logistic regression odds ratios and linear regression beta coefficients showing levels of association between parental/peer physical activity support, parental disapproval for not exercising and the physical activity response variables. Adolescents who reported having parents that disapproved of them not exercising had 1.72 times lower odds of engaging in 3 or more hours of sedentary behaviors per day (p<0.001). For every 1-point increase in parental support for physical activity, adolescents had 1.1 lower odds of engaging in three or more hours of sedentary activity per day (p<0.05), 1.14 higher odds of engaging in five or more days of moderate physical activity per week (p<0.001), 1.12 higher odds of engaging in three or more days of vigorous physical activity per week (p<0.001), and had a physical activity score that was 2.4 points higher (p<0.001). For every 1-point increase in peer support for physical activity, adolescents had 1.1 lower odds of engaging in three or more hours of sedentary activity per day (p<0.001), 1.17 higher odds of engaging in five or more days of moderate physical activity per week (p<0.001), 1.15 higher odds of engaging in three or more days of vigorous physical activity per week (p<0.001), and had a physical activity score that was 2.91 points higher (p<0.001).

Other analyses were also conducted with the parental and peer support as categorical variables rather than using a continuous scale. For these analyses, response options were categorized into never (0-3), sometimes (4-8), and always (9-12), and odds ratios were determined using never as the referent. All results were in a similar trend and remained significant.

DISCUSSION

This study adds to the literature by analyzing a larger, diverse statewide sample to determine dietary and physical activity patterns associated with parental and peer support, in 8th and 11th grade adolescents in Texas, capturing both early and late adolescence. The SPAN population is unique in that it is more ethnically diverse than the U.S. in general, and thus, the Texas population can be considered a bellwether for future population changes in the U.S.

Data were stratified by gender and demographic findings were similar between boys and girls. The results from our study indicate that parents and peers have a significant effect on the dietary and physical activity behaviors of adolescents in Texas, with parents and peers having a similar influence on dietary behaviors and peers having a greater influence on adolescent physical activity levels. In general, adolescents that perceived receiving parental and peer support had higher odds of reporting healthier dietary and physical activity behaviors than adolescents who did not perceive receiving any support.

Diet is an important factor in the development of a healthy lifestyle. The results from the current study clearly indicate that adolescents, who had parents who disapproved of unhealthy eating and received parental support for a healthy diet had higher odds of consuming one or more fruits and vegetables per day, lower odds of consuming two or more sugary beverages per day,

and had an overall healthier diet than adolescents who did not have parents who disapproved of unhealthy eating or received lower parental support for a healthy diet. These results are supported by a number of other studies [35-38,40]. Results from the present study also revealed a strong association between parental support for a healthy diet and the availability of healthy foods in the home. Perceived parental disapproval for unhealthy eating and parental support for a healthy diet were associated with higher odds of having healthy food available in the home. This finding is similar to a study conducted by Boutelle et al. which found that both mothers' concern for healthy eating and adolescents' perception of their mother's concern for healthy eating was associated with a healthier home food environment [40].

The present study also expands the limited research about how peers influence each other's diets. The findings demonstrated that there was a significant relationship between peers and their friends' dietary choices. Adolescents that received support from their peers had higher odds of consuming one or more fruits and vegetables per day, and had better overall diets than adolescents who did not receive peer support. These results are supported by previous studies [41-43,45]. A systematic review of peer influence on diet in adolescents exhibited results that were similar to the current study and found that dietary behaviors of adolescents were positively related to those of their peers [41]. The current findings are also similar to a study conducted by Bruening et al. which found that positive dietary behaviors by peers were associated with positive dietary behaviors in adolescents and that friends exhibited similarities in their healthy eating patterns [45]. A study conducted by Finnerty and coworkers found that peers did not have a significant effect on dietary intake [43]. However, this study was conducted with a younger study population (mean age 11.4 years), than the current study sample (mean age 14.9 years). The

results corroborate the results of Stok and co-researchers, who studied adolescents in Europe, and showed that peer support for healthy eating was associated with healthy eating behaviors [42].

It is known that physical activity is associated with a lower risk of obesity, while sedentary activity is associated with a greater risk [8,9]. Our study found that adolescents in Texas who had parents that disapproved of them not exercising and who received parental support for physical activity had lower odds of engaging in three or more hours of sedentary behaviors per day and higher odds of engaging in both five or more days of moderate physical activity per week and three or more days of vigorous physical activity per week. These results are consistent with previous studies that showed that parental support influenced child and adolescent physical and sedentary activity levels [30-33,65,66].

These findings also demonstrated that peers strongly influenced adolescent physical and sedentary behaviors, with adolescents who received peer support having lower odds of engaging in three or more hours of sedentary behaviors per day and higher odds of engaging in five or more days of moderate physical activity and three or more days of vigorous physical activity per week. These results are supported by other scientific literature that showed similar correlations between peer support and physical activity levels [41,43,47]. Our study also revealed that boys had higher odds of receiving peer physical activity support than girls. These findings are similar to another study, published by St. George et al., which found that boys received more support from their peers to engage in physical activity [44]. It is also noteworthy that, in our study, adolescents reported receiving peer physical activity support more frequently than parental physical activity support; this is in contradiction to a study conducted by Ling and colleagues which observed that parents were the primary means of social support for physical activity [46]. These differing results might be explained by differences in study populations. The sample used by Ling and co-

researchers consisted of only girls in the 5th-7th grade, while our sample consisted of boys and girls in the 8th and 11th grade.

It was interesting to explore differences in Texas adolescents' dietary preferences with respect to several demographic variables. In a previous study, we examined differences between dietary behaviors among gender, ethnicity, BMI class, and parent education [67]. In this study, the relationship between gender and physical and sedentary activity were investigated. Results comparing gender and physical activity showed girls less frequently engaged in sedentary and physical activity behaviors and had lower odds of engaging in sedentary and physical activity behaviors. This finding is consistent with results from several other studies [9,68-73].

Associations between race/ethnicity and physical activity were also examined. Similar to other published studies, adolescents categorized as White/Other were compared with those of African-American and Hispanic races/ethnicities. Our findings indicated that both African-American and Hispanic adolescents had higher odds of engaging in three or more hours of sedentary activity per day than White/Other adolescents. This finding among African-American adolescents is consistent with a number of other reports, which observed that African-American adolescents more frequently engaged in sedentary behaviors when compared to White adolescents [71,72,74-76]. However, previous studies have reported mixed results with regards to sedentary behaviors among Hispanic adolescents [71,74-77]. While results from three studies are consistent with our findings [71,74,77], two studies have reported that Hispanic adolescents less frequently engage in sedentary behaviors than White/Other adolescents (in contradiction of our findings) [75,76]. Therefore, more research is needed to fully understand differences in sedentary activity among Hispanic adolescents.

Adolescents with overweight or obesity had lower odds of engaging in five or more days of moderate physical activity per week compared to adolescents with healthy weights. This is consistent with multiple studies which have found similar results [9,69,70]. Our results also revealed that adolescents with overweight and obesity more frequently had parents who disapproved of not exercising and had higher odds of having parents who disapproved of them not exercising. This could indicate that perhaps physical activity rules were put in place in an effort to curb adolescent overweight or obesity by the parents.

Based on results from our study, intervention programs should be designed and tailored to target parents and peers to increase social support for adolescents. The results from the current study indicate that parents play an important role even among the adolescent age group. Community-level programs could be implemented, which focus on educating and getting parents more involved in supporting their adolescents' health through behaviorally-based activities to increase parental and peer support and involvement. Previous studies have shown that interventions that included parents as agents of change were more effective than a child-centered approach in reducing obesity [78-84].

Peers are important to consider during adolescence because much time is spent with peers during this age period. Adolescents spend time with their peers during school hours and through after school activities. After school programs could be implemented that focus on educating students on health behaviors as well as focusing on the best ways to support their friends in living healthy lifestyles. A recent review has shown that adolescent interventions that focus on enhancing peer support have demonstrated positive outcomes and that adolescents engaging in intervention programs in a group setting are beneficial [81].

This study had both limitations and strengths. The cross-sectional study design prevented us from making any causal inferences between parental/peer support and physical activity behaviors among Texas adolescents. However, this design did give us a large and diverse statewide sample with which to examine these associations and to help develop intervention strategies for a broad range of diverse populations. The measurements in this study were obtained from self-report, which could lead to underreporting, failure to report, or biased data. However, SPAN questions have previously been evaluated for reliability and validity in adolescent populations, and cognitive interviews were used to determine how questions on the survey were interpreted to ensure that our questions are measuring what they are intended to measure [55-57,85]. Another limitation was that the questions used to capture fruit and vegetable and sugary beverage consumption only asked about the previous day, and this may not adequately capture usual dietary patterns. Our parental support measures also did not distinguish between mothers and fathers, so we were unable to draw conclusions about whether one parent's support had a greater impact compared to the other. Unmeasured variables may also have had confounding effects on our results, despite our adjustment for several covariates. We believe that this is unlikely given the large size of the dataset, and the consistency of our findings with previous studies.

CONCLUSION

Findings from this study indicate that parental and peer social support is associated with healthier dietary and physical activity behaviors in adolescents, in Texas. Based on results from our study, intervention programs should be designed and tailored to target parents and peers to increase social support for adolescents. Adolescents are at a developmental phase in which they are experiencing an increase in autonomy, and forming new lifestyle habits that can persist into

adulthood and have a lifelong impact [86,87]. It is therefore crucial to create and develop effective behaviorally-based educational and intervention programs that promote a healthy lifestyle that can be sustained into adulthood.

STUDY TWO

INTRODUCTION

Parents play a critical role in ensuring that their children develop healthy lifestyle habits. Parents influence what their children learn, how they respond to environments, and what they expect of themselves [26]. Adolescents, in particular, are of a difficult age group for parents. During puberty, adolescents start to feel a great sense of autonomy, and they start to increase their decision-making abilities; forming new lifestyle habits that can persist into adulthood and have a lifelong impact [28,86,87]. This normal part of growing up only becomes problematic when adolescents start making poor decisions especially in regards to diet and physical activity [28]. It is therefore crucial for parents to help guide their children in establishing healthy habits that can be sustained into adulthood.

In previous studies, interventions that included and focused on parents as agents of change have been successful in reducing obesity [78-80,83,88-93]. School-based interventions that have a parental component have been shown to be successful and have resulted in significant reductions of weight-related health behaviors [80]. However few studies have examined programs that target adolescents and the studies that do have inconsistent findings [81].

Current research on children has shown that interventions that include parents are effective in reducing weight and changing the dietary and physical activity behaviors of children [92-94]. A study conducted by Kim et al. revealed that an intervention with parental involvement

was more effective at increasing the dietary self-efficacy of children and promoting the parent-child relationship [94]. Another study by Boutelle and colleagues showed that both a parent-only intervention and a parent-child intervention were effective in lowering BMI and caloric intake per day [93].

Very few studies, however, have examined interventions that have included parents among adolescents specifically, and even fewer have examined school-based interventions that include a parental component in adolescent populations. A study conducted by Ochoa-Aviles and co-workers showed that a school-based intervention that included parents was successful in decreasing the consumption of unhealthy snack food and reducing the waist circumference among adolescents [95]. Adolescents in the intervention also decreased their sedentary activity time and performed better on the vertical jump test and speed shuttle run test when compared to the control group [95]. Another study conducted by Jelalian et al. showed that adolescents in an intervention group with minimal parental involvement showed a greater decrease in BMI [84]. However, adolescents in the active treatment group with parental involvement still showed significant decreases in weight [84].

More research is needed to examine the effects that parental involvement has on school-based interventions in adolescents. The objective of this study is to understand the dietary, physical activity, and weight-related effects of a school-based intervention with a parental support component on adolescents using the Coordinated Approach To Child Health (CATCH) Middle School Project.

METHODS

Project Description

The Central Texas CATCH Middle School Project (CATCH MS) was a school-based health program aimed at promoting healthy eating, physical activity, and obesity prevention among middle school students living in central Texas. The CATCH project targets various stakeholders (e.g., administrators, teachers, PE specialists, cafeteria staff, parents & students) and settings (classroom, PE, food service, school events) within the school context for the promotion of child health. The CATCH MS project was developed from the original CATCH program and the Incorporating More Physical Activity in Teens (IMPACT) (Sharma et al.), which was shown to be highly effective in elementary school students [96,97]. The project was funded by the Michael & Susan Dell Foundation between December 2008 and December 2012. Thirty middle schools from five central Texas independent school districts (Austin ISD, Del Valle ISD, Manor ISD, Pflugerville ISD and Round Rock ISD) were selected to participate in the study.

Study Design

A group randomized serial cross-sectional design was employed to evaluate the effect of three program support conditions (n=10 schools per condition) on student energy-balance behaviors: Basic (training and curriculum only, comparison group), Basic Plus (training and curriculum plus CATCH facilitator support), and Basic Plus Social Marketing (all inputs plus social marketing and Parents CATCH On component). The CATCH MS Program was delivered to all 6^{th}-8^{th} grade students at the participating schools.

The study sample consisted of serial cross-sectional samples of 8th grade students from the selected schools that were selected and measured each spring for the three and half year project period. Serial cross-sectional surveys have previously been shown to be able to assess the impact of an intervention on group indices of health, especially when used with homogeneous or stratified and matched schools [98-101].

Outcome evaluation measures included a CATCH Middle School questionnaire comprised of self-reported measures on dietary behaviors and physical activity; anthropometric measures of height and weight; and structured observations of physical activity engagement using SOFIT. The study was reviewed and approved by the University of Texas School of Public Health Committee for the Protection of Human Subjects and participating school district institutional review boards.

Intervention Description

Three study conditions (n=10 schools in each condition) guided the program's implementation and evaluation: a "Basic Schools" training and curriculum-only condition (condition 1), a "Basic Plus" condition in which schools also received CATCH facilitator support (condition 2), and "Basic Plus Social Marketing (SM)" condition in which schools received additional social marketing campaigns to promote PA ("get ur 60") and displace SSB consumption with water consumption ("get ur H20") (condition 3). The Basic Plus SM condition also received additional parent outreach support via a partnership with Action for Healthy Kids that encouraged parent participation in health promotion as well as parent health messaging [102].

CATCH is comprised of six core components. The CATCH Campus Team, led by a designated CATCH Champion and comprised of key school stakeholders (teachers, PE specialists, cafeteria managers, administrators, specialized staff, and parents) who engage in local decision making, action planning and coordination of actions via a CATCH Coordination Toolkit and participation in CATCH best practice workshops. CATCH PE, which aims to increase the amount of time students engage in moderate and vigorous physical activity (MVPA) via organizational strategies, games and lessons. CATCH Classroom, a student-centered curriculum designed to promote energy balance-related behaviors and related psychosocial

constructs via 6-8 lessons for each grade level (6th-8th) designed to be incorporated into core classes such as science, math, health and advisory periods as well the promotion of activity breaks (included in curriculum) and teacher encouragement and modeling of healthy behaviors. CATCH Eat Smart Cafeteria, which promotes GO, SLOW and WHOA food classification via menu planning with cafeteria staff and labeling of menu offerings via online and in-school menus, the serving line, and cafeteria signage. CATCH Family/Parent Outreach, which aims to educate and assist parents in providing support for their children's PA and healthy eating through Family Nights, school-wide events that include taste-testing, dance, aerobics, and other promotional activities; presentations at PTA meetings; promotion of parental involvement on the CATCH team; parent newsletters; and parent-child CATCH homework activities. CATCH Social Marketing "get ur 60" and "get ur H2O" campaigns include: messaging informed by students to promote PA and water consumption via wristbands, water bottles, knapsacks, balls, and posters; increased access to water via 'hydration stations' placed in cafeterias and installations of new water fountains for filling up of water bottles; creation of "Open Gym" activity time, supervised free-play before school and during lunch; and promotion of water-only policies at school events.

Measures

Vegetable consumption was measured with the question "Yesterday, how many times did you eat vegetables? (Include all cooked and uncooked vegetables; beans; salads; and boiled, baked, and mashed potatoes. DO NOT count French fries or chips)". Fruit consumption was measured with the question "Yesterday, how many times did you eat fruit? (Fruits are all fresh, frozen, canned, or dried fruits.)". Water consumption was measured with the question "Yesterday, how many times did you drink a bottle or glass of water?". Soda consumption was

measured with the question “Yesterday, how many times did you drink any regular (NOT diet) sodas or soft drinks?” The responses to these questions ranged from 0 to 5 or more times. Items assessing consumption of various index foods were evaluated for reliability and validity [55].

Physical activity was measured with two questions. Moderate physical activity was measured with the question “During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?” Vigorous physical activity was measured with the question “During the past 7 days, on how many days did you exercise or take part in physical activity that made your heart beat fast and made you breathe hard for at least 20 minutes outside of regular school hours?” The answer choices to these questions ranged from 0 to 7 days.

Data Analysis

All statistical analyses for the CATCH data were performed using the statistical software package STATA version 13.0. Descriptive statistics were calculated and differences in the frequency or mean of the energy-balance related variables were examined by implementation period and study condition. Multilevel mixed-effects linear regression analyses were conducted to determine statistical differences in the frequency of the dietary and physical activity behaviors, after adjusting for school. Significance of results was based on a p value of <0.05.

RESULTS

The demographics of the study population are presented in Table 8. The mean age of the sample was 13.9 years. The sample was split approximately evenly by gender, and consisted of 36.6% White/Other, 12.8% African American, and 50.6% Hispanic students. The majority (62%) of the students were at a healthy weight, while nearly 18% were overweight and 20% were obese. The sample was also split evenly among implementation level and measurement period.

All intervention conditions experienced an increase in mean vegetable consumption, and no significant differences were found between the intervention conditions. However, the Basic Plus Social Marketing implementation had the greatest increase in mean vegetable consumption over time (0.303) compared to 0.257 and 0.225 in the Basic Plus and the Basic implementations, respectfully. All implementation programs experienced increases in mean fruit consumption from baseline to follow up, and the Basic Plus Social Marketing implementation experienced a greater increase in fruit consumption over the four years of the study (0.210; p=0.05). The Basic Plus Social Marketing intervention condition produced the greatest increase in mean fruit consumption (0.506 times/day) compared to 0.376 and 0.297 times/day in the Basic Plus and the Basic implementations, respectfully. All intervention conditions experienced increases in mean water consumption, and the Basic Plus Social Marketing intervention experienced a greater increase in water consumption from baseline to follow up (0.375; p=0.001). The Basic Plus Social Marketing implementation had an increase in mean water consumption of 0.963, compared to 0.182 and 0.048 in the Basic Plus and the Basic implementations, respectfully.

All intervention conditions exhibited an increase in an overall mean healthy eating score, and no significant differences were found between the implementation programs. However, the Basic Plus Social Marketing implementation showed the greatest increase in healthy eating scores (19.321), compared to 13.87 and 10.557 in the Basic Plus and the Basic implementations, respectfully. The mean increase in parental support was significantly greater for the Basic Plus Social Marketing intervention at baseline to follow up (2.006 p=0.013). The Basic Plus Social Marketing intervention exhibited a mean increase in parental support of 0.263, compared to 0.131, and -1.743 in the Basic Plus and the Basic intervention conditions, respectfully. No

changes were seen in soda consumption, moderate physical activity and vigorous physical activity over the timeframe of the intervention.

DISCUSSION

The present study is the first to analyze and examine the effects of parental involvement in a school-based intervention program, targeting a large, diverse and representative statewide sample of adolescents in Texas. Adolescents are an important age group to study, because during these formative years adolescents start to feel a great sense of autonomy, and increase their decision making abilities; forming new lifestyle habits that can persist into adulthood and have a lifelong impact [28,86,87]. Adolescents can also have a strong influence on the foods that their parents purchase, and often have a variety of foods to choose from [103]. Parents, therefore have an important role to play in the development of healthy lifestyle habits for their children. Overall findings indicate that 8th grade students in the Basic Plus Social Marketing intervention condition which included the parental outreach component, had the greatest increases in mean fruit, vegetable, and water consumption and had a greater increase in the overall healthfulness of their diets, based on an overall healthy eating score. Students in this condition also experienced a greater increase in parental support for healthy eating and physical activity at the end of the intervention compared to students in the other conditions.

To date, few studies have examined the health outcomes of interventions that have included parents or parental components [84,95]. The majority of studies in this area have been focused on child populations ranging in ages from 6-12 and very few of these studies focus on school-based intervention programs that incorporate parents [92-94]. In the present study, including parents and having a parental component had a positive impact on the effectiveness of the school-based intervention.

An important finding in our study was that students in the Basic Plus Social Marketing implementation reported a significantly greater mean increase in perceived parental support from baseline to follow up, compared to the Basic and Basic Plus implementations. This finding is significant because parental support has been shown to be associated with healthier dietary and physical activity behaviors in adolescents. Adolescents who receive parental support have higher odds of eating healthier diets, consuming more fruits and vegetables and less sugary foods and drinks, as well as engaging in more physical activity and less sedentary behaviors [30-33,35-38,40,65,66]. This finding suggests that future programs and interventions should focus on increasing parental social support by incorporating parents into their respective programs.

It is well known that a healthy diet is abundant in fruits and vegetables, yet fruit and vegetable intake is still low among adolescents and well below the recommended requirements [16,104]. This is also despite the fact that fruits and vegetables have numerous known health benefits, such as reducing risks for many diseases and cancers and helping to manage body weight [11,17]. In the present study, all CATCH intervention conditions exhibited an increase in both mean fruit and vegetable consumption over the course of the study. Students in the Basic Plus Social Marketing intervention, which included the parental outreach component, experienced the greatest mean increases in fruit and vegetable consumption. The students in this intervention arm also experienced the greatest increases in their healthy eating scores, which means they consumed healthier diets at the end of the last measurement period when compared to students in the other intervention conditions. This shows that incorporating parents in a school-based intervention can have a positive impact on the fruit and vegetable consumption and overall healthfulness of the students' diets.

The present study does have some limitations. The measurements in this study were based on self-report, however the measures used have been evaluated for validity and reliability in adolescent populations. The study population is limited to students from central Texas, however the sample is large, and diverse, which allows for greater generalizability across middle-school adolescent populations. There was also no control condition within the CATCH program.

CONCLUSION

Findings from the present study of 8th grade adolescents in Texas, indicate that incorporating and including parents and having a parental component that focuses on getting parents involved in a school-based intervention results in healthier dietary behaviors. Future educational and intervention programs should focus on incorporating parents to help improve desired health outcomes.

CONCLUSIONS

Physical activity and dietary behaviors have long been known to have an impact on obesity among adolescents. Many adolescents however, do not meet the daily recommended requirements for engaging in physical activity or consuming fruits and vegetables. This study aimed at examining the associations between parental and peer social support and positive health behaviors in adolescents.

The results of Study One indicate that adolescents who receive parental and peer social support have high odds of engaging in moderate and vigorous physical activity, and consuming healthier diets, and lower odds of engaging in sedentary behaviors, and consuming sugary beverages. The results of Study Two detail the differences between intervention conditions that

incorporated parents compared to those that did not. Incorporating and including parents in a school-based health intervention and having a parental component that focused on getting parents more involved and active around what their adolescents consume in their diets, resulted in healthier dietary behaviors.

Data from the two studies provide further information on the importance of social support in fighting obesity across early and late adolescence. Adolescents are at a developmental phase in which they are experiencing an increase in autonomy, and forming new lifestyle habits that can persist into adulthood and have a lifelong impact. It is therefore crucial to create and develop effective educational and intervention programs that promote a healthy lifestyle that can be sustained into adulthood.

TABLES

Table 1. Demographic Characteristics of 8th and 11th grade students that participated in the TX SPAN survey

	Total (n=6716)	**Boy (n=3251)**	**Girl (n=3465)**
Age, Years, Mean	14.88	14.9	14.8
Grade, %			
8th	53.3	53.6	53.0
11th	46.7	46.4	47.0
Ethnicity, %			
White/Other	39.8	40.1	39.6
African-American	14.6	14.5	14.7
Hispanic	45.6	45.5	45.7
BMI Class[1], %			
Healthy Weight	62.0	57.6	66.4
Overweight	15.7	16.1	15.3
Obese	22.3	26.3	18.3
Parent Education, %			
Some college or more	40.3	40.7	39.9
High school or less	59.7	59.3	60.1
Socioeconomic Status, %			
Highest Tertile	25.0	24.2	25.9
Middle Tertile	38.2	38.2	38.1
Lowest Tertile	36.8	37.7	35.9

Note: 1. Overweight is defined as >85th and <95th percentile, while Obese is defined as ≥95th percentile

Table 2. Frequencies of parent and peer dietary support and dietary intake variables, TX SPAN 8th-11th grade students, 2009-2011

	Parental Disapproval for Unhealthy Eating		**Parental Support for a Healthy Diet Scale**	**Peer Support for a Healthy Diet Scale**	**Fruits and Vegetables**		**Sugary Beverages**		**SPAN Healthy Foods Score**
	Not Upset	Upset	Mean	Mean	0 per day	1 or more per day	0 or 1 per day	2 or more per day	Mean
Gender, %									
Male	66.4	33.6	7.1	4.5	18.8	81.2	45.7***	54.3***	-3.622
Female	63.4	36.6	7.4	4.9	16	84	60.4	39.6	-2.072
Grade, %									
8th	57***	43	7.5	4.6	17.5	82.5	52.9	47.1	-1.801
11th	74.5	25.5	7.0	4.8	17.3	82.7	52.9	47.1	-4.069
Ethnicity, %									
White/Other	67.2	32.8	7.3	4.5	11.9	88.1***	57	43	0.204*
African-American	75.9	24.1	7.5	5.5	19.5	80.5	43.2	56.8	-7.343
Hispanic	59.3	40.7	7.1	4.6	21.6	78.4	52.5	47.5	-4.111
BMI Classification, %									
Healthy Weight	71.8***	28.2	7.2	4.7	15.7	84.3	50.5	49.5	-3.044
Overweight	57.9	42.1	7.6	5.1	19.8	80.2	58.5	41.5	-1.138
Obese	51.2	48.8	7.2	4.4	20.6	79.4	55.7	44.3	-3.545
Parent Education, %									
Some College or more	64.9	35.1	7.8	4.9	14.5*	85.5	57.1**	42.9	-1.848
High School or less	64.2	35.8	6.9	4.6	18.7	81.3	46.7	53.3**	-4.074
Socioeconomic Status, %									
Highest Tertile	57.8	42.2	7.0	4.7	22.6	77.4	49.9	50.1	-5.985
Middle Tertile	67.7	33.3	7.1	4.6	18	82	53	47	-2.719
Lowest Tertile	67.3	32.7	7.5	4.9	13.3**	86.7	54.9	45.1	-0.875
TOTAL	64.9	35.1	7.15	4.90	17.4	82.6	52.9	47.1	-2.858

*Note: Pearson chi-square tests and t-tests were calculated to determine differences by categorical and continuous demographic variables, respectively. *P<0·05, **P<0·01, ***P<0·001.*

Table 3. Frequencies of parent and peer physical activity support, by demographic characteristics, TX SPAN 8th and 11th grade students, 2009-2011

	Parental Disapproval for not exercising		Parental Physical Activity Support	Peer Physical Activity Support	Sedentary Activity		Moderate Physical Activity		Vigorous PA		Physical Activity Score
	Not Upset	Upset	Mean	Mean	< 3 hrs/day	≥ 3 hrs/day	Less than 5 days/wk	5 or more days/wk	Less than 3 days/wk	3 or more days/wk	Mean
Gender, %											
Male	50.4	49.6	5.6	6.4	30.7***	69.3	37.8**	62.2	21.5***	78.5	-13.23
Female	56.0	44,0	5.44	5.6	46.6	53.4	51.4	48.6	32.7	67.3	-12.36
Grade, %											
8th	45.9***	54.1	5.9	5.9	36.1	63.9	43.8	56.2	26.9	73.1	-12.97
11th	62.1	37.9	5.0	6.1	41.3	58.7	45.3	54.7	27.1	72.9	-12.62
Ethnicity, %											
White/Other	55.8	44.2	5.3	5.8	45.7***	54.3	41.4*	58.6	23.1	76.9	-10.69
African-American	61.0	39.0	6.2	6.8	23.8	76.2	40.3	59.7	26.6	73.4	-11.56
Hispanic	48.3	51.7	5.5	5.8	36.9	63.1	48.5	51.5	30.5	69.5	-15.08
BMI Classification, %											
Healthy Weight	58.8***	41.2	5.2	5.9	39.3	60.7	40.4**	59.6	25.5	74.5	-10.63
Overweight	43.7	56.3	5.9	6.1	38.8	61.2	48.0	52.0	27.2	72.8	-13.48
Obese	44.2	55.8	5.9	6.1	36.1	63.9	53.4	46.6	30.9	69.1	-18.21
Parent Education, %											
Some College or more	52.5	47.5	6.1	6.3	36.0	64.0	39.9*	60.1	25.4	74.6	-10.35
High School or less	52.1	47.9	5.2	5.8	34.9	65.1	50.7	49.3	29.7	70.3	-14.31
Socioeconomic Status, %											
Highest Tertile	48.5	51.5	5.4	5.8	31.4	68.6	54.7*	45.3	33.5*	66.5	-16.67
Middle Tertile	56.5	43.5	5.3	6.1	40.2	59.8	39.1	60.9	23.5	76.5	-9.05
Lowest Tertile	53.2	46.8	5.7	6.0	41.6	58.4	43.1	56.9	26.1	73.9	-13.75
TOTAL	53.2	46.8	5.7	6.4	38.5	61.5	44.5	55.5	27.0	73.0	-12.81

*Note: Pearson chi-square tests and t-tests were calculated to determine differences by categorical and continuous demographic variables, respectively. *P<0·05, **P<0·01, ***P<0·001.*

Table 4. Associations between parent/peer support for a healthy diet, and demographic variables, TX SPAN 2009-2011

	Parental Disapproval for Unhealthy Eating		**Parental Support for a Healthy Diet**		**Peer Support for a Healthy Diet**	
	Odds Ratio	P-value	Beta Coeff	P-value	Beta Coeff	P-value
Gender[1]						
Girl	1.28 (.94, 1.74)	0.112	0.30 (-0.14, 0.74)	0.18	0.38 (-0.12, 0.87)	0.137
Grade[2]						
11th	0.47 (0.32, 0.68)	P< 0.001	-0.41 (-0.79, -0.02)	0.038	0.27 (-0.22, 0.77)	0.269
Ethnicity[3]						
African-American	0.58 (0.37, 0.90)	0.016	0.19 (-0.35, 0.74)	0.489	0.92 (0.25,1.59)	0.007
Hispanic	1.17 (0.74, 1.84)	0.501	0.03 (-0.57, 0.63)	0.923	0.16 (-0.37, 0.70)	0.556
BMI Class[4]						
Overweight	1.85 (1.31, 2.62)	0.001	0.50 (-0.03, 1.03)	0.065	0.41 (-0.20, 1.01)	0.118
Obese	2.66 (1.92, 3.68)	P<0.001	0.14 (-0.47, 0.76)	0.648	-0.23 (-0.69, 0.24)	0.339
Parent Education[5]						
Some College or more	1.09 (.80, 1.50)	0.568	0.78 (0.20, 1.37)	0.009	0.20 (-0.16, 0.57)	0.266
Socioeconomic Status[6]						
Middle Tertile	0.98 (0.64, 1.49)	0.911	-0.24 (-0.71, 0.24)	0.325	-0.32 (-1.07, 0.44)	0.412
Highest Tertile	1.18 (0.80, 1.72)	0.404	-0.37 (-0.92, 0.18)	0.188	-0.20 (-0.92, 0.51)	0.576

Note: Confidence intervals for odds ratios are in parenthesis. Referents were [1]Boy, [2]8th, [3]White/Other, [4]Healthy Weight, [5]High school or less, [6]Lowest tertile

Table 5. Associations between parent/peer support for physical activity, and demographic variables, TX SPAN 2009-2011

	Parental Disapproval for Not Exercising		**Parental Support for Physical Activity**		**Peer Support for Physical Activity**	
	Odds Ratio	P-value	Beta Coeff	P-value	Beta Coeff	P-value
Gender[1]						
Girl	0.83 (0.67, 1.03)	0.082	-0.10 (-0.50, 0.30)	0.615	-0.74 (-1.36, -0.12)	0.021
Grade[2]						
11th	0.53 (0.39, 0.70)	P<0.001	-0.84 (-1.35, -0.32)	0.002	0.22 (-0.38, 0.82)	0.465
Ethnicity[3]						
African-American	0.80 (0.54, 1.18)	0.249	0.84 (0.31, 1.37)	0.002	0.85 (0.22, 1.48)	0.008
Hispanic	1.26 (0.86, 1.82)	0.231	0.32 (-0.26, 0.90)	0.284	0.07 (-0.49, 0.64)	0.802
BMI Class[4]						
Overweight	1.78 (1.21, 2.61)	0.004	0.67 (0.12, 1.21)	0.017	0.16 (-0.42, 0.73)	0.591
Obese	1.81 (1.29, 2.54)	0.001	0.71 (0.08, 1.33)	0.027	0.09 (-0.61, 0.79)	0.802
Parent Education[5]						
Some College or more	1.03 (0.78, 1.36)	0.846	0.89 (0.39, 1.39)	0.001	0.47 (-0.12, 1.05)	0.117
Socioeconomic Status[6]						
Middle Tertile	0.87 (0.62, 1.21)	0.389	-0.30 (-0.86, 0.267)	0.298	0.15 (-0.67, 0.97)	0.721
Highest Tertile	0.94 (0.64, 1.40)	0.775	-0.33 (-0.91, 0.26)	0.267	0.26 (-0.78, 0.84)	0.949

Note: Confidence intervals for odds ratios are in parenthesis. Referents were [1]Boy, [2]8th, [3]White/Other, [4]Healthy Weight, [5]High school or less, [6]Lowest Tertile

Table 6. Multiple logistic regression and linear regression associations between parent/peer support, sociodemographic factors and dietary behaviors, TX SPAN 2009-2011

	Fruits and Vegetables		Sugary Beverages		SPAN Healthy Foods Score	
	Odds Ratio	P-value	Odds Ratio	P-value	Beta Coeff	P-value
Perceived Parental Disapproval for unhealthy eating[1]						
Upset	1.67 (1.25, 2.23)	0.001	0.71 (0.51, 1.01)	0.054	10.16 (7.23, 13.09)	P<0.001
Parental Support for a healthy diet						
One point increase in scale	1.19 (1.12, 1.25)	P<0.001	0.92 (0.85, 0.99)	0.02	1.58 (0.98, 2.17)	P<0.001
Peer Support for a healthy diet						
One point increase in scale	1.14 (1.08, 1.20)	P<0.001	0.99 (0.94, 1.04)	0.751	1.20 (0.33, 2.07)	0.007
Gender[2]						
Girl	1.11 (0.80, 1.55)	0.524	0.51 (0.38, 0.69)	P<0.001	1.48 (-1.59, 4.55)	0.342
Grade[3]						
11th	1.11 (0.79, 1.56)	0.531	0.94 (0.65, 1.37)	0.752	-2.26 (-6.74, 2.21)	0.319
Ethnicity[4]						
African-American	0.60 (0.37, 0.98)	0.039	1.72 (1.14, 2.59)	0.01	-6.47 (-11.05, -1.89)	0.006
Hispanic	0.61 (0.38, 0.98)	0.042	0.93 (0.64, 1.36)	0.711	-1.43 (-4.68, 1.82)	0.386
BMI Class[5]						
Overweight	0.92 (0.67, 1.25)	0.584	0.61 (0.44, 0.84)	0.002	3.21 (-0.52, 6.94)	0.091
Obese	0.85 (0.56, 1.27)	0.417	0.69 (0.47, 1.04)	0.073	0.90(-2.72, 4.52)	0.624
Parent Education[6]						
Some College or more	1.18 (0.85, 1.63)	0.317	0.58 (0.42, 0.82)	0.002	1.58 (-1.01, 4.17)	0.23
Socioeconomic Status[7]						
Middle Tertile	0.86 (0.59, 1.25)	0.429	0.96 (0.52, 1.75)	0.884	-1.26 (-7.47, 4.95)	0.689
Highest Tertile	0.69 (0.44, 1.07)	0.098	1.10 (0.63, 1.93)	0.725	-4.48 (-10.87, 1.91)	0.168

Note: Confidence intervals for odds ratios are in parenthesis. Referents were [1]Not upset, [2]Boy, [3]8th, [4]White/Other, [5]Healthy Weight, [6]High school or less, [7]Lowest Tertile

Table 7. Multiple logistic regression and linear regression associations between parent/peer support, sociodemographic factors and physical activity behaviors, TX SPAN 2009-2011

	Sedentary Behaviors		**Moderate Physical Activity**		**Vigorous Physical Activity**		**Physical Activity Score**	
	Odds Ratio	P-value	Odds Ratio	P-value	Odds Ratio	P-value	Beta Coefficient	P-value
Perceived Parental Disapproval for not exercising[1]								
Upset	0.58 (0.43, 0.77)	P<0.001	1.12 (0.81, 1.55)	0.497	1.25 (0.90, 1.74)	0.186	3.43 (-1.91, 8.77)	0.206
Parental Support for physical activity								
One point increase in scale	0.93 (0.88, 0.99)	0.016	1.14 (1.07, 1.21)	P<0.001	1.12 (1.10, 1.17)	P<0.001	2.40 (1.27, 3.54)	P<0.001
Peer Support for physical activity								
One point increase in scale	0.93 (0.90, 0.97)	P<0.001	1.17 (1.13, 1.22)	P<0.001	1.15 (1.10, 1.20)	P<0.001	2.91 (2.01, 3.81)	P<0.001
Gender[2]								
Girl	0.46 (0.33, 0.66)	P<0.001	0.53 (0.37, 0.74)	P<0.001	0.53 (0.42, 0.67)	P<0.001	0.14 (-5.86, 6.14)	0.963
Grade[3]								
11th	0.93 (0.66, 1.30)	0.654	0.77 (0.57, 1.04)	0.087	0.84 (0.60, 1.18)	0.32	-0.24 (,-8.66, 8.18)	0.956
Ethnicity[4]								
African-American	2.66 (1.57, 4.50)	P<0.001	1.07 (0.77, 1.50)	0.669	0.83 (0.54, 1.27)	0.391	-2.04 (-12.40, 8.32)	0.698
Hispanic	1.43 (1.04, 1.97)	0.029	0.87 (0.69, 1.10)	0.239	0.75 (0.49, 1.13)	0.165	-2.91 (-10.62, 4.80)	0.457
BMI Class[5]								
Overweight	0.89 (0.60, 1.32)	0.559	0.69 (0.53, 0.92)	0.011	0.90 (0.60, 1.33)	0.58	-2.69 (-7.80, 2.62)	0.319
Obese	0.86 (0.528, 1.26)	0.436	0.57 (0.40, 0.83)	0.004	0.75 (0.52, 1.10)	0.132	-7.23 (-15.28, 0.83)	0.078
Parent Education[6]								
Some College or more	1.00 (0.76, 1.31)	0.99	1.37 (0.96, 1.96)	0.083	1.10 (0.71, 1.67)	0.698	3.57 (-5.31, 12.44)	0.428
Socioeconomic Status[7]								
Middle Tertile	1.25 (0.80, 1.96)	0.317	1.214 (0.85, 1.71)	0.288	1.05 (0.69, 1.59)	0.819	6.18 (-4.90, 17.27)	0.272
Highest Tertile	1.39 (0.89, 2.17)	0.149	0.75 (0.53, 1.06)	0.106	0.77 (0.50, 1.20)	0.25	-0.50 (-9.27, 8.28)	0.911

Note: Confidence intervals for odds ratios are in parenthesis. Referents were [1]Not upset, [2]Boy, [3]8th, [4]White/Other, [5]Healthy Weight, [6]High school or less, [7]Lowest Tertile

Table 8. Demographic Characteristics of the Central Texas CATCH Middle School Project 2008-2012 8th grade Population

	Total (n=11,114)
Age, Years, Mean	13.86
Gender, %	
Boy	50.1
Girl	49.9
Ethnicity, %	
White/Other	36.6
African-American	12.8
Hispanic	50.6
BMI Class[1], %	
Healthy Weight	62.6
Overweight	17.8
Obese	19.6

Note: 1. Overweight is defined as >85th and <95th percentile, while Obese is defined as ≥95th percentile

FIGURES

Figure 1. Mean Differences Among Three Study Conditions from baseline to follow up

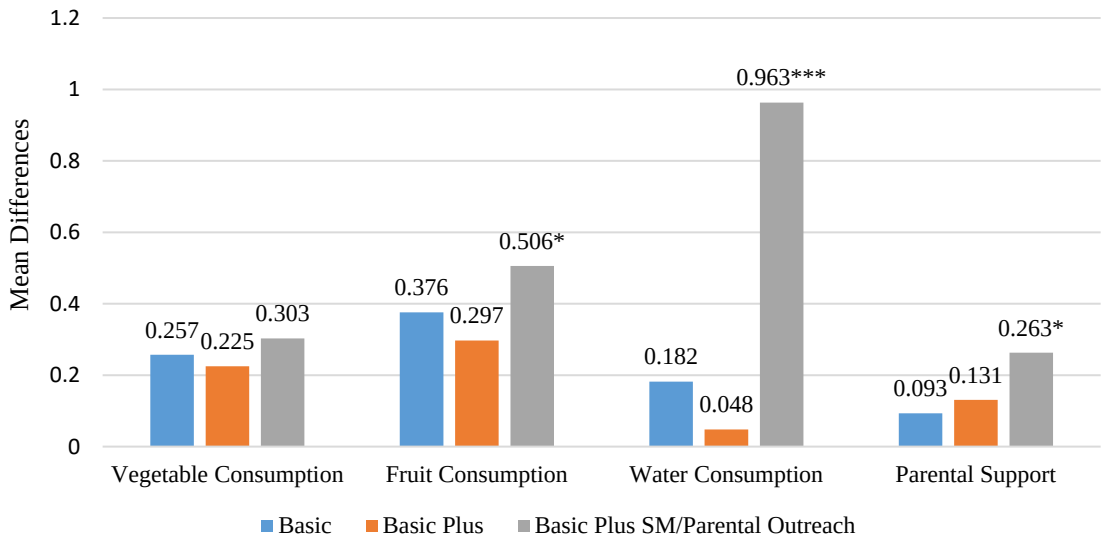
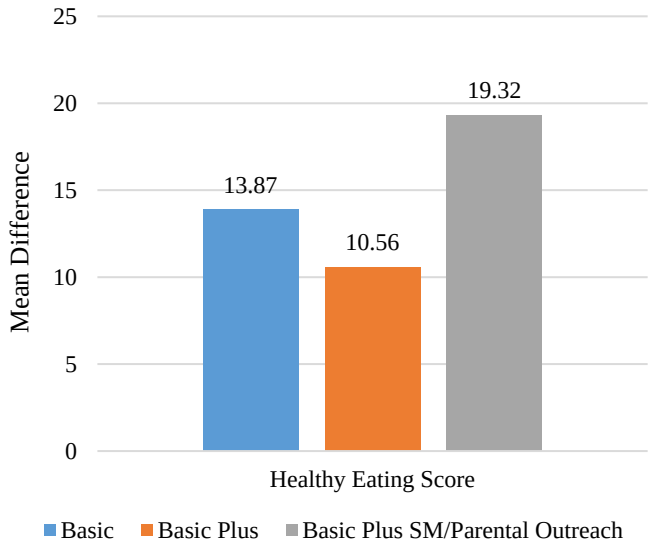


Figure 2. Mean Differences in Healthy Eating Score from baseline to follow up



REFERENCES

1. Ogden CL, Carroll MD, Lawman HG, et al. Trends in obesity prevalence among children and adolescents in the united states, 1988-1994 through 2013-2014. *JAMA*. 2016;315(21):2292-2299.

2. Skinner AC, Perrin EM, Skelton JA. Prevalence of obesity and severe obesity in US children, 1999-2014. *Obesity*. 2016;24(5):1116-1123.

3. Nutrition, physical activity and obesity data, trends and maps web site. https://nccd.cdc.gov/NPAO_DTM/LocationSummary.aspx?state=Texas. Updated 2015. Accessed 2/23, 2017.

4. Segal LM, Rayburn J, Beck SE. The state of obesity: Better policies for a healthier america 2017. . 2017.

5. Skinner AC, Perrin EM, Moss LA, Skelton JA. Cardiometabolic risks and severity of obesity in children and young adults. *N Engl J Med*. 2015;373(14):1307-1317.

6. Reilly JJ, Kelly J. Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *Int J Obes*. 2011;35(7):891-898.

7. Physical Activity Guidelines Advisory Committee. Physical activity guidelines advisory committee report, 2008. *Washington, DC: US Department of Health and Human Services*. 2008;2008:A1-H14.

8. Zhang G, Wu L, Zhou L, Lu W, Mao C. Television watching and risk of childhood obesity: A meta-analysis. *Eur J Public Health*. 2016;26(1):13-18.

9. Nemet D. Childhood obesity, physical activity, and exercise. *Pediatric exercise science*. 2016;28(1):48-51.

10. Healthy eating for a healthy weight. https://www.cdc.gov/healthyweight/healthy_eating/. Updated 2016. Accessed 4/1, 2017.

11. Mytton OT, Nnoaham K, Eyles H, Scarborough P, Ni Mhurchu C. Systematic review and meta-analysis of the effect of increased vegetable and fruit consumption on body weight and energy intake. *BMC Public Health*. 2014;14:886-2458-14-886.

12. Forshee RA, Anderson PA, Storey ML. Sugar-sweetened beverages and body mass index in children and adolescents: A meta-analysis. *Am J Clin Nutr*. 2008;87(6):1662-1671.

13. Malik VS, Willett WC, Hu FB. Sugar-sweetened beverages and BMI in children and adolescents: Reanalyses of a meta-analysis. *Am J Clin Nutr*. 2009;89(1):438-9; author reply 439-40.

14. Ebbeling CB, Feldman HA, Chomitz VR, et al. A randomized trial of sugar-sweetened beverages and adolescent body weight. *N Engl J Med*. 2012;367(15):1407-1416.

15. Fruit and vegetable consumption among high school students — united states, 2010. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6046a3.htm. Updated 2011. Accessed 07/20, 2016.

16. Kimmons J, Gillespie C, Seymour J, Serdula M, Blanck HM. Fruit and vegetable intake among adolescents and adults in the united states: Percentage meeting individualized recommendations. *Medscape J Med*. 2009;11(1):26.

17. Hung H, Joshipura KJ, Jiang R, et al. Fruit and vegetable intake and risk of major chronic disease. *Journal of the National Cancer Institute*. 2004;96(21):1577-1584.

18. Powell ES, Smith-Taillie LP, Popkin BM. Added sugars intake across the distribution of US children and adult consumers: 1977-2012. *Journal of the Academy of Nutrition and Dietetics*. 2016;116(10):1543-1550. e1.

19. Grimes CA, Riddell LJ, Campbell KJ, Nowson CA. Dietary salt intake, sugar-sweetened beverage consumption, and obesity risk. *Pediatrics*. 2013;131(1):14-21. doi: 10.1542/peds.2012-1628.

20. Scharf RJ, DeBoer MD. Sugar-sweetened beverages and children's health. *Annu Rev Public Health*. 2016;37:273-293.

21. Schulze MB, Manson JE, Ludwig DS, et al. Sugar-sweetened beverages, weight gain, and incidence of type 2 diabetes in young and middle-aged women. *JAMA*. 2004;292(8):927-934.

22. Powell E, Smith L. Recent trends in added sugar intake among U.S. children and adults from 1977-2010. . 2014.

23. Arcan C, Hannan PJ, Fulkerson JA, et al. Associations of home food availability, dietary intake, screen time and physical activity with BMI in young american-indian children. *Public Health Nutr*. 2013;16(01):146-155.

24. Campbell KJ, Crawford DA, Salmon J, Carver A, Garnett SP, Baur LA. Associations between the home food environment and obesity-promoting eating behaviors in adolescence. *Obesity*. 2007;15(3):719-730.

25. Kelder SH, Hoelscher D, Perry CL. How individuals, environments, and health behaviors interact. In: Glanz K, Rimer BK, Viswanath K, eds. *Health behavior theory, research, and practice.* 5th ed. Jossey-Bass; 2015:159-159-181.

26. Phillips DA, Shonkoff JP. *From neurons to neighborhoods: The science of early childhood development.* National Academies Press; 2000.

27. Savage JS, Fisher JO, Birch LL. Parental influence on eating behavior: Conception to adolescence. *J Law Med Ethics*. 2007;35(1):22-34.

28. Poskitt EME, Edmunds L. How do we approach the overweight/obese child and family? In: *Management of childhood ObesityH.* Cambridge: Cambridge University Press; 2008:46-57. http://ezproxy.lib.utexas.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=221275&site=ehost-live.

29. Whitney E, Rolfes S. Life cycle: Nutrition: Infancy, childhood and adolescence: Understanding nutrition. *Thomson Wadsworth USA*. 2008:547-585.

30. Ornelas IJ, Perreira KM, Ayala GX. Parental influences on adolescent physical activity: A longitudinal study. *Int J Behav Nutr Phys Act*. 2007;4.

31. Gustafson SL, Rhodes RE. Parental correlates of physical activity in children and early adolescents. *Sports Medicine*. 2006;36(1):79-97.

32. Yao CA, Rhodes RE. Parental correlates in child and adolescent physical activity: A meta-analysis. *International journal of behavioral nutrition and physical activity*. 2015;12(1):10.

33. Jago R, Fox KR, Page AS, Brockman R, Thompson JL. Parent and child physical activity and sedentary time: Do active parents foster active children? *BMC Public Health*. 2010;10(1):194.

34. Lopez NV, Ayala GX, Corder K, et al. Parent support and parent-mediated behaviors are associated with children's sugary beverage consumption. *Journal of the Academy of Nutrition and Dietetics*. 2012;112(4):541-547.

35. Eisenberg CM, Ayala GX, Crespo NC, et al. Examining multiple parenting behaviors on young children's dietary fat consumption. *Journal of Nutrition Education and Behavior*. 2012;44(4):302-309.

36. Gibson E, Wardle J, Watts C. Fruit and vegetable consumption, nutritional knowledge and beliefs in mothers and children. *Appetite*. 1998;31(2):205-228.

37. Miller P, Moore RH, Kral TVE. Children's daily fruit and vegetable intake: Associations with maternal intake and child weight status. *Journal of Nutrition Education and Behavior*. 2011;43(5):396-400.

38. Rodenburg G, Oenema A, Kremers SPJ, van de Mheen D. Parental and child fruit consumption in the context of general parenting, parental education and ethnic background. *Appetite*. 2012;58(1):364-372.

39. Harris TS, Ramsey M. Paternal modeling, household availability, and paternal intake as predictors of fruit, vegetable, and sweetened beverage consumption among african american children. *Appetite*. 2015;85:171-177.

40. Boutelle KN, Birkeland RW, Hannan PJ, Story M, Neumark-Sztainer D. Associations between maternal concern for healthful eating and maternal eating behaviors, home food availability, and adolescent eating behaviors. *Journal of Nutrition Education and Behavior*. 2007;39(5):248-256.

41. Chung SJ, Ersig AL, McCarthy AM. The influence of peers on diet and exercise among adolescents: A systematic review. *J Pediatr Nurs*. 2017;36:44-56.

42. Stok FM, de Vet E, de Wit JB, Luszczynska A, Safron M, de Ridder DT. The proof is in the eating: Subjective peer norms are associated with adolescents' eating behaviour. *Public Health Nutr*. 2015;18(06):1044-1051.

43. Finnerty T, Reeves S, Dabinett J, Jeanes YM, Vögele C. Effects of peer influence on dietary intake and physical activity in schoolchildren. *Public Health Nutr*. 2010;13(03):376-383.

44. St. George SM, Wilson DK. A qualitative study for understanding family and peer influences on obesity-related health behaviors in low-income african-american adolescents. *Childhood Obesity*. 2012;8(5):466-476.

45. Bruening M, Eisenberg M, MacLehose R, Nanney MS, Story M, Neumark-Sztainer D. Relationship between adolescents' and their friends' eating behaviors: Breakfast, fruit, vegetable, whole-grain, and dairy intake. *Journal of the Academy of Nutrition and Dietetics*. 2012;112(10):1608-1613.

46. Ling J, Robbins LB, Resnicow K, Bakhoya M. Social support and peer norms scales for physical activity in adolescents. *Am J Health Behav*. 2014;38(6):881-889.

47. Fitzgerald A, Fitzgerald N, Aherne C. Do peers matter? A review of peer and/or friends' influence on physical activity among american adolescents. *J Adolesc*. 2012;35(4):941-958.

48. Case KR, Perez A, Saxton DL, Hoelscher DM, Springer AE. Bullied status and physical activity in texas adolescents. *Health Educ Behav*. 2016;43(3):313-320.

49. Pérez A, Hoelscher DM, Springer AE, et al. Physical activity, watching television, and the risk of obesity in students, texas, 2004-2005. *Prev Chronic Dis*. 2011;8(3):A61.

50. Ranjit N, Evans MH, Byrd-Williams C, Evans AE, Hoelscher DM. Dietary and activity correlates of sugar-sweetened beverage consumption among adolescents. *Pediatrics*. 2010;126(4):e754-e761. doi: 10.1542/peds.2010-1229.

51. Dortch KS, Gay J, Springer A, et al. The association between sport participation and dietary behaviors among fourth graders in the school physical activity and nutrition survey, 2009–2010. *American Journal of Health Promotion*. 2014;29(2):99-106.

52. Hoelscher DM, Day RS, Lee ES, et al. Measuring the prevalence of overweight in texas schoolchildren. *Am J Public Health*. 2004;94(6):1002-1008.

53. Hoelscher DM, Kelder SH, Pérez A, et al. Changes in the regional prevalence of child obesity in 4th, 8th, and 11th grade students in texas from 2000–2002 to 2004–2005. *Obesity*. 2010;18(7):1360-1368.

54. Perez A, Hoelscher DM, Frankowski RF, Day RS, Lee ES.
Statistical design, sampling weights and weight adjustments of the school physical activity and nutrition (SPAN) population-based surveillance 2009-2010 study. *Joint Statistical Meetings Proceedings*. 2010:3397.

55. Hoelscher DM, Day RS, Kelder SH, Ward JL. Reproducibility and validity of the secondary level school-based nutrition monitoring student questionnaire. *J Am Diet Assoc*. 2003;103(2):186-194.

56. Penkilo M, George GC, Hoelscher DM. Reproducibility of the school-based nutrition monitoring questionnaire among fourth-grade students in texas. *Journal of Nutrition Education and Behavior*. 2008;40(1):20-27.

57. Thiagarajah K, Fly AD, Hoelscher DM, et al. Validating the food behavior questions from the elementary school SPAN questionnaire. *Journal of Nutrition Education and Behavior*. 2008;40(5):305-310.

58. Zabinski MF, Daly T, Norman GJ, et al. Psychosocial correlates of fruit, vegetable, and dietary fat intake among adolescent boys and girls. *Journal of the Academy of Nutrition and Dietetics*. 2006;106(6):814-821.

59. Donnelly R, Springer A. Parental social support, ethnicity, and energy balance-related behaviors in ethnically diverse, low-income, urban elementary schoolchildren. *J Nutr Educ Behav*. 2015;47(1):10-18.

60. Windle M, Grunbaum JA, Elliott M, et al. Healthy passages: A multilevel, multimethod longitudinal study of adolescent health. *Am J Prev Med*. 2004;27(2):164-172.

61. Ranjit N, Wilkinson AV, Lytle LM, Evans AE, Saxton D, Hoelscher DM. Socioeconomic inequalities in children's diet: The role of the home food environment. *International Journal of Behavioral Nutrition and Physical Activity*. 2015;12(1):S4.

62. Prochaska JJ, Rodgers MW, Sallis JF. Association of parent and peer support with adolescent physical activity. *Res Q Exerc Sport*. 2002;73(2):206-210.

63. Dishman RK, Hales DP, Sallis JF, et al. Validity of social-cognitive measures for physical activity in middle-school girls. *J Pediatr Psychol*. 2009;35(1):72-88.

64. Stata M. 13.0. *College Station, TX: StataCorp*. 2013.

65. Eisenberg ME, Larson NI, Berge JM, Thul CM, Neumark-Sztainer D. The home physical activity environment and adolescent BMI, physical activity, and TV viewing: Disparities across a diverse sample. *Journal of racial and ethnic health disparities*. 2014;1(4):326-336.

66. Trost SG, Loprinzi PD. Parental influences on physical activity behavior in children and adolescents: A brief review. *American Journal of Lifestyle Medicine*. 2011;5(2):171-181.

67. Haidar A, Carey FR, Ranjit N, Archer N, Hoelscher D. Self-reported use of nutrition labels to make food choices is associated with healthier dietary behaviours in adolescents. *Public Health Nutr*. 2017;20(13):2329-2339.

68. Groth SW, Rhee H, Kitzman H. Relationships among obesity, physical activity and sedentary behavior in young adolescents with and without lifetime asthma. *Journal of Asthma*. 2016;53(1):19-24.

69. Butte NF, Puyau MR, Adolph AL, Vohra FA, Zakeri I. Physical activity in nonoverweight and overweight hispanic children and adolescents. *Med Sci Sports Exerc*. 2007;39(8):1257-1266.

70. D'Addesa D, D'Addezio L, Martone D, et al. Dietary intake and physical activity of normal weight and overweight/obese adolescents. *Int J Pediatr*. 2010;2010:785649.

71. Belcher BR, Berrigan D, Dodd KW, Emken BA, Chou CP, Spruijt-Metz D. Physical activity in US youth: Effect of race/ethnicity, age, gender, and weight status. *Med Sci Sports Exerc*. 2010;42(12):2211-2221.

72. Butt J, Weinberg RS, Breckon JD, Claytor RP. Adolescent physical activity participation and motivational determinants across gender, age, and race. *Journal of Physical Activity and Health*. 2011;8(8):1074-1083.

73. Minges KE, Chao A, Nam S, Grey M, Whittemore R. Weight status, gender, and race/ethnicity: Are there differences in meeting recommended health behavior guidelines for adolescents? *The Journal of School Nursing*. 2015;31(2):135-145.

74. Andersen RE, Crespo CJ, Bartlett SJ, Cheskin LJ, Pratt M. Relationship of physical activity and television watching with body weight and level of fatness among children: Results from the third national health and nutrition examination survey. *JAMA*. 1998;279(12):938-942.

75. Matthews CE, Chen KY, Freedson PS, et al. Amount of time spent in sedentary behaviors in the united states, 2003-2004. *Am J Epidemiol*. 2008;167(7):875-881.

76. Carson V, Staiano AE, Katzmarzyk PT. Physical activity, screen time, and sitting among US adolescents. *Pediatric exercise science*. 2015;27(1):151-159.

77. Whitt-Glover MC, Taylor WC, Floyd MF, Yore MM, Yancey AK, Matthews CE. Disparities in physical activity and sedentary behaviors among US children and adolescents: Prevalence, correlates, and intervention implications. *J Public Health Policy*. 2009;30(1):S309-S334.

78. Golan M, Crow S. Targeting parents exclusively in the treatment of childhood obesity: Long-Term results. *Obes Res*. 2004;12(2):357-361.

79. Golan M, Crow S. Parents are key players in the prevention and treatment of weight-related problems. *Nutr Rev*. 2004;62(1):39-50.

80. Lindsay AC, Sussner KM, Kim J, Gortmaker S. The role of parents in preventing childhood obesity. *The Future of Children*. 2006;16(1):169-186.

81. Jelalian E, Evans EW. Behavioral intervention in the treatment of obesity in children and adolescents: Implications for mexico. *Nutr Rev*. 2017;75(suppl 1):79-84.

82. Boutelle KN, Cafri G, Crow SJ. Parent-only treatment for childhood obesity: A randomized controlled trial. *Obesity*. 2011;19(3):574-580.

83. Janicke DM, Sallinen BJ, Perri MG, et al. Comparison of parent-only vs family-based interventions for overweight children in underserved rural settings: Outcomes from project STORY. *Arch Pediatr Adolesc Med*. 2008;162(12):1119-1125.

84. Jelalian E, Hadley W, Sato A, et al. Adolescent weight control: An intervention targeting parent communication and modeling compared with minimal parental involvement. *J Pediatr Psychol*. 2014;40(2):203-213.

85. Brener ND, Billy JOG, Grady WR. Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: Evidence from the scientific literature. *Journal of Adolescent Health*. 2003;33(6):436-457.

86. Nelson MC, Story M, Larson NI, Neumark-Sztainer D, Lytle LA. Emerging adulthood and college-aged youth: An overlooked age for weight-related behavior change. *Obesity*. 2008;16(10):2205-2211.

87. Steinbeck K, Baur L, Cowell C, Pietrobelli A. Clinical research in adolescents: Challenges and opportunities using obesity as a model. *Int J Obes*. 2009;33(1):2-7.

88. Golan M, Weizman A, Apter A, Fainaru M. Parents as the exclusive agents of change in the treatment of childhood obesity. *Am J Clin Nutr*. 1998;67(6):1130-1135.

89. Golan M, Weizman A. Familial approach to the treatment of childhood obesity: Conceptual model. *J Nutr Educ*. 2001;33(2):102-107.

90. Golan M. Parents as agents of change in childhood obesity-from research to practice. *Pediatric Obesity*. 2006;1(2):66-76.

91. Golan M, Kaufman V, Shahar DR. Childhood obesity treatment: Targeting parents exclusively v. parents and children. *Br J Nutr*. 2006;95(5):1008-1015.

92. Loveman E, Al-Khudairy L, Johnson RE, et al. Parent-only interventions for childhood overweight or obesity in children aged 5 to 11 years. *The Cochrane Library*. 2015.

93. Boutelle KN, Cafri G, Crow SJ. Parent-only treatment for childhood obesity: A randomized controlled trial. *Obesity*. 2011;19(3):574-580.

94. Kim HS, Park J, Park K, Lee M, Ham OK. Parent involvement intervention in developing weight management skills for both parents and overweight/obese children. *Asian nursing research*. 2016;10(1):11-17.

95. Ochoa-Avilés A, Verstraeten R, Huybregts L, et al. A school-based intervention improved dietary intake outcomes and reduced waist circumference in adolescents: A cluster randomized controlled trial. *Nutrition journal*. 2017;16(1):79.

96. Hoelscher DM, Springer AE, Ranjit N, et al. Reductions in child obesity among disadvantaged school children with community involvement: The travis county CATCH trial. *Obesity*. 2010;18(S1).

97. Hoelscher DM, Feldman HA, Johnson CC, et al. School-based health education programs can be maintained over time: Results from the CATCH institutionalization study. *Preventive Medicine*. 2004;38(5):594-606. doi: https://doi-org.ezproxy.lib.utexas.edu/10.1016/j.ypmed.2003.11.017.

98. Gail MH, Mark SD, Carroll RJ, Green SB, Pee D. On design considerations and randomization-based inference for community intervention trials. *Stat Med*. 1996;15(11):1069-1092.

99. Feldman HA, McKinlay SM. Cohort versus cross-sectional design in large field trials: Precision, sample size, and a unifying model. *Stat Med*. 1994;13(1):61-78.

100. Murray DM. *Design and analysis of group-randomized trials.* Vol 29. Monographs in Epidemiology & B; 1998.

101. Yee JL, Niemeier D. Advantages and disadvantages: Longitudinal vs. repeated cross-section surveys. *Project Battelle*. 1996;94(16):7.

102. Springer AE, Kelder SH, Byrd-Williams CE, et al. Promoting energy-balance behaviors among ethnically diverse adolescents: Overview and baseline findings of the central texas CATCH middle school project. *Health Education & Behavior*. 2013;40(5):559-570.

103. Wilson G, Wood K. The influence of children on parental purchases during supermarket shopping. *International Journal of Consumer Studies*. 2004;28(4):329-336.

104. Fruit and vegetable consumption among high school students—united states, 2010. *JAMA*. 2012;307(2):135-137.

AUTHOR BIORGRAPHY

Amier Haidar is a biochemistry major in the Health Science Scholars honors program at the University of Texas at Austin. Amier's inspiration for the project came from his passion of working out and staying physically active, as well as eating healthy and how his parents played an active and crucial role throughout his childhood in ensuring that healthy foods were available and that he maintained a healthy diet and was physically active.

After graduation, Amier will attend McGovern Medical School as part of the Class of 2022, with the plans of earning a MD/MPH dual-degree. He hopes to continue conducting public health research and wants to apply a public health perspective towards medicine, so that interventions and educational efforts can be in place to help individuals before they reach the doctor's office.