ASSOCIATIONS AMONG OBESITY, PHYSICAL ACTIVITY, NUTRITION, AND FAMILY ENVIRONMENT IN ADOLESCENTS

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ABSTRACT

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The ability to screen for risk factors (e.g., physical activity, dietary behavior, and screen time behavior) that relate to obesity risk in youth and the development of multi-disciplinary pediatric obesity treatment programs are vital in addressing the global pediatric obesity problem. The Family Nutrition and Physical Activity (FNPA) Screening Tool is a screening instrument that can be used to assess the family and home environment, which influences the health behaviors and obesity risk of children. FitKids360 is an obesity treatment program for 5-16 year olds that utilizes the FNPA as part of its assessment of pediatric obesity risk. However, the FNPA has not been examined in adolescents and has never been examined directly for its relationship with measures that represent constructs comprising the FNPA (e.g., child physical activity, diet quality). Similarly, FitKids360 has never been evaluated solely with an adolescent population. This dissertation was divided into two studies, and its overall purpose was two-fold: 1) To examine the association of the FNPA screening tool with physical activity, dietary quality, and screen time behaviors in ninth grade students, as well as its relationship to obesity risk; 2) To evaluate the FitKids360 intervention, implemented as part of the Commit to Healthy Hearts Program, in participating ninth grade students.

In Study One, a total of 175 ninth grade students were measured for physical activity, dietary quality, and screen time behavior using the Physical Activity Questionnaire for Adolescents (PAQ-A), Healthy Eating Index-2010 (HEI-2010), and self-reported total screen
time, respectively. Students were also assessed for height and weight to calculate body mass
index (BMI) and for percent body fat using a portable stadiometer and electronic scale,
respectively. Parents of the students completed the FNPA survey. Associations among the
FNPA score, PAQ-A score, HEI-2010 and total screen time were determined along with
differences in FNPA score by weight status using correlation, regression, and logistic regression
analyses. In Study Two, 16 overweight/obese students completed the 7/8-week long FitKids360
program. Process evaluation of the FitKids360 program was conducted to determine reach, dose,
and fidelity of the program. Assessments of weight status, physical activity, dietary behaviors,
FNPA, and physical activity and dietary self-efficacy were taken at baseline, post-7/8-weeks and
3-months post-intervention were conducted and analyzed using repeated measures ANOVA.

Overall, no significant associations were found among the total FNPA score, PAQ-A
score, HEI-2010 score, and total screen time in adolescents; however, the FNPA-Diet construct
score was associated with HEI-2010 score. No significant differences in the FNPA were found
by weight status. Process evaluation results showed that the FitKids360 program was positively
received by staff and family participants and that the program was delivered with high fidelity.
Pre-post assessments from baseline to 7/8-week follow-up showed a significant improvement in
FNPA score (53.1 to 58.3), but no other significant differences in any other health outcome.

This study highlights that the FNPA Screening Tool may not be associated with health
behaviors or obesity risk in an adolescent population. The FitKids360 program was shown to
decrease BMI z-score, and notably improved FNPA scores, despite the fact that the FNPA was
not related to health outcomes. Further research is needed to explore the utility of the FNPA and
to evaluate the FitKids360 program with a larger sample size.
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<td>Academy of Nutrition and Dietetics</td>
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<td>BMI</td>
<td>Body mass index</td>
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<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
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<td>CHH</td>
<td>Commit to Healthy Hearts</td>
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<td>CVD</td>
<td>Cardiovascular disease</td>
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<td>FFQ</td>
<td>Food frequency questionnaire</td>
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<td>Family Nutrition and Physical Activity</td>
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<td>PAQ-A</td>
<td>Physical Activity Questionnaire for Adolescents</td>
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<tr>
<td>SCD</td>
<td>Sudden cardiac death</td>
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<td>Screen time</td>
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CHAPTER 1: INTRODUCTION
General background of pediatric obesity

Obesity is one of the leading causes of mortality, morbidity, disability, healthcare utilization, and healthcare costs in the United States (US) making it a priority health concern for our society [1-3]. Over the past 30 years there has been a significant increase in the prevalence of overweight and obesity among both adults and youth in the US [4]. Currently, 32% of US youth are overweight or obese [4]. The causes for this high prevalence of pediatric obesity are not completely understood, but lifestyle behaviors associated with positive energy balance (i.e., high in caloric intake and low in physical activity) are believed to play a critical role [5]. Some of the numerous consequences of obesity are increased risk for the development of a number of adverse health outcomes such as coronary heart disease, type 2 diabetes, cancers (endometrial, breast, and colon), hypertension, dyslipidemia, stroke, liver disease, sleep apnea, respiratory problems, depression, and anxiety [3]. These consequences, coupled with the fact that obese children and adolescents are more likely to be obese as adults [6-8], highlight that it is imperative that one of the solutions to the US obesity epidemic is to initiate the treatment of obesity early in life to reduce future adverse health outcomes in obese youth.

Screening for obesity among youth & obesity interventions

Appropriate screening is the first step in obesity treatment. Evidence has shown that at risk children and adolescents can be identified and treated [9] after effective screening processes are used to identify obesity. In a recommendation by the U.S. Preventive Services Task Force, clinicians are advised to screen children ages 6 to 18 years for obesity and refer them to weight management programs to improve their weight status, if necessary [9]. Because both height and weight are purportedly routinely measured during health maintenance visits, body mass index (BMI) has become the most popular method for obesity screening among children and
adolescents. Although the assessment method of using BMI is important in the process of identifying obese youth, researchers have suggested that screening tools be developed that identify youth who are “at risk” of becoming obese [10]. Additionally, healthcare providers and clinicians often do not screen beyond just the assessment of BMI in identifying obesity risk. To address these problems, screening tools need to examine more than just BMI, and should specifically address health-related behaviors associated with obesity risk (e.g., diet and physical activity) and factors that impact these behaviors (e.g., the family and home environment) [10].

It is well established that unhealthy dietary behavior and physical inactivity are the two key risk factors influencing obesity at any age [11]. Research also suggests that self-efficacy (i.e., belief/confidence that one can achieve a specific outcome) plays an important role in dietary and physical activity behaviors in youth and obesity risk [12, 13]. This is because having more confidence in achieving physical and dietary goals likely leads to the initiation of the behaviors, increased effort in trying to achieve said behaviors, and increased resistance to avoid failure. Among children, the family environment plays an important role, through their support and encouragement, in determining dietary and physical activity behaviors [14, 15] as well as dietary and physical self-efficacy [16-18]. Children are unique in that their dietary and physical activity behaviors and self-efficacy are influenced directly by parents and indirectly through the environment provided to them. Because of the influence that parents have on their children, evaluating family behaviors and the home environment are needed as part of the obesity screening process. Specific factors related to family behaviors and/or the home environment could be targeted in intervention programs to prevent and/or treat obesity in youth. However, from a methodological standpoint it has been difficult to capture the shared family and child environment.
In recent years, the Family Nutrition and Physical Activity (FNPA) Screening Tool, which assesses family environmental and behavioral factors (e.g., diet, physical activity, sedentary time, sleep patterns, TV in bedroom, food availability) that influence children’s risk for becoming overweight, was developed and evaluated in first graders for its predictive validity of assessing risk for becoming obese [19]. Results showed that FNPA score was associated with a change in BMI over a 1-year period after accounting for baseline BMI, parent BMI, and other demographic variables [20]. Several other studies have examined the utility of the FNPA screening tool by exploring its association with other health outcomes besides obesity. One study conducted by Yee et al. found the FNPA to be associated with adiposity measures and cardiovascular disease risk in primarily Caucasian, 5th graders [21]. In another study, Yee and colleagues found the FNPA to be associated with risk of having acanthosis nigricans (in press), an indicator of insulin resistance in elementary aged youth. The FNPA has several advantages as a screening instrument including that it takes little time to administer (~5-10 minutes), is easy to use, combines information from a variety of behaviors related to child obesity in the family environment, and has potential for use by pediatricians, school nurses, and other health professionals for assessing a child’s family and home environment and his/her risk for becoming overweight. However, the FNPA has only been examined in elementary aged children. Thus, additional research using the FNPA is warranted to examine its utility in different settings and populations and with other health behaviors (e.g., physical activity, diet, sleep time). With further research using the FNPA, the survey could become a valuable tool for determining specific family behaviors and aspects of the home environment that could be targeted in youth obesity interventions.
**Pediatric obesity prevention and treatment intervention programs**

Many leading organizations and expert panels have recommended timely interventions to address the pediatric obesity epidemic [4, 22]. Behavior modification interventions have been the most widely studied interventions for pediatric obesity [23]. These behavior modification interventions promote weight loss or maintenance through modifications in both physical activity and diet without the use of pharmaceutical drugs. Behavior modification intervention programs have been implemented in various settings including clinical offices, schools, community settings, family homes, etc. Many youth behavior modification interventions for obesity have their origins in individual family counseling (i.e., one clinician/healthcare professional counseling one family), but over the years there has been a growing need for a structured process to treat pediatric obesity and a need for more effective intervention programs [24] in order to address the global obesity epidemic.

In 2007, an Expert Committee comprising of representatives from 15 professional organizations convened to create recommendations for clinicians as to how to approach the prevention, assessment, and treatment of childhood obesity [25]. The recommendations proposed a systematic, staged approach to treating obesity in youth that included brief, office-based intervention followed by a systematic intensification of efforts, tailored to the capacity of a clinical office, the motivation of the family, the presence of risk factors and the degree of obesity, with the most intensive stage of treatment to be considered only for individuals who have not responded positively to other intervention treatments. The four staged approach is as follows: Stage 1 – Prevention Plus, Stage 2 – Structured Weight Management, Stage 3 – Comprehensive, Multidisciplinary Intervention, and Stage 4 – Tertiary Care Intervention. The Expert Committee also recommended that health care providers unite to develop programs
representative of the staged approach to improve health outcomes in obese youth through early identification, creation of the best possible home and family environment, and provision of structured-guidance to obese youth and their families.

Among these programs is a further need for collaboration among those who play an integral role in the health of children and adolescents (e.g., primary care office, homes, schools, community centers). In a systematic review examining weight management intervention programs in children and adolescents [24], the authors determined that there are behavioral interventions in specialty care clinics and schools that have been effective in improving weight measures (e.g., BMI, percent body fat, waist circumference), but there still remains a greater need for developing such programs in general clinical care clinics and community environments. This same recommendation was made in the U.S. Department of Human Health Services’ 5-year follow up report to the 2008 Physical Activity Guidelines for Americans [26]. In this Midcourse Report, the authors noted that community programs and strategies to improve physical activity behavior in youth are limited, as are those based in clinical settings. They recommended that programs be developed and evaluated in community and clinical settings to see if they serve as viable means to improve risk factors and outcomes of obesity in youth. Given that physical activity and healthful eating is one of the primary lifestyle behaviors targeted for modification in a vast majority of pediatric obesity interventions, these recommendations from the Midcourse Report highlight the greater need for the development of weight management programs which target these 2 behaviors in these settings.

**Commit to Healthy Hearts - Overview**

In the spring of 2012, Genesys Hospital, located in Grand Blanc, MI, piloted a community-based sudden cardiac death (SCD) screening program for high school youth called
Commit to Healthy Hearts (CHH) in Genesee County, specifically in Grand Blanc, MI. While three youth at risk for SCD were identified, CHH also found that 27% of screened youth had other cardiovascular disease (CVD) risk factors. When treatment referral resources were sought to serve these at-risk youth, minimal services were available to address primary prevention of the serious health outcomes associated with CVD risk factors. This is particularly significant since Genesee County ranks among the worst for health outcomes in Michigan: 77th out of 82 counties, and 82nd for health behaviors (County Health Rankings). Heart disease is the leading cause of death in Genesee County with a rate of 254.9 (per 100,000) compared to 231.1 (per 100,000) in the State and 203.1 (per 100,000) nationally. Diabetes (10.6%), and physical inactivity (62.0%) also rank significantly higher than State (10.0% diabetes, 53.6% physical inactivity), and national rates (9.3% diabetes, 49.6% physical inactivity). Although adolescence is a key age to prevent cardiovascular disease [27], research has shown that adolescents have low compliance in seeking preventive healthcare [28]. Treating these youth sooner could significantly improve the health of the Grand Blanc community. To accomplish this goal, the CHH program engaged multidisciplinary service providers – health, education and community – with the goals of:


CHH Part 2. FitKids360 Program and Program Evaluation Research: To implement an established, evidence-based weight management program in at-risk youth identified in the cardiovascular risk assessment. The standard FitKids360 Program [29], was implemented in Genesee County to improve cardiovascular health risk. The FitKids360 Program targets obesity as the main risk factor. The
FitKids360 Program Evaluation Research evaluated the effectiveness of the FitKids360 Program.

CHH Part 3. Population Heart Health: Provide healthy lifestyle population health components to Grand Blanc High School students via community partners’ already established programs.

Origin of the FitKids360 program and its use in Commit to Healthy Hearts

In response to the rising pediatric obesity epidemic, FitKids360, a comprehensive healthy lifestyle program, was developed by a team of individuals at Spectrum Health, Healthier Communities, and Helen DeVos Children’s Hospital in Grand Rapids, MI, to help obese children and their families lead healthier lives and improve their health [29]. FitKids360 provides basic education about nutrition, facilitating positive behavior change, and exercise combined with fun physical activities sessions. FitKids 360 also implements behavior change techniques aimed at improving physical activity and dietary self-efficacy in participants and their families to hopefully empower them to adopt healthier physical activity and dietary behaviors. FitKids360 was originally designed for children and adolescents, ages 5 to 16 years, who have a BMI that is at least the 85th percentile and are ready to make lifestyle changes to become healthier. Youth participants are required to be accompanied by a parent or guardian throughout their participation in the program due to the influence that parents have on their child’s health. All members of a participant’s immediate family are invited to join and provide social support.

The FitKids360 program consists of an orientation session followed by six, once-a-week, two-hour sessions delivered by a team of experts including a pediatrician or health care provider, registered dietitian, health behavior specialist, and an exercise physiologist, personal trainer or fitness instructor. Students and families must commit to consistent participation in class and
during the week to participate. To maintain fidelity, the FitKids360 model is required to be implemented in a standardized manner. Standardized instructor training, materials, and programmatic delivery are required. Since one of the Commit to Healthy Hearts objectives was to evaluate an intervention program that can be offered to the ninth graders who were identified as overweight or obese from the cardiovascular risk screening, FitKids360 was the intervention program used and evaluated in this dissertation. For experimental design purposes, ninth graders who qualified for the FitKids360 program, but declined to participate, were asked to serve as a comparison group to compare with those who participated in FitKids360.

**Summary and purpose of dissertation**

With childhood and adolescent obesity being an important public health concern, there is a strong need for screening youth for BMI and other risk factors related to obesity risk. Upon identifying overweight/obesity in youth, comprehensive treatment is recommended to promote improvement in weight status and health behaviors related to obesity risk. Both the Family Nutrition and Physical Activity (FNPA) screening tool and the FitKids360 program highlight the importance of the role that parents have with regard to the “obesogenic risk” that may exist within a family and in the home environment (primarily in relation to physical activity and diet). Along with physical activity, diet, and screen time, the FNPA screening tool has been one of the primary outcome measures used to determine the effectiveness of the FitKids360 program; however, only one study has been published on the effectiveness of FitKids360 [29], which showed an improvement in moderate-to-vigorous physical activity, several dietary behaviors, and total FNPA score. This study was comprised primarily of younger children. This dissertation is the first to report on how FitKids360 influences FNPA scores of adolescent participants.
To date, most research has shown the FNPA score to be inversely associated with the risk of being overweight/obese in youth. Because the FNPA is composed of questions that assess familial and home environmental factors (e.g., physical activity, diet, and screen time), researchers have questioned whether the FNPA score would then be associated with actual measures of physical activity, dietary quality, and screen time in youth. Also, because studies examining the FNPA have only been conducted using primarily elementary children, this dissertation sought to examine if the FNPA could be utilized in an adolescent population. Results from this part of the dissertation shed light on the ability to use the FNPA in obesity intervention programs for adolescents.

With the limited number of clinical and community programs designed to prevent and/or treat obesity in youth, it is important to evaluate any programs that are developed, such as the FitKids360 Program. This would help in gaining insights into the best practices/approaches into addressing this problem. A collaboration with Genesys Hospital in Grand Blanc, MI, allowed the opportunity to evaluate the FitKids360 program in Grand Blanc solely on adolescents and determine if such a program is effective and feasible to conduct in this particular community. To date, there has only been one published study on the effectiveness of the FitKids360 program, which focused on participants who were 6-15 years old [29]. The FitKids360 program has never been implemented with solely adolescent participants (i.e., older than 14 years of age) and their parents. Results from this part of the dissertation will serve to evaluate the FitKids360 program’s effectiveness and feasibility and acceptability as well as to examine what impact the program has on adolescents and their parents in relation to healthy-related behaviors.

This dissertation is divided into two studies, and its overall purpose is two-fold: 1) To examine the association of the Family Nutrition and Physical Activity (FNPA) Screening Tool
with physical activity, dietary quality, and screen time in adolescents; 2) To evaluate the FitKids360 intervention, implemented as part of the Commit to Healthy Hearts Program, in participating 9th graders from Grand Blanc High School.

Overall, this dissertation included five research questions:

**Specific aims and hypotheses**

Family Nutrition and Physical Activity (FNPA) Screening Tool and Physical Activity, Dietary, and Screen Time Behaviors

1. **Examine the association of the Family Nutrition and Physical Activity (FNPA) Screening Tool with physical activity, dietary quality, and screen time in adolescents.**

   It was hypothesized that there would be a significant positive association between the FNPA score and physical activity and dietary behaviors. It was hypothesized that there would be a significant negative association between the FNPA score and screen time.

2. **Examine if the FNPA scores differ by weight status.**

   It was hypothesized that the FNPA scores would significantly differ by weight status, with FNPA scores being the highest among normal weight subjects and the lowest among obese subjects.

**FitKids360 Intervention Evaluation**

3. **Evaluate the feasibility and acceptability of the intervention related to (a) instructor satisfaction/evaluation; and (b) family/youth satisfaction.**

   Feedback from the FitKids 360 participants (parents & youth), program instructors, and program volunteers were used for this specific aim. This aim was not hypothesis driven.
4. **Evaluate the reach, dose, and fidelity of the FitKids360 intervention.**

Reach was determined via attendance of FitKids360 participants to weekly classes. Dose was assessed via observations of each weekly class and documenting if the particular components of each weekly class were actually delivered by the intervention team. Dose was also determined by documenting the number of lesson objectives completed. Fidelity was assessed by observing each class component (Physical Activity/Exercise, Nutrition, Behavioral, Group Exercise) and recording the quality of the delivery of each component of the lesson using a customized form. This aim was not hypothesis driven.

5. Explore if FitKids360 participants showed any improvements in physical activity, dietary quality, screen time, physical activity and dietary self-efficacy, and FNPA score from baseline to 7/8-weeks/ follow-up and 3-month follow-up. It was hypothesized that FitKids360 participants would have increases in physical activity, dietary quality, physical activity and dietary self-efficacy, and FNPA score and a significant decrease in screen time at 7/8-week follow-up and at 3-months follow-up compared to values assessed at baseline.
REFERENCES


CHAPTER 2: LITERATURE REVIEW
Introduction

The following chapter contains the literature review for this dissertation study. As this dissertation examines risk factors related to obesity in children and adolescents, a general overview of the prevalence and consequences of obesity in youth is summarized. Next, information on how the specific risk factors being examined in this dissertation (i.e., physical activity, diet, screen time, family/home environment) are related to obesity in youth. An overview and studies of the Family Nutrition and Physical Activity (FNPA) Screening Tool are then reviewed. Last, weight management/obesity interventions in youth are discussed specifically by the location that the intervention is conducted in (i.e. school, home, clinical, community).

Obesity in youth: prevalence and consequences

Over the past 30 years, the prevalence of obesity in children and adolescents has risen. Currently, an estimated 32% of US youth 2-19 years of age are overweight or obese, and 17% of youth are obese [1]. This prevalence of obesity does not differ between boys and girls or between age groups (6- to 11- year-olds versus 12- to 19-year-olds). However, significant racial disparities in obesity prevalence exist among children and adolescents. Obesity prevalence is higher among Hispanics (22.4%) and non-Hispanic black youth (20.2%) compared to non-Hispanic white youth (14.1%). Due to this growing health problem among youth, childhood obesity has been described as the primary childhood health problem in developed nations [2].

Children and adolescents who are obese are likely to be obese adults [3-5]. A systematic review on the tracking of childhood overweight and obesity into adulthood reported relative risks of adult obesity from 2.0-10.0 for overweight children and a higher risk from adolescence to
adulthood (12.0-15.0) [6]. Due to this tracking of obesity from childhood and adolescence into adulthood, it is important to provide early prevention of adult obesity for youth.

Childhood obesity has immediate effects on health and well-being across many different aspects of life. Results from the Bogalusa Heart Study have shown that obese youth are more likely to have risk factors for cardiovascular disease [7]. Higher rates of hypertension have been detected among obese youth compared to normal weight youth [8-10]. Results from the Bogalusa Heart Study showed that overweight children were 4.5 and 2.4 times more likely to have elevated systolic blood pressure and diastolic blood pressure, respectively, compared to normal weight children [8]. The Muscatine and Pathological Determinants of Atherosclerosis (PDAy) studies have also highlighted the origins of cardiovascular disease risk factors such as high low-density lipoprotein (LDL) cholesterol, low high-density lipoprotein (HDL) cholesterol, and high triglycerides in overweight and obese youth [11, 12]. Researchers have shown that obese adolescents are more likely to have prediabetes, a condition in which blood glucose levels indicate a high risk for the development of diabetes [13]. Obese youth have also been found to be at greater risk for behavioral, social, and psychological problems like poorer self-esteem and stigmatization compared to their normal weight peers. [14, 15]. In light of all the immediate effects that obesity has on children and adolescent’s health and well-being, intervention treatment needs to be delivered swiftly to obese youth in order to diminish the effects of these health adversities as soon as possible.

With childhood obesity there is also concern for long-term effects. Like obesity, cardiovascular disease risk factors tend to track from childhood into adulthood. In the Bogalusa Heart Study, 61% of children who had the highest risk for cardiovascular disease at baseline were found to still have the highest risk for cardiovascular disease 8 years later [16]. With
obesity being a risk factor for CVD development, childhood obesity could increase CVD risk in adults. Also, with obese youth being at increased risk of staying obese as adults, they are at increased risk of developing many types of cancer, including breast, colon, endometrium, esophagus, kidney, pancreas, gall bladder, thyroid, ovary, cervix, and prostate, as well as multiple myeloma and Hodgkin’s lymphoma [17]. These long-term effects of obesity in youth on health and well-being highlight how important it is to treat the problem of obesity early in life to prevent the increased risk and development of these health adversities into adulthood.

Most childhood obesity studies examining correlates of obesity among children and adolescents have tended to examine simple, bivariate relationships. A model proposed by Davison and Birch [18] applies Ecological Systems Theory (EST) into describing how obesity develops during childhood (Figure 1). This model of explaining the etiological factors related to obesity in youth establishes that childhood obesity is multi-factorial and requires that in order to prevent and/or treat childhood obesity that multiple factors should be addressed. For this dissertation, the evidence that exists about how the factors of physical activity, dietary quality, screen time, and the family and home environment relate to obesity will be explored.
Physical activity and obesity in youth

Over a half-century ago, the importance of physical activity in the etiology of obesity was reported [19]. Since then, several researchers have found that physical activity is positively associated with numerous health benefits (e.g., improved weight control, reduction in anxiety and stress, improvement in muscular strength & endurance), and physical inactivity is one of the predominant risk factors for overweight and obesity [20]. This makes physical activity a behavior to target in the prevention and treatment of obesity both during childhood and adulthood.
Several large, cross-sectional studies [21-23] and a recent literature review [24] have shown physical activity to be inversely related to obesity in children and adolescents. Results from the European Youth Heart Study (EYHS) showed physical activity (as measured by accelerometry) to be inversely related to Swedish children and adolescents’ risk of being obese and having high waist circumference [23]. Although there is concern for the results of studies that utilize assessment methods of self-report for physical activity, a review by Jiminez-Pavon and colleagues [24] examined 47 studies that measured both objectively measured habitual physical activity and adiposity in children and adolescents and found consistent negative associations between physical activity and adiposity. In general, most evidence supports that higher levels of habitual physical activity are protective against child and adolescent obesity.

Research has also shown that obese children are less physically active than their normal weight peers, regardless of the measurement technique utilized to assess physical activity [25-28]. For example, Yu and colleagues found obese youth, using habitual heart rate monitoring, spent 30% less time in physical activities and 51% more time in sedentary activities compared to their non-obese counterparts [26]. These findings highlight how little physical activity obese children and adolescents get and how much more at risk they are at for the consequences of obesity than their normal weight counterparts.

**Diet and obesity in youth**

Along with physical activity, diet has been claimed by health experts to be the other cornerstone of the energy balance equation related to the development of overweight and obesity among children and adolescents [29]. It is well known that proper nutrition leads to the promotion of optimal, healthy growth and development of children and adolescents and a reduced risk of obesity [30]. However, the current environment found in US society today
(including food stores, restaurants, the school setting, and work setting) and customs surrounding food have been labeled “obesogenic” due to the contributions made to an imbalance in the energy balance equation by snacking, meals away from the household, increase in portion sizes, and an increase in the consumption of sugar-sweetened beverages [31-33]. There also exists a shortage of vegetables, whole grains, fruits, and milk products available [33]. The state of the US food environment can clearly be seen when comparing dietary behavior between obese children and adolescents with their non-obese counterparts. Recent national representative data show that low dairy intake is associated with increased BMI, percent body fat [34], and increased waist circumference in adolescent boys and girls [35]. Data also show that lower intakes of fruits and vegetables is inversely related to adiposity and that children and adolescents who consume more servings of meat tend to have larger waist circumferences [35]. Thus, in order to address the obesity epidemic that US youth face, the foods available to children and adolescents must change to provide fewer unhealthy foods and more healthy foods that are not high in calories.

Since dietary recommendations are a central component of any comprehensive treatment or intervention for obesity in youth, it is important that there be a consensus on the effectiveness on specific youth dietary recommendations; however, there is none. A systematic review by Gibson and colleagues examined nine studies designed to reduce weight in overweight and obese children and adolescents highlighted that low-carbohydrate diets, whether low-glycemic or not in nature, were just as effective as energy-restricted low-fat diets for short term weight loss in obese children and adolescents [36]. The authors noted that their most surprising finding from the review was the little amount of evidence supporting any sort of dietary advice for treating obesity in youth despite the enormity of the public health problem of childhood obesity. More
research is needed to determine which dietary recommendations are effective in reducing obesity risk in youth both for short-term and long-term effectiveness.

The goal in addressing the childhood obesity epidemic is to achieve an energy balance that includes not just achieving a healthy amount of physical activity, but consuming a health diet comprised of an energy intake that does not cause an energy imbalance. However, recent data show that despite an increase in the prevalence of childhood obesity over the last 12 years, energy intake has not changed among children and adolescents [37]. Despite no observable increase in youth energy intake over the last 12 years, children and adolescent diets continue to be a major public concern in relation to obesity risk because of the high prevalence of obesity. This interesting observation suggests that addressing dietary factors in relation to childhood obesity should include more than just total energy intake. Further research on diet and obesity in youth should focus on using assessments of overall diet quality and dietary pattern instead of single nutrients, such as total dietary fat.

**Sedentary time and obesity in youth**

Sedentary behavior, defined as any waking activity characterized by an energy expenditure $\leq 1.5$ metabolic equivalents and a sitting or reclining posture [38], has been reported in recent systematic reviews to be related to increased adiposity in youth [39,40]. Self-reported sedentary behaviors reported in the literature (e.g., self-reported accounts of television viewing, computer use, and video game playing, etc.) have consistently been found to be inversely associated with obesity and cardiometabolic risk in youth populations, independent of physical activity levels [22, 41-43]. In contrast, some studies that have utilized accelerometer-derived measures of sedentary behavior not revealed any significant association between sedentary behavior and obesity and cardiometabolic risk in youth [44-45]. Further research is needed to
better understand how sedentary behavior is related to obesity in children and adolescents so that intervention programs can develop strategies to minimize sedentary behavior.

**Screen time and obesity in youth**

Coupled with physical activity, sedentary behavior has also been examined as a variable that could potentially be associated with obesity in children and adolescents. Most research has measured sedentary behavior by expressing it as the amount of screen time watched (typically television). A few cross-sectional studies have found positive associations between the amount of television watched and weight status in children and adolescents [21, 46-48]. Several of these studies have also found a significant positive correlation between time spent watching television and the energy intake and percent of kilocalories from fat and significant inverse correlations with fruit and vegetable consumption [46-48]. These results could explain how screen time and diet are interrelated with obesity risk among children and adolescents. Aside from cross-sectional data, a few longitudinal studies have examined how screen time is associated with obesity [49-51]. Boone and colleagues followed adolescents from a large cohort who were tracked from adolescence into young adulthood and reported that for both males and females, significantly higher odds for incident obesity were observed with greater hours of screen time during adolescence as well as an increase in screen time from adolescence to early adulthood [50]. Also, two studies that followed children from birth found that TV viewing in childhood predicts obesity risk well into adulthood [52,53]. This extensive amount of research has confirmed that there is a link between screen time (predominantly TV viewing) and obesity in children and adolescents.

However, today there are more sources of screen time available to children and adolescents outside of just television. Today, children and adolescents are exposed to screen
time through video games played through the television, computer, or on handheld devices like cell phones and portable gaming systems. They are also exposed to a greater amount of time spent using smart phones and computers. Thus, total screen time should encompass time spent watching television, playing video games, and using one’s smart phone and computer (for non-academic purposes). In summary, on the basis of the available evidence on how screen time is related to obesity in youth, screen time should be an area targeted in the prevention and treatment of obesity by reducing screen time for children and adolescents and also the family.

**Physical activity and dietary self-efficacy and obesity in youth**

Self-efficacy is defined as the belief in one’s own ability to achieve actions necessary to produce a desired effect [54]. Self-efficacy can explain the relationship between an individual’s confidence in achieving and maintaining a behavioral change. An individual with higher self-efficacy is more likely to increase the level of effort put in towards initiating a behavior change compared to an individual with lower self-efficacy. Therefore, pediatric obesity interventionists should consider that an intervention program, whether focused on physical activity, diet, and/or other health behaviors, could be more effective by implementing behavior change techniques that enhance physical or dietary self-efficacy and evaluate physical and/or dietary self-efficacy as an outcome in determining changes in health behavior. However, not much is known about what the optimal psychological/behavioral intervention should be to elicit health behavior changes in obese youth. One study aimed to add to this literature gap by examining how a counseling component could be added to a standard care program (i.e., focused on improved physical activity and nutrition) and how it would influence health-related outcomes in overweight and obese adolescents [55]. Walpole and colleagues believed that motivational interviewing would provide guidance to participants by focusing their attention on statement indicating the
need/desire to make a health behavior change. This “change talk” would modify intrinsic motivation and strengthen a participant’s desire to make a positive health behavior change. The counseling component added to the experimental group was motivational interviewing conducted by a clinical psychologist trained in motivational interviewing. Outcome measures included dietary self-efficacy and anthropometric measurements (BMI z-score and body weight). Upon completion of the intervention, no significant group differences were found between the experimental vs. control groups. The results from this study suggest that perhaps more than just one type of counseling intervention should be utilized in an obesity treatment program with youth.

Much more research has been conducted examining how physical activity influences physical activity self-efficacy in youth. A review by Cataldo and colleagues [56] examined how physical activity intervention programs were associated with changes in self-efficacy in children and adolescents. A secondary purpose was to examine the effect of physical activity-self efficacy ratings with weight reduction goals. Interventions varied in terms of length (8 weeks to 3 years) and frequency (1 session – 5 sessions a week). Assessments of self-efficacy were various across studies included in the review: perceived barriers, exercise self-efficacy, diet self-efficacy, barriers to exercise, and combinations of self-efficacy measures. The review found moderately strong evidence to support that physical activity intervention programs might improve physical activity self-efficacy and that multidisciplinary intervention programs that include physical activity could elicit positive health behavior change in children and adolescents. The review identified that the potential mechanism for this improvement in physical activity self-efficacy was due to success in the intervention (i.e., becoming more physically active) at eliciting increased/sustained confidence in being physically active. In obese youth populations, these
health behavior changes could lead to an improvement in weight status both in the short-term and long-term.

Several studies have also examined how interventions have influenced specifically dietary self-efficacy in children and adolescents [57-59]. Wright and colleagues implemented a 6-week nutrition and physical activity intervention in 8-12 year old children [57]. 12-month post-intervention follow up data showed significant increases in self-efficacy for healthy food choices as well as an increase in dietary intake of vegetables and fruits. Similar positive increases were found in a study by Wall and colleagues [59] whose 4-week nutrition intervention program in fourth grade students elicited improvements in vegetable-related attitude and self-efficacy. A review paper on the determinants of fruit and vegetable consumptions among 6-12 year old children found that self-efficacy one of the most common personal determinants highlighted in the literature to be related to fruit and vegetable consumption [58]. Like physical activity, dietary intervention programs for obese youth should include a dietary/nutrition component to improve self-efficacy related to healthy eating so that dietary benefits can be acquired both short-term and long-term.

**Parental influence & family/home environment on physical activity, diet, and screen time**

Family/home environment and behaviors also influence obesity in children and adolescents by shaping their physical activity, sedentary, and dietary behaviors [60-62] and modifying their physical activity and dietary self-efficacy. Mechanisms identified as to how the family/home environment and behaviors influence obesity in children include social support, modeling of health behaviors, and the structuring of a healthy home environment and lifestyle [14]. Aspects that relate to the family and home environment include accessibility, availability, parental role modeling, and parental policies [14]. These aspects individually and interactively
create a complex social environment that has a profound effect on the lifestyle choices that children and adolescents make, including those related to physical activity, diet, and sedentary behavior [63, 64].

Parental role modeling is important as a social support role related to whether their children are physically active or not. They play critical roles by reducing or eliminating barriers to good health, overseeing choices about health, and modeling positive, appropriate behavior [62]. Parents who participate in exercise or activity have children who are more likely to be active [65]. A study by Moore and colleagues [66] found children aged 4-7 years of age were 3.5-6.0 times more likely to be physically active when one or both of their parents were active compared to children with two inactive parents. Parents do not necessarily have to demonstrate elite athletic ability or engage in a specialized sport to be considered someone who is very a successful performer. Habitual walking, doing yard work, and doing household physical activities are ways that parents can illustrate how physical activity plays a role in life to children. However, negative parental support behaviors can adversely affect a child’s physical activity behavior [67]. These can include parents who spend a lot of time in sedentary activities like television watching and computer use and parents who do not have a routine physical activity pattern to demonstrate to their children. Pediatric obesity treatment programs should aim to explore if any any negative role modeling exists in a family or home that might lead to a reduction in physical activity levels [67-69].

Parenting styles also can have an influence on children’s physical activity behavior. Specific parenting practices describe behaviors that a parent implements to facilitate physical activity [70]. A recent study conducted in the US reported that children who had permissive mothers were the most physically active, and any sort of logistic support for physical activity
was associated with increased physical activity levels [71]. Another study by Jago and colleagues [72] found maternal permissive parenting to be associated with higher levels of moderate-to-vigorous physical activity compared to authoritative parenting. The results from these studies show that parents should be encouraged to provide increased support for their children’s physical activity and that different parenting styles have different effects on their children’s physical activity behaviors. Interventions should consider working with parents of obese youth on a parenting style that promotes healthy physical activity in their children to obtain short term and long-term health benefits to reduce obesity risk.

Parental role modeling is also important in demonstrating healthy eating for children and adolescents. Several studies have shown that parental role modeling of consuming healthy foods was positively associated with a child’s dietary intake and preference for fruits and vegetables [73-75]. Parents can influence children’s healthy eating through a variety of means such as providing the food environment at home and making particular foods available/accessible. Parents can also model healthy eating and use appropriate feeding practices (e.g., healthy eating guidance, practice of consuming fruits and vegetables, monitoring, restriction). Like with physical activity, parents can also negatively influence their children’s dietary behaviors through negative role modeling practices (e.g., modeling a high consumption of low-density nutritious foods, not making fruits and vegetables available/accessible, not providing an adequate number of meals throughout a day). It is important to examine the role that parents play in their children’s dietary behaviors in order to improve dietary intake to reduce obesity risk [69].

A growing body of research exists that examines the effect of parenting style on children’s dietary behaviors [76-81]. Some studies have shown that adolescents raised by parents with an authoritative style consumed healthier food than those raised by other styles [78,
however, two other studies that examined an adolescent population did not find such an association [76, 80]. Results from these studies can differ depending how the classification of parenting styles was determined and what measures were used to determine parenting style. This area of research continues to be a growing area to approach children and adolescents’ dietary behaviors and the role that the family and home environment plays in whether that dietary behavior is healthy or not.

In summary, the role that the family/home environment and behaviors play in a child’s risk for obesity is very important. The family/home environment may be an opportunity for interventions for obese youth. However, since the evaluation and assessment of family structures and behaviors is complex and difficult, determining which factors of the family and home environment have an effect on childhood obesity risk is difficult to assess in a simple manner. This complexity and difficulty also translates to how to design intervention programs for obese youth that aim to modify the family and home environment. Thus, there is need for the development of screening tools that would allow interventionists to assess the family and home environment and the level of risk associated with that environment for creating an “obeseogenic” home.

The Family Nutrition and Physical Activity (FNPA) Screening Tool

One of the available screening tools for family nutrition and physical activity is the Family Nutrition and Physical Activity (FNPA) Screening Tool. The FNPA was developed at Iowa State University by Ihmels and colleagues to assess family environment and behavioral factors that may be associated with children’s risk of becoming overweight [82]. The basis of the FNPA stems from an Evidence Analysis project supported by the American Dietetic Association (ADA) [83]. The ADA Evidence Analysis on Childhood Overweight is an ongoing
project to determine and grade the strength of scientific evidence relating physical activity and
dietary behaviors with the risk of becoming overweight and obese. The ADA Evidence Analysis
identified ten primary factors (Table 1) that were positively associated with becoming
overweight and obese; however, twenty-one questions were created for the survey to better
assess the constructs of the FNPA. The questions are coded on a 1, 2, 3, or 4 point Likert scale.
The total scores for each construct are summed to provide an overall summary score. A higher
FNPA summary score is indicative of a favorable, healthy family environment while a low
FNPA summary score is indicative of a family environment that is high risk for children
becoming overweight. Scores range from 20-80. At this time, there are no cutpoints available to
categorize risk.

Table 1. Ten domains used to create the FNPA.

<table>
<thead>
<tr>
<th>Domain</th>
<th>Example of question from the FNPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast and family meal</td>
<td>Does the child eat breakfast and does the family eat a meal together?</td>
</tr>
<tr>
<td>Modeling of nutrition</td>
<td>Does the family watch TV while eating and do they eat fast food during the week?</td>
</tr>
<tr>
<td>Nutrient dense foods</td>
<td>Does the family eat prepackaged food or do they use fresh foods and fruits and vegetables?</td>
</tr>
<tr>
<td>High calorie beverages</td>
<td>Does the family drink soda and Kool-Aid or 100% fruit juices and low fat milk?</td>
</tr>
<tr>
<td>Restriction and reward</td>
<td>Does the family use food as a reward and do they restrict unhealthy foods?</td>
</tr>
<tr>
<td>Parent modeling physical activity</td>
<td>Do the parents participate in physical activity and does the family participate or play together?</td>
</tr>
<tr>
<td>Child’s physical activity</td>
<td>Does the child participate in physical activity and organized sports?</td>
</tr>
<tr>
<td>Screen time</td>
<td>How many hours of screen time does the child get?</td>
</tr>
<tr>
<td>TV in bedroom</td>
<td>Does the child have a TV in his bedroom and do the parents monitor the screen time?</td>
</tr>
<tr>
<td>Sleep and schedule</td>
<td>How many hours does the child sleep and is there a bedtime routine?</td>
</tr>
</tbody>
</table>

Adopted from Ihmels et al. (2009) [82]
Validation of the FNPA

The FNPA was first evaluated in an urban, Midwestern (Des Moines, IA) school district by examining the association between FNPA scores and BMI of 854 first grade children. The sample was predominantly Caucasian (57.5%), with smaller percentages of African-Americans (15.3%), Hispanics (16.9%), Asians (5.6%), and other minorities (4.7%). The targeted schools varied in socioeconomic status (SES) with 5 schools in high SES, 17 schools of middle SES status, and 15 schools of low SES (66% of more of the students eligible for free or reduced lunches).

Results revealed that lower income families reported lower FNPA scores compared to higher income families. Children who had FNPA scores in the lowest tertile had an odds ratio of 1.7 (95% CI = 1.07 – 2.80) for higher risk of “obesogenic” environment compared to children who had summary scores in the highest tertile; however, when accounting for parental BMI as a covariate, this association was reduced and no longer significant (indicating that parental BMI needs to be considered when examining the effectiveness of the FNPA).

Use of the FNPA with other health outcomes

The first study to examine associations between the FNPA and other health outcomes was by Yee et al. in 2011. In the study, Yee et al. examined the association between the FNPA and weight status and cardiovascular disease (CVD) risk in fifth grade children from mid-Michigan. CVD risk was assessed using a continuous CVD score created from summing the z-scores of several CVD risk factors: waist circumference, total cholesterol-to-HDL cholesterol ratio, and percent body fat. The FNPA was found to be significantly associated with BMI (r=-0.43) and percent body fat (r=-0.43). The FNPA was also found to be significantly and negatively correlated with 2 of the 3 individual CVD risk factors (r=-0.36 for waist
circumference; \( r=-0.12 \) for mean arterial pressure). The FNPA was significantly associated with the continuous CVD risk score (\( r=-0.22 \)); however, the FNPA only explained 6% of the variance with most of the variance driven by waist circumference; thus, the authors asserted that the relationship between the FNPA and CVD risk was driven mainly by obesity related measures and that other factors should be considered when determining CVD risk.

Another study conducted by Yee et al. (in press) examined the association between the FNPA and Acanthosis Nigricans (AN) in low socioeconomic, urban children from mid-Michigan. AN is a physiological condition associated with insulin resistance and is characterized by a hyperpigmented, papillomatous, velvety, cutaneous thickening that can occur on any part of the body: axilla, sides of the neck, the groin, antecubital and popliteal surfaces, umbilical area, and even mucosal surfaces. The FNPA was found to be significantly associated with risk of having AN on the back of the neck. The results from this study further highlighted how the FNPA Screening Tool could be used to assess how the family and home environment relates to risk of other health outcomes besides obesity.

The FNPA was the first instrument to combine information from a variety of behaviors (e.g. diet, physical activity and screen time, sleep patterns, family structure) related to child obesity to evaluate family environments. The FNPA has potential for use by pediatricians, school nurses, and other health professionals for quickly assessing a child’s family and home environment and his/her risk for becoming overweight. However, the only published studies examining the utility of the FNPA have been in limited populations (primarily elementary aged students, predominantly Caucasian and middle socioeconomic class). Also, to date, no test-retest reliability measures exists for the FNPA nor do set cutpoints to determine the difference between
“low” and “high” risk from the FNPA score. Additional research using the FNPA is warranted to validate its usage in different settings, populations, and other health behaviors.

**Weight management/obesity interventions in youth**

In response to the growing pediatric obesity epidemic over the last few decades, public health programs and organizations as well as state and federal funded programs have developed and implemented weight management interventions to prevent and/or treat obesity for children and adolescents. The primary goal of most childhood obesity prevention programs is to prevent non-overweight children from becoming overweight or obese, while the primary goal of obesity treatment programs is for pediatric obese patients to lose weight. However, a large number of programs that are designed for obesity prevention may also include helping overweight or obese children lose or stabilize their weight. A majority of interventions largely aim to accomplish their goal by modifying physical activity, diet, and/or sedentary activity. The interventions that have been implemented have varied depending on the setting in which they took place. Thus, this portion of the literature review will examine previous research according to the site of where the intervention took place (i.e., school, home, clinical, community).

**School-based weight management/obesity interventions in youth**

The school setting is an ideal setting to implement an obesity intervention program due the large number of children who attend public or private school and the number of hours children spend at school each school day. In a meta-analysis by Gonzalez-Suarez and colleagues [84], a review of 19 studies highlighted the overall effects of school-based interventions that were designed to decrease overweight or obesity risk by increasing physical activity, decreasing participation in sedentary activities, and decreasing intake of food high in fat and sugar. Meta-analysis results showed that the odds of participants’ being overweight or obese in the school-
based intervention programs were significantly protective in the short term (OR=0.74, 95% CI=0.60,0.92) compared with control groups. This highlighted that the intervention was more effective in decreasing the number of participants who became overweight or obese. Some interventions’ durations were less than 6 months, and some were greater than 2 years; however, interventions that were implemented for more than 1 year had higher odds of decreasing the prevalence of obesity. Also, not all interventions were based on a conceptual theory. Despite showing a decrease in the prevalence of overweight and obesity, results also showed that school-based interventions were not effective in reducing BMI between treatment groups vs. control groups, which was in contrast to a meta-analysis by Katz and colleagues [85] which showed physical activity and nutrition interventions with obese children and adolescents resulted in significant decreases in the BMI of the treatment group compared to a control group. However, it should be noted that BMI naturally increases as children and adolescents age since they experience increases in both height and weight with normal growth.

Given the results from studies utilizing a school-based intervention to prevent and/or treat pediatric obesity, school principals and policy makers can utilize the school setting as part of the public health strategy for preventing and treating childhood obesity.

**Home-based weight management/obesity interventions in youth**

Interventions that take place in the home setting tend to be more family-oriented in terms of accomplishing healthier behaviors for not just obese children, but for their parents and/or siblings as well. The setting is a logical choice to intervene since children develop their behaviors, attitudes, and values in the home setting [86]. Also, intervening at home gives interventionists the chance to work directly with parents under the comfort of their own roof. It
is also widely recognized the family and home environment significantly influence a child’s physical activity and dietary behaviors [60, 69].

There has been much research on pediatric obesity interventions evaluated in randomized controlled trials were implemented in strictly the home environment [87-91]. Three of these studies, included a 52-week study period that enrolled children and adolescents aged 4 to 17 years [88-90]. All three studies delivered an intervention that was a combination of both physical activity and diet. One study examined the effect of the intervention on television viewing, snack/sweet intake, eating out, and family physical activity [89]. Another reported how an educational program on diet and physical would affect children’s intake of fruits, vegetables, fat, and sugar [88]. The third assessed how effective an intervention on dietary fat, television viewing, fruit and vegetable consumption, and physical activity on children preschool-aged children was [90]. None of these studies reported any beneficial effects of their intervention on BMI, BMI z-score, weight, or the prevalence of overweight or obesity. Another randomized control study that implemented a diet-only intervention (focused on calcium rich diet) in 9-year old, normal weight girls showed that from pre-post there were no differences in physical activity, weight, BMI, or fat mass between those in the treatment vs. control group [87]. A systematic review of six home-based childhood obesity prevention interventions reported that none of the interventions had a significant effect on body weight in overweight and obese participants [91].

Overall, from these particular studies the evidence is weak for physical activity and/or diet interventions delivered in the home setting to have favorable effects on weight-related outcomes in children and adolescents. These findings suggest that perhaps longer interventions are needed when delivered in the home setting or that greater reach of the intervention must occur (e.g., actual modification of the food environment in the household or increasing the
availability of a physical activity environment). Additional research is needed to test pediatric obesity interventions in the home setting.

**Clinical-based weight management/obesity interventions in youth**

Since most children and adolescents see a primary care provider on an annual basis, the health care system setting can provide a promising opportunity to set up a pediatric obesity prevention and/or treatment program [92]. The clinical setting can be one where clinicians work directly with obese children and adolescents as well as their families to decrease their obesity risk and live a healthier lifestyle.

A systematic review by Sargent and colleagues [93] was the first to review the effectiveness of interventions in the primary care setting. All 17 studies were randomized controlled trials including children and adolescents from 3 to 17 years old who were obese, overweight, or at risk of obesity based on parental obesity. All studies were based on behavior modification and emphasized different behavioral targets: physical activity and diet (n=5), sedentary behavior (n=4), caloric restriction (n=4), attending physical activity sessions (n=4), and diet alone (n=3). Results from the review found 12 of the 17 studies to be effective across a wide variety of outcome measures. For example, a study by Savoye and colleagues [94] reported 6 and 12 month improvements in weight, BMI, body fat, and homeostasis model assessment of insulin resistance (HOMA-IR) in 209 obese children and adolescents after implementing an intensive, family based program covering nutrition, exercise, and behavioral modification. Another study found significant improvements in the primary outcome measures (physical and sedentary behavior; percent of energy from fruits and vegetables) in 878 adolescents who participated in a primary care, office-based intervention involving primary care counseling and telephone counseling [95]. However, there were no significant changes in secondary outcomes.
of body weight or BMI. Although the quantity and quality of the amount of evidence for treating obesity in youth through clinical interventions continues to grow, further research is needed to fill significant gaps in the understanding how to prevent and treat childhood obesity in the clinical setting.

Overall, results from the few obesity interventions for youth implemented in the clinical suggest they are effective and should be considered as an opportunity to prevent and/or treat obesity in children and adolescents. Future research is needed to determine the best components that should comprise clinical interventions and what program design is most effective.

**Community-based weight management/obesity interventions in youth**

There has been a recent increase in the number of childhood obesity intervention programs in the community setting. Interventions implemented in the community setting can affect various aspects across the population and provide a healthy environment for children and adolescents reduces obesity risk. Community interventions are those that address changes in policy, legislation, the built environment, and/or the pricing of food that is locally available.

According to a systematic review of community-based childhood obesity intervention programs [96], only one study that was conducted exclusively in the community setting exists [97], while several other intervention programs included the community and an additional setting (e.g., school, home, primary care) [98-101]. A study by Eiholzer and colleagues [97] was the only study to examine a pediatric obesity intervention program exclusively in the community. Based on previous work that showed that daily high-intensity resistance training increased spontaneous daily physical activity, the authors examined whether high-intensity training conducted hourly twice a week in 46 boys improved fat mass. No significant change was detected after 12 months. However, the design of this study and the fact that the subjects were
recruited from 2 hockey teams reduce its label as a true community level pediatric obesity intervention program. The other studies identified in the review implemented an intervention program aimed at preventing and/or treating childhood obesity using a multitude of settings that included the community setting. For example, Sallis and colleagues [99] evaluated the effects of an environmental, policy, and social marketing intervention on physical activity and fat in take in middle school students in the US. The intervention was implemented at both the community level as well as the school setting. Two-year follow up results after the delivery of the intervention showed a significant decrease in BMI for boys, but not girls.

The overall results of the existing evidence show equivocal results as to how effective the community setting alone can be utilized to address the childhood obesity problem. It is likely that interventions that combine the use of multiple settings including the community would be more effective than just a single setting. Specifically, a combination of the school and community intervention seems to be effective and the most feasible of any combination of intervention settings [96]. Understanding further how the community setting can be utilized to effectively prevent and/or treat childhood obesity is an important area of research. Further research with consistent methods are needed to examine how to implement effective, community based pediatric obesity programs.

In summary, the increasing amount and quality of research on interventions for obese children and adolescents suggests that behavioral interventions are most likely safe for children aged 4-18 years old and have the potential to be effective. Further issues to consider with weight management/obesity intervention programs in youth are what is the optimal duration, intensity, and frequency needed to elicit significant changes, what behavior(s) should be targeted for intervening, and how the design and components of an intervention change depending on the
setting it is implemented in (school, home, clinical, community). Another limitation with the current research is the many different measures of weight change that are used as outcome measures for these programs. Further research is needed to identify if weight change measures should be the primary outcome measure of interventions or perhaps health behavior changes (e.g., physical activity, diet, screen time, self-efficacy, etc.). More research is also needed to examine what intervention programs work best in combination of settings (e.g., school + home; clinical + community) as well as intervention types (e.g., behavioral + pharmacologic intervention). With the pediatric obesity epidemic likely to still remain an important public health problem for the near future, the development of weight management/obesity intervention programs in youth will likely continue to grow as well as the research evaluating them.

**Literature review summary**

The prevalence of childhood obesity in the US is very concerning. Children who are obese face increased risk of short-term consequences and long-term consequences that are of physiological, psychological, sociological, and socioeconomic nature. Research has shown that obese children are more likely to be obese adults and have increased risk for a multitude of health problems. Identifying and assessing factors related to obesity risk in youth is important. Beyond just using the popular method of BMI, other influential factors should be assessed including the family and home environment, physical activity, dietary quality, and screen time behaviors. The family and home environment is of particular research interest due to the fact that children and adolescents often have their physical activity, dietary, and screen time behaviors dictated or influenced by the environment their parents provide to them and the home practices and behaviors that parents implement. The Family Nutrition and Physical Activity (FNPA) Screening Tool is one assessment method that examines how the family and home
environment and behaviors are related to obesity. Research has shown the FNPA to be associated with a child’s weight status and cardiovascular disease risk; however, future research is needed to examine its utility in various settings and among other populations with which it has not been tested.

With the increasing prevalence of obesity in the US, the development of intervention programs for youth are needed to control this epidemic. Intervention programs, both of preventative nature and treatment nature, are needed and should be implemented across various settings. By utilizing different settings, these programs have the potential to reach a great amount of the US population and thus be accessible for everyone who is at risk of the consequences of obesity. Pediatric obesity intervention programs have been delivered primarily at the school setting, but there is future promise in the development of programs at the clinical, community, and home level, all of which thus far have been great under utilized. The most effective programs would be ones that combine multiple settings and not just intervene with children, but also with the families of children since, as previously mentioned, that parents have such a large influence on factors related to obesity risk among youth. Future research is needed to evaluate any such programs that are developed and can confirm how effective these interventions may be and their feasibility to be implemented towards reducing childhood obesity risk.

The FitKids360 program serves as an opportunity to address childhood obesity. FitKids360 is a multicomponent program covering physical activity, diet, and behavioral components and aspects of the childhood obesity problem. The program is also family oriented and does more than just intervene with obese children and adolescents by requiring parents/guardians to participate in the intervention program. FitKids360 is also unique in that it
is low-cost and free of charge to qualifying participants and that those serving on the interventionists’ side of the program volunteer their time to be part of FitKids360. Strengths of the FitKids360 program are that it is family-oriented, low cost to deliver, is evidence based, and address multiple areas related to obesity risk (i.e., physical activity, nutrition, social/behavioral). A weakness of the program is that it does not have an underlying theoretical basis in its design. Because of this, any success does not have any specific underlying explanation. However, this program was designed primarily by clinicians under the Chronic Care Model, an organized framework for improving chronic illness at the individual and population level and represents a clinical best practice approach to childhood obesity treatment. Future research evaluating the FitKids360 program will lead to further information on how effective the program is in varied populations and settings and will serve useful to researchers, public health professionals, and medical professionals who are involved in addressing the pediatric obesity epidemic.
REFERENCES
REFERENCES


CHAPTER 3: METHODS
**Study 1 Protocol**

As part of the Commit to Healthy Hearts (CHH) Project, a cardiovascular risk screening was conducted near the beginning of the Fall semester (month of September) of the 2014-2015 school year at Grand Blanc High School (GBHS) with the ninth grade students enrolled in Physical Education or Health class. All ninth grade students that were present at school on the screening day(s) were screened; however, only data from students who provided assent and written parent consent were used for this dissertation. A measurement team of MSU Kinesiology and Genesys Medical Regional Center research staff collected cardiovascular risk data pertaining to: anthropometrics, lifestyle behaviors (i.e., physical activity, dietary, screen time) and psychosocial variables (i.e., physical activity self-efficacy, dietary self-efficacy). Approval was obtained from the MSU Biomedical Institutional Review Board.

**Participants**

Participants were all assenting ninth grade students (806 total grade students; 596 enrolled in Physical Education or Health) and consenting parents from Grand Blanc High School who allowed MSU researchers to use their data for this dissertation study. The only exclusion criterion was any student not physically or mentally able to complete the assessments done as part of the CHH program.

**Recruitment**

At the beginning of the school year, a letter from the GBHS principal was sent home to parents of ninth graders informing them about the CHH project. This letter provided information about MSU’s role in the program and requested to use data collected from the CHH program for this dissertation study. Assent forms were handed out and explained to ninth grade students in their Health or Physical Education Class. Parental consent was mailed home to parents.
**CHH screening protocol**

The screening was carried out at GBHS across seven days over two weeks, utilizing both the West and East campus buildings due to GBHS class design dynamics (i.e., students from all grades take classes in both buildings and cross during specified hours). The screening took place across a total of 13 Health and Physical Education classes. Anthropometric measurements took place in empty classrooms or in a secluded part of a classroom/gymnasium behind a privacy screen. Surveys were completed in students’ classrooms (Health) or gymnasium (Physical Education). Research team members were present to instruct the participants about completing the survey and answered any questions they had.

**Anthropometrics**

Standing height and sitting height were measured to the nearest 0.1 cm using a Shorr Board stadiometer (Shorr Productions, Olney, Maryland) and a stool of known height. For both standing and sitting height, participants were asked to remove their shoes. If the participant’s hair was impeding a valid measurement, the measurer asked the participant to adjust his or her hair, if possible. Participants were then asked to stand as erect as possible on the Shorr Board with weight evenly distributed on both feet and with their heels touching the board and placed together or with toes pointed out. The technician asked the participant to adjust his/her head into the Frankfort horizontal plane (i.e., where the tragus of the ear is parallel with the lower orbit). The participant was then asked to inhale and hold a breath before the measurer brings the measurement board down to the head. Height was recorded before the participant was asked to step out from the Shorr Board. This entire procedure was repeated for duplicate measures. If the two measures were not within 0.4 cm then a third measure was taken. The average of the two nearest values was used as the standing height measurement. Sitting height was measured using
the same procedures above, but was taken with the participant in a seated position on a
standardized measurement stool of known height. The participant was asked to have his/her legs
hanging off from the edge of the stool without the feet touching anything. Sitting height was
obtained by subtracting the height of the stool, and the average of the two nearest values within
0.4 cm was used. Body mass and percent body fat were measured once using a Tanita BC-534
bioelectrical impedance analysis scale (Tanita Corporation, Tokyo, Japan). Participants were
asked to remove their shoes and socks, as well as any other weighed objects (i.e., cell phones,
chains, etc.), before stepping onto the scale with their feet in contact with the metal analytic
sensors and weight evenly distributed. Body mass index (BMI) was calculated as body weight in
kilograms divided by standing height in meters squared (kg/m$^2$). Weight status was classified
using age- and sex-specific BMI cutpoints provided by the Centers for Disease Control (CDC)
[1].

**Physical activity and screen time behaviors**

Participants reported their physical activity behavior by completing the Physical Activity
Questionnaire for Adolescents (PAQ-A). This 8-item, 7-day self-report recall questionnaire was
developed to assess general physical activity levels for high school students approximately 13-19
years of age. It assesses frequency of participation in different physical activities such as sports
or activities that make subjects sweat or make their legs feel tired, or activities that make subjects
breathe hard, such as running and climbing. The PAQ-A also assesses information about
physical activity during spare time, physical education class and lunchtime, and after school. A
PAQ-A score is determined from 8 of the items. The score ranges from 1-5, with higher scores
indicating more frequent participation in physical activity. The validity of the PAQ-A has been
examined in a few studies. One study assessing the convergent validity of the PAQ-A [2] found
moderate associations of the PAQ-A with an activity rating survey (r=0.33), the Leisure Time Exercise Questionnaire (r=0.57), a Caltrac motion sensor (r=0.33), and the 7-day physical activity recall interview (r=0.59). Another study found the PAQ-A to moderately correlate (rho=0.39) with total physical activity and moderate-to-vigorous physical activity (rho=0.34) in Spanish adolescents measured via accelerometer [3].

Time spent watching television, using video games, and using the computer (for non-academic purposes) on both a typical weekday and weekend day were self-reported. Average hours of screen time per week were determined using the formula:

\[
\frac{((\text{Hours of TV time on weekdays} \times 5 \text{ days}) + (\text{Hours of TV time on weekends} \times 2 \text{ days}))}{7 \text{ days}} + \\
\frac{((\text{Hours of Video game time on weekdays} \times 5 \text{ days}) + (\text{Hours of Video game time on weekends} \times 2 \text{ days}))}{7 \text{ days}} + \\
\frac{((\text{Hours of Computer time on weekdays} \times 5 \text{ days}) + (\text{Hours of Computer time on weekends} \times 2 \text{ days}))}{7 \text{ days}}.
\]

Although it has not been validated, this method of determining screen time has been used in previous studies [4-6]. A study by Laurson and colleagues showed test-retest Pearson correlations for this screen time assessment method to be 0.50 for TV, 0.52 for video game, and 0.55 for total screen time [7]. For assessment of meeting screen time recommendations, the guidelines of <2 hours per day proposed by the American Academy of Pediatrics was used [8].

**Dietary behaviors**

Dietary behavior was self-reported by subjects using the Block Kids Food Frequency Questionnaire (FFQ) for Kids (Block Dietary Data Systems, Berkeley, CA; (http://www.nutritionquest.com). FFQs are commonly used as an assessment tool for nutritional intake. Studies have shown them to be as accurate as multiple 24-hour recalls, while reducing
subject burden [9, 10]. The Block FFQ for Kids is composed of 77 food and beverage options that are coded based on frequency of consumption during the previous 7 days. Serving size estimates were aided by the use of printed serving size example pictures. Research staff members were trained to administer the survey per instructions from the company. Upon completion the questionnaires were examined for completeness and then mailed back to Nutritionquest for dietary analysis. Results from the analysis included daily estimates of macronutrients, micronutrients, and servings per day of fruits, vegetables, dairy, grains, and meats, beans, & legumes. Using the results from the questionnaire, the Healthy Eating Index-2010 (HEI) was determined for each subject. The HEI is comprised of 12 components (fruits, vegetables, dairy, grains, meat, total fat, saturated fat, cholesterol, sodium, food variety) that are scored from a scale of 0 to 10 points each and then summed together to create an overall HEI score (range: 0 – 100) [11, 12]. For interpreting HEI scores, a higher HEI score is representative of a better quality of dietary intake. An HEI score greater than 80 is considered “good diet quality” and a score under 50 is considered as “poor diet quality” [13]. A study by Cullen et al. [14] examining the validity and reliability of the Block Kids Questionnaire with two 24-hour dietary telephone recalls among youth aged 10 to 17 years found intraclass reliability coefficients >0.30 for most nutrient variables and correlation coefficients ranging from 0.69 to -0.03 among all nutrient variables. The authors also found the majority of correlation coefficients to be higher in subjects >12 years old, suggesting that the Block Kids FFQ appears more useful for adolescents.

**Family Nutrition and Physical Activity Screening Tool**

The Family Nutrition and Physical Activity (FNPA) Screening Tool (Appendix A), developed by Ihmels and colleagues [15], assesses family environmental and behavioral factors
that influence children’s risk for becoming overweight. The FNPA was developed through a comprehensive Evidence Analysis supported by the American Dietetic Association [16] designed to determine the strength of evidence linking physical activity and diet behaviors with overweight/obesity in children. The Evidence Analysis identified 10 primary factors (breakfast and family meals, modeling of nutrition, nutrient dense foods, high calorie beverages, restriction and reward, parent modeling physical activity, child’s physical activity, screen time, TV in the bedroom, sleep and routine schedule) that were positively associated with becoming overweight and obese. The FNPA is comprised of 20 items with scores ranging from 20-80 with lower scores indicating an adverse, more obesogenic environment. Studies have shown the FNPA score to be associated with weight status and cardiovascular disease risk as well as a valid predictor of BMI change. The FNPA was mailed home to the parents of the 9th grade students. Instructions were included asking parents to complete the FNPA and return it with their child back to GBHS where a member of the research team collected returned FNPA surveys. Upon return, the FNPA was screened for completeness and determination of total score. To date there has been no published test-retest data on the FNPA.

**Statistical analyses**

Descriptive statistics were calculated for all variables. Sex differences were determined via independent t-tests.

**Specific aims and hypotheses**

**Family Nutrition and Physical Activity (FNPA) Screening Tool and Physical Activity, Dietary Quality, and Screen Time Behaviors**

1. *Examine the association of the Family Nutrition and Physical Activity (FNPA) Screening Tool with physical activity, dietary quality, and screen time in adolescents.*
It was hypothesized that there would be a significant positive association between the FNPA score and physical activity and dietary behavior. It was hypothesized that there would be a significant negative association between the FNPA score and screen time. To determine potential associations, multiple linear regression analyses were used with the FNPA score as a dependent variable and the PAQ-A score, HEI score, and total screen time as independent variables. Analyses were conducted independently with each variable and together in one model. Additionally, analyses examined specific construct scores (i.e., child physical activity behavior, dietary behavior, and screen time behavior) from the FNPA with their measured counterpart (child physical activity behavior and PAQ-A score, dietary behavior and HEI score, and screen time behavior with total screen time). Covariates in the analyses included sex, race, and BMI percentile.

A priori power analyses identified a projected sample size of 30 adolescents in order to obtain a statistical power level of 0.80 with an effect size of 0.50 and an alpha level of 0.05. The sample size for this study was adequate in meeting statistical power level requirements.

2. Examine if the FNPA scores differ by weight status.

It was hypothesized that the FNPA scores would be significantly differ by weight status with FNPA scores being the highest among normal weight subjects and the lowest among overweight/obese subjects. Median split was used to determine cut points for FNPA group analysis since cut points do not currently exist for the FNPA. Logistic regression was used to evaluate the association of FNPA score groups (low and high) with weight status (normal weight, overweight/obese). Odds ratios and 95% confidence intervals were determined from the logistic regression analyses. Covariates controlled for in the analyses included sex and race.
A priori power analyses identified a projected sample size of 274 adolescents in order to obtain a statistical power level of 0.80 with an odds ratio set at 2.0 and an alpha level of 0.05. The sample size for this study was not adequate in meeting statistical power level requirements.

**Study 2 protocol**

One of the goals of the CHH Project was to implement an intervention program with 9th grade students who were identified as overweight/obese during the in-school cardiovascular risk screening. The intervention program that was chosen to be implemented as part of CHH was FitKids360, a multicomponent, family-oriented, low-cost healthy lifestyle program designed to target overweight and obese children and adolescents 5-16 years of age and their families [17]. FitKids360 was designed and created by the collaborative efforts of a team of health professionals (e.g., pediatricians, nurses, dieticians, social workers, exercise physiologist) from Spectrum Health and Helen DeVos Children’s Hospital. The overall goal of FitKids360 is to treat pediatric overweight and obesity by improving the patients’ physical activity, dietary, and screen time behaviors and the family’s “obesogenic” risk score.

**Recruitment for FitKids360 from CHH program**

Upon determination of weight status in the participants from the Commit to Healthy Hearts cardiovascular screening, those who were determined to have a BMI that was greater than or equal to the age- and sex-specific 85th percentile and gave permission to be contacted participated in the FitKids360 program. A follow-up call was made by the CHH project coordinator to subjects and their parents to inform them about the FitKids360 program and their eligibility. Additional information about the FitKids360 program was sent via e-mail to families. Families that are eligible to be part of FitKids360, but declined to participate, were asked to have anthropometric and survey measurements (described below) assessed at the school before and
immediately after the conclusion of the FitKids360 program so that their data could be used as a comparison condition for examination of any differences to those who participated in the program.

**Background of FitKids360**

FitKids360 begins with a two-hour orientation followed by six weekly sessions. Each two-hour session includes educational sessions on physical activity, nutrition, and social behavioral topics. Also, at least 30 minutes of physical activity are delivered for families through activities arranged by FitKids360 instructors. Some sessions also include information on other topics, such as bullying, self-esteem and communication and additional activities like games and cooking demonstrations. Incentives are provided to encourage attendance and participation. A team of health professionals who have been trained in childhood obesity and weight management teaches the program. Each team includes a pediatrician, registered dietitian, behavioral health expert, and a personal trainer or fitness instructor. Also helping with the FitKids360 program were medical student volunteers who served as case-mentors to families. To make the program as effective as possible, parents/guardians attend sessions and actively participate and offer support and encouragement. Family involvement helps improve the home environment, which makes it easier for children to make healthy choices.

**Implementation of FitKids360**

In previous deliveries of the FitKids360 program, various site facilities have been used to implement the class: churches, pediatric clinics, hospitals, wellness centers, YMCAs, etc. For the FitKids360 program delivered through the CHH program and Genesys, the program utilized the Genesys Athletic Club (GAC), a state-of-the-art fitness facility associated with Genesys Regional Medical Center. The program utilized several classrooms within the GAC as well as a
small gymnasium. Also, special outfitted areas within the GAC such as the indoor track and yoga studios were used as GAC venues to host FitKids360 activities.

FitKids360 began in mid-October. In the beginning of the week of the orientation session, the CHH project coordinator made phone calls to each family to: 1) inquire if they would be in attendance at orientation; and 2) to arrange for transportation if needed (i.e., cab service paid through the CHH grant funding). This call from the coordinator is a standard practice that is part of the FitKids360 program design.

At the beginning of Orientation, a welcome table operated by staff members of the FitKids360 program was setup to greet families, log them in for attendance, and to provide program binders. Upon the start of the Orientation session, assessments for both parents/guardians and children were carried out. These assessments are typically measured at the Orientation session and at the last week of the FitKids360 program as part of the program design and are described below.

**Anthropometrics**

The same previously described anthropometric measurements for the CHH program were collected for participants in the FitKids 360 program as part of the FitKids360 program requirements. The same procedures for the measurements were used. However, for the research purposes of this dissertation, for both the subjects in the treatment group and comparison group, the measurements from the original CHH school screening were used as baseline measurements.

**Physical activity, diet, and screen time assessments**

FitKids360 uses a questionnaire to assess physical activity, diet, and screen time. Due to the design of the program and the limited amount of time in weekly sessions, this questionnaire is short in nature and uses only a handful of questions to assess physical activity, diet, and screen time.
time. In compliance with the program, the Grand Blanc site made use of this questionnaire along with other measurement tools (see following text) to better capture physical activity and diet, specifically.

The standard FitKids360 questionnaire uses a single question used to assess physical activity. This question asks the participating child to report on average the amount of time he/she spends getting moderate-to-vigorous exercise for a weekday and a weekend day. We also implemented the PAQ-A (as used in the CHH program) to assess physical activity at the end of the program (used the PAQ-A from the cardiovascular screening as baseline measure). Diet was assessed on the FitKids360 questionnaire using 7 questions taken from the Youth Risk Behavior Surveillance System (YRBSS) survey. These 7 questions ask the participating child to report how many times per day (in the last 7 days) they have consumed various food items (i.e., fruit juice, fruit, vegetables, whole wheat foods, sugar sweetened beverages, sugar sweetened dessert items, and dairy products). The Grand Blanc site also implemented the Gladys Block FFQ (as used in the CHH program) to assess diet at the end of the program and used the FFQ completed at the cardiovascular screening as the baseline measurement. Screen time was assessed on the FitKids360 questionnaire using the same method as previously described for assessing screen time in the CHH program. The baseline screen time measurement used was that from the cardiovascular screening.

**Family and home environment assessment**

FitKids360 utilizes the Family Nutrition and Physical Activity (FNPA) Screening Tool (as used in Study 1) to assess the family and home environment of participating families. Since it is one of the primary outcome measures of FitKids360, the FNPA is typically administered to parents/guardians at the FitKids360 class to be completed and returned to FitKids360 staff the
same day. The FNPA surveys completed during the program at Orientation and at the last week of the program were used as the baseline and post-assessment FNPA measurement, respectively.

**Self-efficacy assessments**

Physical activity self-efficacy was assessed using a questionnaire (Appendix B) developed by Motl and colleagues [18]. This measure of self-efficacy consists of 15-items rated on a 5-point scale ranging from 1 (Disagree a lot) to 5 (Agree a lot). A sample statement from the survey is: “I can be physically active during my free time on most days even if I have a lot of homework.” The interfactor correlation from testing the factorial invariance of the questionnaire was 0.61, indicating acceptable temporal stability of the factors comprising the questionnaire. The Cronbach alpha for the current investigation was 0.792.

Dietary self-efficacy, focusing on fruit and vegetable intake, was assessed using items adapted from a questionnaire (Appendix C) developed by Baranowksi and colleagues [19]. Each of the 20 items asks, “How sure are you that you can …”. Dichotomous “sure” and “not sure” response categories can be selected for each item. An example item from the questionnaire is “How sure are you that you can ask someone in your family to buy 3 fruits or vegetables at least one time?” Cronbach’s alpha values were 0.84 and 0.85 for items regarding fruits and vegetables, respectively, revealing good scale reliability of the questionnaire [19].

**FitKids360 program layout**

As stated previously, FitKids360 begins with a two-hour orientation followed by six weekly sessions. After the orientation session, each weekly, two-hour session includes educational sessions on physical activity, nutrition, and social behavioral topics. Also, at least 30 minutes of physical activity are delivered for families through activities arranged by FitKids360 instructors. For the Spring 2015 cohort an eight-week long FitKids360 program was delivered,
with an extra week used for a grocery store field trip. Below is a table summarizing the topics covered throughout the entire program:

Table 2. The FitKids360 curriculum.

<table>
<thead>
<tr>
<th>Week</th>
<th>Behavior</th>
<th>Nutrition</th>
<th>Exercise/screen time</th>
</tr>
</thead>
</table>
| 1    | Family goals  
Identify family support groups (30 min)* | “Healthy counts” (8-7-6-5-4-3-2-1-0)  
Food guide pyramid (20 min)* | FITT  
Group exercise (30 min)* |
| 2    | Emotions (60 min)*** | Label reading (40 min)*** | Activity circle (15 min)*  
Group exercise (30 min)* |
| 3    | Bullying (20 min)*  
Bullying (10 min)*** | Portion size (20 min)*  
Drinks (10 min)* | Role modeling (15 min)*  
Game-chore game (10 min)***  
Group exercise (35 min)*** |
| 4    | Self-esteem (40 min)** | Meal planning  
Healthy snacking (40 min)**  
Make healthy snack (30 min)*** | Screen time (20 min)*  
Game-commercial break activities (15 min)***  
Group exercise (35 min)*** |
| 5    | Communication (15 min)**  
Stress (15 min)** | Eating out  
School lunches (30 min)* | Exercise discussion (15 min)*  
Game***  
Group exercise (30 min)* |
| 6    | Discipline/structure (30 min)**  
Share successes/award incentives (30 min)* | Jeopardy game (nutrition and exercise) (30 min)* | Game***  
Final biometric assessment (30 minutes)***  
Group exercise (20 min)* |

* = patients and parent(s), ** = parents only, *** = patients only
Adapted from Tucker et al. (2014) [17]

**Process evaluation of FitKids360**

In order to properly assess and evaluate the FitKids360 program, feasibility, program feedback, and process evaluation data were collected. Process evaluation is useful in understanding the dynamics of an intervention program and optimizing the efficacy of the program [20]. Process evaluation typically involves measuring intervention reach, dose, and fidelity, in addition to feasibility and acceptability. As the program coordinator, the lead author observed every lesson delivered in the FitKids360 curriculum.
Feasibility information and program feedback

FitKids360 uses instructor/volunteer and family evaluation forms (Appendix D and E) to assess the opinions of those involved in the FitKids360 program. The instructor/volunteer form is eight questions in length with three “Yes and No” questions and three open-ended questions. The 10-question family form consist of five “Yes and No” questions, three questions each with three answer choices, and two open-ended questions. These evaluation forms were given to families (both parent/guardian and child complete them together), instructors, and program volunteers. These evaluation forms were delivered during the last week of the program. In this study, they were used to evaluate the feasibility and acceptability of the FitKids360 program.

Dose

Dose includes what the intended amount of planned sessions that are delivered during the intervention [21]. In this case, the specific lessons (exercise, nutrition, and social behavioral) delivered each week and the components that comprise each of those lessons were considered dose. The novel approach of examining lesson objectives completed within each specific lesson was also used as an assessment of dose. The evaluator of the intervention was present each week and logged delivery of intervention components through direct. The specific tool that was utilized for this was a custom log (Appendix F) to document the FitKids360 curriculum delivery and its components. This log included three section dedicated to each component being evaluated with deliverance of the lesson and individual lessons tasks/objectives completion being documented.

Reach

Reach is the proportion of the intended target intervention group that participates in the intervention [21]. This is typically measured by attendance. It is standard practice for
FitKids360 to have an attendance log documenting whether a family is present or not for each session of the duration of the program. In this study an attendance log was used to assess the reach component of the process evaluation (Appendix G).

**Fidelity**

Fidelity is a measure that assesses if the intervention was implemented as planned [21]. This component was assessed by observing each class component (Physical Activity/Exercise, Nutrition, Behavioral) and recording the quality of the delivery of each component of the lesson using a 23-item customized form evaluating the instructor, children, parents, and mentors (Appendix H). Each item was scored on a scale from 1-4 (1=None; 2=Some; 3=Most; 4=All). Compared to documenting dose, the Group Exercise component was evaluated for fidelity. Because the Group Exercise component of the FitKids360 intervention serves an important role in the overall design of the program, assessment of its delivery quality was examined. The average fidelity score was determined for each of the four components that was evaluated.

**FitKids360 post-intervention assessment (7/8-week follow-up/3-month follow-up)**

Upon completion of the FitKids360 program, participating families were assessed for follow-up measurements that were conducted approximately 3 months after the end of the program. Assessments included anthropometric measurements (standing & sitting height, weight, and percent body fat for children, which were collected at GBHS, and survey measurements for both children (physical activity, diet, screen time, physical activity and dietary self-efficacy) and parents/guardians (FNPA). These surveys were the same ones utilized in CHH and FitKids360 that were implemented at Orientation week and at the last week of the program.
Statistical analyses

Descriptive statistics were calculated for all variables. Sex differences were determined via independent t-tests.

FitKids360 Intervention Evaluation

3. Evaluate the feasibility and acceptability of the intervention related to (a) instructor satisfaction/evaluation; and (b) family/youth satisfaction.

Feedback from the FitKids 360 participants (parents/guardians & youth), program instructors, and program volunteers were used for this specific aim. This aim was not hypothesis driven. The feedback and program evaluation forms completed by the families and instructors were examined and summarized to evaluate the feasibility and acceptability of the FitKids360 intervention.

4. Evaluate the reach, dose, and fidelity of the FitKids360 intervention.

Reach was determined via attendance of FitKids360 participants to weekly classes. Dose was assessed via observations of each weekly class and documenting if the particular components of each weekly class were actually delivered by the intervention team. Dose was also assessed by documenting the number of lesson objectives completed. Fidelity was assessed by observing each class component (Physical Activity/Exercise, Nutrition, Behavioral, Group Exercise) and recording the quality of the delivery of each component of the lesson using a customized form.

5. Explore if FitKids360 participants show any improvements in physical activity, dietary quality, screen time, physical activity and dietary self-efficacy, and FNPA score from baseline to 7/8-week follow-up and 3-month follow-up.

A repeated measures ANOVA was used to compare baseline measurements to 7/8 weeks post-measurement and at 3-months follow-up data for physical activity, diet, screen time, physical
activity and dietary self-efficacy, and FNPA score measurements. Bonferroni correction was used to adjust for multiple comparisons.

A priori power analyses identified a projected sample size of 27 adolescents in order to obtain a statistical power level of 0.80 with an effect size of 0.50 and an alpha level of 0.05. The sample size for this study was not adequate in meeting statistical power level requirements.
APPENDICES
**APPENDIX A: Family Nutrition and Physical Activity (FNPA) Screening Tool**

Child’s Name: ___________________ Parent Name: ___________________ Date: ________________

**Family Nutrition & Physical Activity Assessment Questionnaire**

This questionnaire asks you to fill out some information about your child and your family. For each question, please select the answer that best represents your child/family.

<table>
<thead>
<tr>
<th>Question</th>
<th>Almost Never</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My child eats breakfast....</td>
<td></td>
<td></td>
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<tr>
<td>2. Our family eats meals together....</td>
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<td>3. Our family eats while watching TV ...</td>
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<td>4. Our family eats fast food....</td>
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<td>5. Our family uses microwave or ready to eat foods ...</td>
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<tr>
<td>6. My child eats fruits and vegetables at meals or snacks...</td>
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<td>7. My child drinks soda pop or sugar drinks...</td>
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<tr>
<td>8. My child drinks low fat milk at meals or snacks...</td>
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<td>9. Our family monitors eating of chips, cookies, and candy...</td>
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<td>10. Our family uses candy as a reward for good behavior...</td>
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<tr>
<td>11. My child spends less than 2 hours on TV/games/computer per day</td>
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<td>12. Our family limits the amount of TV our child watches...</td>
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<td>13. Our family allows our child to watch TV in their bedroom...</td>
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<tr>
<td>14. Our family provides opportunities for physical activity</td>
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<tr>
<td>15. Our family encourages our child to be active every day</td>
<td></td>
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<tr>
<td>16. Our family finds ways to be physically active together ...</td>
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<tr>
<td>17. My child does physical activity during his/her free time...</td>
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<tr>
<td>18. My child is enrolled in sports or activities with a coach or leader</td>
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<tr>
<td>19. Our family has a daily routine for our child’s bedtime...</td>
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<tr>
<td>20. My child gets 9 hours of sleep a night ...</td>
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</tbody>
</table>
APPENDIX B: Physical activity self-efficacy survey

Please circle the number which most closely describes how much you agree or disagree with each statement. Remember that physical activity can be any play, game, sport, or exercise that gets you moving and breathing harder. There are no wrong answers. (Circle one number for each item).

<table>
<thead>
<tr>
<th></th>
<th>Disagree a lot</th>
<th>Disagree a little</th>
<th>Neither Agree nor Disagree</th>
<th>Agree a little</th>
<th>Agree a lot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I can be physically active during my free time on most days.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. I can ask my parent or other adult to do physically active things with me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. I can be physically active during my free time on most days even if I could watch TV or play video games instead.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. I can be physically active during my free time on most days even if my friends want me to do something else.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. I can ask my parent or other adult to sign me up for a sport, dance, or other physical activity program.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. I can be physically active during my free time on most days even if it is very hot or cold outside.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. I can ask my best friend to be physically active with me during my free time on most days.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. I can ask my parent or other adult to get me the equipment and clothes I need to be physically active.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. I can ask my parent or other adult to take me to a physical activity or sport practice.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. I can be physically active during my free time on most days even if I have a lot of homework.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. I can be physically active during my free time on most days even if I have to stay at home.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
12. I have the coordination I need to be physically active during my free time on most days.

13. I can be physically active during my free time on most days no matter how busy my day is.

14. I can be physically active during my free time on most days no matter how tired I may feel.

15. I can be physically active during my free time on most days even when I'd rather be doing something else.
APPENDIX C: Dietary self-efficacy survey

Please check the box which most closely describes how much you are sure or not sure with each statement. There are no wrong answers. (CHECK ONE BOX FOR EACH ITEM).

<table>
<thead>
<tr>
<th>How sure are you that you can...</th>
<th>Sure</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. eat 1 portion of fruit for a snack at home at least one time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. eat 1 portion of fruit at lunch at least one time on a school day?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. eat 1 portion of fruit for dinner or supper at home at least one time</td>
<td></td>
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<tr>
<td>4. eat 1 portion for lunch at least one time on a non-school day, including weekend?</td>
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<tr>
<td>5. eat 1 portion of fruit for a snack at home at least 4 days a week?</td>
<td></td>
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<tr>
<td>6. eat 1 portion of fruit for lunch most non-school days, including weekends?</td>
<td></td>
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</tr>
<tr>
<td>7. eat 1 portion of fruit at a fast food place at least one time?</td>
<td></td>
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<tr>
<td>8. ask someone in family to buy 3 fruit or vegetables at least one time?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. ask someone in family to serve 1 fruit instead of your usual dessert/dinner most nights?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. ask someone in family to buy your favorite fruit or vegetable every week?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. ask someone in family to buy 3 fruit or vegetables every week?</td>
<td></td>
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</tr>
<tr>
<td>12. eat 1 portion of fruit most times when you eat at a fast food place?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. ask someone in family to serve 2 vegetables for dinner at least one time?</td>
<td></td>
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<tr>
<td>14. cut up 1 portion of vegetables and eat it with a dip for a snack at least one time?</td>
<td></td>
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<tr>
<td>15. eat 1 portion of vegetables at lunch at least one time on a school day?</td>
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<tr>
<td>16. ask someone in family to serve 2 vegetables for dinner most nights?</td>
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<tr>
<td>17. eat 1 portion of vegetables most times when you eat at a cafeteria?</td>
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<tr>
<td>18. eat 3 portions of vegetables at least 4 days a week at school?</td>
<td></td>
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<tr>
<td>19. eat 1 portion of vegetables most times when you eat at a fast food place?</td>
<td></td>
<td></td>
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<tr>
<td>20. eat 3 portions of vegetables at least 4 days a week, even when you are stressed?</td>
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</table>
APPENDIX D: FitKids360 volunteer/instructor satisfaction survey

FitKids360 Volunteer/Instructor Satisfaction Survey

1. Did you enjoy volunteering for FitKids360?
   - Yes
   - No
   If you answered “no,” please explain:

2. Would you volunteer for FitKids360 again?
   - Yes
   - No
   If you answered “no,” please explain:

3. Did you feel like you were an integral part of the FitKids360 program?
   - Yes
   - No
   If you answered “no,” please explain:

4. What did you like about FitKids360?

5. Do you have any suggestions for improving FitKids360?

6. Do you have any other comments or suggestions regarding your FitKids360 experience?
APPENDIX E: FitKids360 satisfaction survey – end of program

FitKids360 Satisfaction Survey – End of Program

1. Do you feel you learned important information that will help your family be healthier?
   □ Yes
   □ No
   If you answered “no,” please explain:

2. Do you feel like you will be able to continue to make improvements to your family's health by using the strategies you learned in the FitKids360 program?
   □ Yes
   □ No
   If you answered “no,” please explain:

3. Would you recommend FitKids360 to a friend or family member?
   □ Yes
   □ No
   If you answered “no,” please explain:

4. Did you feel that the instructors treated you and your family with respect?
   □ Yes
   □ No
   If you answered “no,” please explain:

5. Did you feel that the instructors were supportive of your family goals?
   □ Yes
   □ No
   If you answered “no,” please explain:
6. This class included an orientation plus six weeks of instruction – rate your feeling of the length of the class:
   - □ Too Long
   - □ Just Right
   - □ Not long enough

7. Do you have any suggestions for improving the curriculum?

8. Would you be interested in attending another class like this?
   - □ Yes
   - □ No
   - □ Unsure
   Please explain why or why not.

9. If you had to pay a fee or co-pay, would you still have attended this class?
   - □ Yes
   - □ No
   - □ Unsure
   Please explain why or why not.

10. Do you have any other comments or suggestions for the FitKids360 Program?
APPENDIX F: FitKids360 lesson documentation form

FitKids360 Process Evaluation Form

Evaluator: _______________ Date: __________ FitKids Week: _____

Physical Activity/Exercise Lesson (Instructor: ______________________)
Overall Topic: ______________________ Lesson Delivered: (Yes/No)

<table>
<thead>
<tr>
<th>Lesson Task/Objective</th>
<th>Completed (Yes/No)</th>
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<tbody>
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</table>

Nutrition/Dietary Lesson (Instructor: ______________________)
Overall Topic: ______________________ Lesson Delivered: (Yes/No)

<table>
<thead>
<tr>
<th>Lesson Task/Objective</th>
<th>Completed (Yes/No)</th>
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Social/Behavioral Lesson (Instructor: ______________________)
Overall Topic: ______________________ Lesson Delivered: (Yes/No)

<table>
<thead>
<tr>
<th>Lesson Task/Objective</th>
<th>Completed (Yes/No)</th>
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** # of tasks and objectives will change depending on week of program
APPENDIX G: FitKids360 attendance sheet

FitKids360 Attendance Tracker Report Sheet

FitKids360 Class Site:
Class Start Date:

<table>
<thead>
<tr>
<th>Referred Participant's Name</th>
<th>Age</th>
<th>M/F</th>
<th>Orient.</th>
<th>1</th>
<th>2</th>
<th>3</th>
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<th>5</th>
<th>6</th>
<th>Total</th>
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<thead>
<tr>
<th>Sibling's Name</th>
<th>Age</th>
<th>M/F</th>
<th>Orient.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Total</th>
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APPENDIX H: FitKids360 fidelity evaluation form

FitKids360 Process Evaluation Form

Evaluator: __________________ Date: ________ FitKids Week: ______

Physical Activity/Exercise Lesson  (Instructor: __________________)
Overall Topic: __________________________

<table>
<thead>
<tr>
<th>Evaluation Item</th>
<th>Rating (1=None; 2=Some; 3=Most; 4=All)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Instructor seemed prepared to teach lesson.</td>
<td></td>
</tr>
<tr>
<td>2. Instructor seemed passionate/engaged to teach lesson.</td>
<td></td>
</tr>
<tr>
<td>3. Instructor created positive, interactive environment.</td>
<td></td>
</tr>
<tr>
<td>4. Children were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
<tr>
<td>5. Parents were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
<tr>
<td>6. Mentors were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
</tbody>
</table>

Nutrition/Dietary Lesson  (Instructor: __________________)
Overall Topic: __________________________

<table>
<thead>
<tr>
<th>Evaluation Item</th>
<th>Rating (1=None; 2=Some; 3=Most; 4=All)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Instructor seemed prepared to teach lesson.</td>
<td></td>
</tr>
<tr>
<td>8. Instructor seemed passionate/engaged to teach lesson.</td>
<td></td>
</tr>
<tr>
<td>9. Instructor created positive, interactive environment.</td>
<td></td>
</tr>
<tr>
<td>10. Children were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
<tr>
<td>11. Parents were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
<tr>
<td>12. Mentors were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
</tbody>
</table>

Social/Behavioral Lesson  (Instructor: __________________)
Overall Topic: __________________________

<table>
<thead>
<tr>
<th>Evaluation Item</th>
<th>Rating (1=None; 2=Some; 3=Most; 4=All)</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Instructor seemed prepared to teach lesson.</td>
<td></td>
</tr>
<tr>
<td>15. Instructor created positive, interactive environment.</td>
<td></td>
</tr>
<tr>
<td>16. Children were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
<tr>
<td>17. Parents were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
<tr>
<td>18. Mentors were actively engaged and enjoyed the session.</td>
<td></td>
</tr>
</tbody>
</table>

Group Exercise  Activity: __________________________

<table>
<thead>
<tr>
<th>Evaluation Item</th>
<th>Rating (1=None; 2=Some; 3=Most; 4=All)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19. Instructor seemed prepared to explain group exercise.</td>
<td></td>
</tr>
<tr>
<td>20. Instructor carried out exercise session to make it fun for all.</td>
<td></td>
</tr>
<tr>
<td>21. Children were actively engaged in group exercise.</td>
<td></td>
</tr>
<tr>
<td>22. Parents were actively engaged in group exercise.</td>
<td></td>
</tr>
<tr>
<td>23. Mentors were actively engaged in group exercise.</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES


CHAPTER 4: RESULTS
Participant characteristics

The target participant pool for this study consisted of ninth grade students from Grand Blanc High School (MI) who were enrolled in Physical Education or Health class in the Fall semester of 2014. In the Fall 2014 semester, there were 806 total ninth grade students, with 596 enrolled in Physical Education or Health Class. Anthropometric and lifestyle survey data (PAQ-A, Block Kids FFQ, self-reported screen time) were collected on 502 of the 596 students across multiple days in September 2014; however, only 394 students (78%) assented to allowing their data to be used for this study. Because the CHH program was collecting anthropometric data on all students for the CHH BMI Screening, the 502 students with anthropometry data comprised the participant pool for which FNPA Screening Tool surveys were sent home. A total of 217 FNPA Screening Tool surveys were returned (return rate of 36%); however, 14 of the participants were excluded from the final analyses as a result of incomplete FNPA survey data. Another 14 participants were further removed as a result of incomplete physical activity data. Seven participants were removed due to dietary data that were determined to be implausible because of a significantly low total kcal value. Furthermore, seven participants were excluded as a result of self-reported screen time ≥3 standard deviations above the mean and determined to be implausible. Thus, the final sample size for Study 1 was 175 (89 boys, 86 girls).

Physical characteristics of the sample are presented in Table 3. The majority of the participants identified themselves as Caucasian (72.0%). Although no individual socioeconomic status data were collected, the median household income for Grand Blanc is $50,742 with 14.5% of the population below the poverty level [1]. Approximately 14% identified as being Black, 3% as Hispanic, and 11% as mixed race. The average age was 14.5 ± 0.5 years old. The mean BMI percentile approximated the 66th percentile for males and the 63rd percentile for females.
Approximately 18% were overweight, and an additional 11% were obese. A greater proportion of males were obese compared to females (16.9% vs. 5.8%; t=2.32, p=0.02). Using FITNESSGRAM standards, 23% were classified as overfat, with no significant differences between genders. BMI percentile and percent body fat were significantly correlated (r=0.67; p<0.0001). Males were significantly taller (t=9.54; p<0.0001) and weighed more than females (t=4.73; p<0.0001) while females had significantly higher percent body fat than males (t=6.13; p<0.0001).

Table 3. Physical characteristics of the sample.

<table>
<thead>
<tr>
<th></th>
<th>Total (n=175)</th>
<th>Males (n=89)</th>
<th>Females (n=86)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean (SD)</strong></td>
<td><strong>Min-Max</strong></td>
<td><strong>Mean (SD)</strong></td>
<td><strong>Mean (SD)</strong></td>
</tr>
<tr>
<td><strong>Age (yrs)</strong></td>
<td>14.5 (0.5)</td>
<td>13.8-16.3</td>
<td>14.6 (0.6)</td>
</tr>
<tr>
<td><strong>Height (cm)</strong></td>
<td>166.8 (9.4)</td>
<td>144.5-190.1</td>
<td>172.2 (9.1)*</td>
</tr>
<tr>
<td><strong>Weight (kg)</strong></td>
<td>62.5 (16.1)</td>
<td>36.4-143.8</td>
<td>67.9 (18.4)*</td>
</tr>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>22.3 (4.6)</td>
<td>15.1-41.9</td>
<td>22.7 (5.2)</td>
</tr>
<tr>
<td><strong>BMI Percentile</strong></td>
<td>64.7 (26.7)</td>
<td>1.0-99.8</td>
<td>66.2 (27.1)</td>
</tr>
<tr>
<td><strong>Percent Body Fat</strong></td>
<td>22.0 (9.4)</td>
<td>5.2-67.8</td>
<td>18.2 (10.0)*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Component</th>
<th>Proportion</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overweight (%)</strong></td>
<td>18.3%</td>
<td>18.0</td>
<td>18.6</td>
</tr>
<tr>
<td><strong>Obese (%)</strong></td>
<td>11.4%</td>
<td>16.9%*</td>
<td>5.8%</td>
</tr>
<tr>
<td><strong>Overfat (%)</strong></td>
<td>22.9%</td>
<td>24.7%</td>
<td>20.9%</td>
</tr>
</tbody>
</table>

Values are mean (SD) or proportion for total sample, males, and females, with minimum and maximum values shown for the total sample.
* Significant difference between males and females (p<0.05)

Participant characteristics on the family environment, physical activity, dietary behaviors, and screen time behaviors are shown in Table 4. The mean FNPA score was 62.9 (5.1) with a minimum score of 49 and maximum score of 75. The mean score was above the midpoint with regards to the possible range of scores on the FNPA (i.e., 20-80; midpoint = 50). The HEI scores for 58% of the participants were classified as “Needs Improvement”, and 42% were “Poor.” No participant had HEI scores that was high enough to be classified as “Good.” A greater proportion of males had a HEI score classified as “Needs Improvement” compared to females.
(61% vs. 55%), but the difference was not statistically significant. The average amount of screen time for the sample was 4.1 (2.6) hours/day with 21.7% meeting the screen time recommendation of <2 hours of screen time/day.

Table 4. Participant characteristics for family environment, physical activity, dietary behaviors, and screen time behaviors.

<table>
<thead>
<tr>
<th></th>
<th>Total (n=175)</th>
<th>Males (n=89)</th>
<th>Females (n=86)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNPA Score</td>
<td>62.9 (5.1)</td>
<td>62.7 (5.2)</td>
<td>63.1 (5.0)</td>
</tr>
<tr>
<td>Healthy Eating Index Score (HEI)</td>
<td>52.8 (10.4)</td>
<td>53.4 (10.9)</td>
<td>52.1 (9.9)</td>
</tr>
<tr>
<td>Total Weekly Screen Time (hours/day)</td>
<td>4.1 (2.6)</td>
<td>4.0 (2.5)</td>
<td>4.2 (2.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Good HEI Score (&gt;80)</td>
<td>0.0%</td>
</tr>
<tr>
<td>% Needs Improvement HEI Score (51-80)</td>
<td>57.7%</td>
</tr>
<tr>
<td>% Poor HEI Score (&lt;51)</td>
<td>42.3%</td>
</tr>
<tr>
<td>% Meeting Screen Time Recommendation (&lt;2 hours/day)</td>
<td>21.7%</td>
</tr>
</tbody>
</table>

Values are mean (SD) or proportion for total sample, males, and females, with minimum and maximum of values shown for the total sample.

**FNPA and physical activity, dietary quality, and screen time (Specific Aim 1)**

It was hypothesized that there would be a significant positive association between the FNPA score and physical activity and dietary quality. It was hypothesized that there would be a significant negative association between the FNPA score and screen time. To determine potential associations, multiple linear regression analyses were run with the FNPA score as the dependent variable and independently with PAQ-A score, HEI score, and total screen time or in one model. Covariates were sex, race, and BMI percentile.

Pearson correlations among the FNPA score, PAQ-A score, Healthy Eating Index (HEI) score, and total screen time (hours/day) are shown in Table 5. All associations were found to be
statistically non-significant (p>0.05). Very weak associations were found among all variables, with the majority of correlations under ± 0.10. The only correlation found to deviate outside of ± 0.10 was between PAQ-A and total screen time (-0.19).

Table 5. Pearson correlation coefficients among FNPA score, PAQ-A score, HEI-2010 score, and total screen time in total sample.

<table>
<thead>
<tr>
<th></th>
<th>FNPA</th>
<th>PAQ-A</th>
<th>HEI</th>
<th>Total Screen Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNPA</td>
<td>--</td>
<td>0.01</td>
<td>-0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>PAQ-A</td>
<td>0.01</td>
<td>--</td>
<td>0.06</td>
<td>-0.19</td>
</tr>
<tr>
<td>HEI</td>
<td>-0.07</td>
<td>0.06</td>
<td>--</td>
<td>-0.06</td>
</tr>
<tr>
<td>Total Screen Time</td>
<td>0.05</td>
<td>-0.19</td>
<td>-0.06</td>
<td>--</td>
</tr>
</tbody>
</table>

To further examine associations of the total FNPA score with PAQ-A score, HEI score, and total screen time, multiple linear regression analyses was used, first without controlling for potential covariates and second controlling for sex, race (Caucasian or not), and BMI percentile. The analyses were first run independently with each variable and then together in one model. Regression analyses between the FNPA score and independently with PAQ-A, HEI-2010 score, and total screen time are shown in Tables 6. No significant relationships were found in any of the analyses between the FNPA score and PAQ-A, HEI-2010 score, and total screen time, with or without covariates. No covariates were found to be significant in any of the models. Table 7 shows the results from the regression analysis with FNPA score, PAQ-A, HEI-2010 score, and total screen time. In the regression analysis including all three independent variables the model was not statistically significant when analyzing with ($R^2=0.132$, $p=0.81$) or without covariates ($R^2=0.085$, $p=0.75$). No covariates were found to be significant in the model.
Table 6. Independent associations of FNPA score and PAQ-A, HEI-2010, and total screen time.

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>R²</th>
<th>Adjusted R²</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAQ-A¹</td>
<td>0.058</td>
<td>0.001</td>
<td>-0.006</td>
<td>0.014</td>
<td>0.91</td>
</tr>
<tr>
<td>PAQ-A²</td>
<td>0.058</td>
<td>0.092</td>
<td>0.008</td>
<td>0.362</td>
<td>0.84</td>
</tr>
<tr>
<td>HEI-2010¹</td>
<td>-0.033</td>
<td>0.013</td>
<td>-0.001</td>
<td>0.792</td>
<td>0.38</td>
</tr>
<tr>
<td>HEI-2010²</td>
<td>-0.036</td>
<td>0.117</td>
<td>-0.010</td>
<td>0.586</td>
<td>0.67</td>
</tr>
<tr>
<td>Screen time¹</td>
<td>0.100</td>
<td>0.056</td>
<td>-0.003</td>
<td>0.441</td>
<td>0.51</td>
</tr>
<tr>
<td>Screen time²</td>
<td>0.128</td>
<td>0.111</td>
<td>-0.011</td>
<td>0.530</td>
<td>0.71</td>
</tr>
</tbody>
</table>

¹ unadjusted model
² adjusted model

Table 7. Associations of FNPA score with PAQ-A, HEI-2010, and total screen time.

<table>
<thead>
<tr>
<th>Model</th>
<th>R²</th>
<th>Adjusted R²</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.085</td>
<td>-0.100</td>
<td>0.411</td>
<td>0.75</td>
</tr>
<tr>
<td>B</td>
<td>0.132</td>
<td>0.018</td>
<td>0.499</td>
<td>0.81</td>
</tr>
</tbody>
</table>

A unadjusted model (PAQ-A, HEI-2010, and total screen time)
B adjusted model (PAQ-A, HEI-2010, and total screen time)

Results from additional regression analyses, with and without adjusting for sex, race, and BMI percentile, examining the association of scores from several FNPA constructs, Physical Activity, Diet, and Screen Time, with PAQ-A, HEI-2010 score, and total screen time, respectively, are shown in Table 8. The only significant association found was between the FNPA-Diet construct score with HEI-2010 scores (p<0.05).
Table 8. Independent associations of FNPA construct scores with PAQ-A, HEI-2010, and total screen time.

<table>
<thead>
<tr>
<th>Model</th>
<th>B</th>
<th>R²</th>
<th>Adjusted R²</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>FNPA-PA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAQ-A¹</td>
<td>0.069</td>
<td>0.018</td>
<td>0.012</td>
<td>3.198</td>
<td>0.075</td>
</tr>
<tr>
<td>PAQ-A²</td>
<td>0.002</td>
<td>0.030</td>
<td>0.007</td>
<td>1.296</td>
<td>0.274</td>
</tr>
<tr>
<td>FNPA-Diet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HEI-2010¹</td>
<td>3.087</td>
<td>0.305</td>
<td>0.301</td>
<td>75.826</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>HEI-2010²</td>
<td>3.072</td>
<td>0.313</td>
<td>0.297</td>
<td>19.336</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>FNPA-ST</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Screen time¹</td>
<td>-0.354</td>
<td>0.170</td>
<td>0.011</td>
<td>2.971</td>
<td>0.087</td>
</tr>
<tr>
<td>Screen time²</td>
<td>-0.366</td>
<td>0.020</td>
<td>-0.003</td>
<td>0.086</td>
<td>0.489</td>
</tr>
</tbody>
</table>

¹ unadjusted model  
² adjusted model  
FNPA-PA = FNPA physical activity construct score  
FNPA-Diet = FNPA diet construct score  
FNPA-ST = FNPA screen time construct score

**FNPA and weight status (Specific Aim 2)**

*It was hypothesized that the FNPA scores would significantly differ by weight status, with FNPA scores being the highest among normal weight participants and the lowest among obese participants. A median split was used to determine cut points for FNPA group analysis since criterion-referenced points do not currently exist for the FNPA. Logistic regression was used to evaluate the association of FNPA score groups (low and high) with weight status (normal weight, overweight, obese). Odds ratios and 95% confidence intervals were determined from the logistic regression analyses. Covariates were sex and race.*

To compare with previous studies utilizing the FNPA Screening Tool, FNPA scores were divided by median split to test for differences in weight status and fatness status, between adolescents with low scores vs. adolescents with high scores. Table 9 shows differences in body size across the low and high groups of the FNPA score. No significant differences were found in BMI, BMI percentile, or percent body fat between the low and high FNPA groups. A greater proportion of participants were obese (t=5.1, p=0.02) in the low FNPA group compared to the
high FNPA group. Further, a greater proportion of participants were classified as overfat in the low FNPA group compared to the high FNPA group, although, this was not statistically significant.

Table 9. Differences in body size by low and high FNPA score. Values are mean (SD) or proportion for each FNPA group.

<table>
<thead>
<tr>
<th></th>
<th>FNPA (Low)</th>
<th>FNPA (High)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;63</td>
<td>&gt;63</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>22.9 (5.6)</td>
<td>21.8 (3.5)</td>
</tr>
<tr>
<td>BMI Percentile</td>
<td>63.7 (29.4)</td>
<td>65.5 (24.3)</td>
</tr>
<tr>
<td>Percent Body Fat</td>
<td>23.2 (10.8)</td>
<td>21.1 (8.0)</td>
</tr>
</tbody>
</table>

Proportions

<table>
<thead>
<tr>
<th></th>
<th>Overweight (%)</th>
<th>Obese (%)</th>
<th>Overfat (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13.6%</td>
<td>17.3%*</td>
<td>28.4%</td>
</tr>
<tr>
<td></td>
<td>22.3%</td>
<td>6.4%</td>
<td>18.1%</td>
</tr>
</tbody>
</table>

* Significantly different between low and high FNPA groups (p<0.05)

Logistic regression results in Table 10 show the odds of being overweight/obese and overfat by FNPA group controlling for age, sex, and ethnicity. No significant associations were found between the FNPA score and weight status or overfatness; although results approached statistical significance in the adjusted model for weight status. Participants in the low FNPA group had an adjusted odds ratio of 1.21 (95% CI = 0.62-2.36; p=0.08) for being overweight/obese compared to the high FNPA group. Participants in the low FNPA group had an adjusted odds ratio of 1.91 (95% CI=0.92-3.95; p=0.59) for being overfat compared to the high FNPA group.
Table 10. Unadjusted and adjusted odds ratio (controlling for age, sex, and race) of being overweight/obese or overfat by FNPA group.

<table>
<thead>
<tr>
<th>FNPA (Low Group)</th>
<th>Unadjusted Odds Ratio</th>
<th>95% CI</th>
<th>Adjusted Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;63</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight/Obese</td>
<td>1.11</td>
<td>0.58-2.12</td>
<td>1.21</td>
<td>0.62-2.36</td>
</tr>
<tr>
<td>Overfat</td>
<td>1.80</td>
<td>0.88-3.67</td>
<td>1.91</td>
<td>0.92-3.95</td>
</tr>
<tr>
<td>FNPA (High Group)</td>
<td>&gt;63</td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

FitKids360 intervention evaluation

Of the 502 ninth grade students from Grand Blanc High School who were measured for anthropometrics, 168 (33.4%) were identified as overweight or obese (BMI percentile greater than or equal to the 85th percentile based on CDC growth charts. These 168 students were invited via a home phone call (via FitKids360 site staff) to participate in the FitKids360 program. With the phone calls made in recruitment for the Fall 2014 class, 30 families responded that they would be interested in participating. In the Spring 2015 class, 15 families responded that they would be participating/interested in joining.

FitKids360 feasibility and acceptability (Specific Aim 3)

Feedback from the FitKids 360 participants (parents/guardians & youth), program instructors, and program volunteers was used to evaluate this specific aim. This aim was not hypothesis driven.

Feasibility and acceptability of the FitKids360 intervention: instructors and volunteers

A standard feedback form from the FitKids360 intervention program (Tucker, 2014) was used to assess the feasibility and acceptability of the intervention from program staff.
Fall 2014 FitKids360 cohort

Table 11 highlights the staff responses for three questions from the end of program survey from the Fall 2014 cohort.

Table 11. Fall 2014 FitKids360 instructor/volunteer survey responses.

<table>
<thead>
<tr>
<th>Question</th>
<th>Instructors: Number Reporting “Yes”</th>
<th>Volunteers: Number Reporting “Yes”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Did you enjoy volunteering for FitKids360?”</td>
<td>5/5 (100%)</td>
<td>9/9 (100%)</td>
</tr>
<tr>
<td>“Would you volunteer for FitKids360 again?”</td>
<td>5/5 (100%)</td>
<td>9/9 (100%)</td>
</tr>
<tr>
<td>“Did you feel like you were an integral part of the FitKids360 program?”</td>
<td>5/5 (100%)</td>
<td>7/9 (78%)</td>
</tr>
</tbody>
</table>

There were two participants who responded with “No” to Question 3 (“Did you feel like you were an integral part of the FitKids360 program?”). The two volunteer participants who answered “No” to Question 3 had the following comments to explain their responses:

Participant 1: “I feel like I could have more of an impact paired with a certain family.”

Participant 2: “Seemed like we had a ton of volunteers and it just seemed like we got in the way.”

Responses to Question 4 (“What did you like about FitKids360?”) were as follows:

- “FitKids360 had a supportive atmosphere and gave the tools and knowledge to support positive lifestyle changes. Lessons across multiple areas (physical activity, nutrition, mental health) were beneficial.”
- “I like the curriculum with all the different parts (mental health, physical activity, nutrition) and I liked all the participation from the parents.”
- “I really enjoyed how many kids participated including siblings who tagged along with the family.”
• “I like how holistic the program was. It wasn’t just talking about nutrition and exercise, but mental and social domains as well as family dynamics.”

• “I like that the whole family is involved in the program.”

• “Exercising with the kids in a variety of activities and eating healthy snacks.”

• “I like that the parents are actively involved throughout each part of the program especially the group exercise activities.”

• “Becoming a part of the lives of the families and helping them live a healthier lifestyle.”

Responses to Question 5 (“Do you have any suggestions for improving FitKids360?”) were as follows:

• “I think the kids sit too long. They should have more time doing physical activity. Parents can do more of the sit down lessons because at the end of the days the kids will mirror their parents.”

• “It should last longer. A lot of information is provided in a short amount of time.”

• “Revising some of the parental discipline curriculum to better cater to a teenage population.”

• “Less lecture time.”

• “Do a wider variety of exercise activities (e.g., different types of games and sports in the gym or going for a walk on the nearby nature trails).”

• “Better time management so that we don’t overrun over two hours”

• “Use a better area of the GAC to hold the talks. Sometimes it was hard to hear each other in loud, open areas. Also, let the families use the gym equipment throughout the program.”
• “Encourage/provide more guidance to the mentors on how to do one-on-one mentoring throughout the program.”

**FitKids360 intervention changes**

Several changes in the programming of the FitKids360 intervention were made before the start of the Spring 2015 cohort in order to further hone the intervention. These changes included:

1) The addition of an extra week to include a class session that was dedicated towards a “Grocery Store Field Trip” at a local VG’s supermarket; 2) Recruiting new medical student volunteers and a greater number compared to the Fall 2014 cohort; 3) Reserving group exercise space throughout the Genesys Athletic Club two months before the beginning of the FitKids360 intervention. The same instructors from the Fall 2014 cohort served as the instructors for the Spring 2015 cohort. Three of the 10 volunteers returned from the Fall while the other seven volunteers were new and involved with FitKids360 for their first time in the Spring.

**Spring 2015 FitKids360 cohort**

Table 12 highlights the responses for three questions from the Volunteer/Instructor from the end of program survey from the Spring 2015 cohort.

<table>
<thead>
<tr>
<th>Question</th>
<th>Instructors: Number Reporting “Yes”</th>
<th>Volunteers: Number Reporting “Yes”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Did you enjoy volunteering for FitKids360?”</td>
<td>5/5 (100%)</td>
<td>9/10 (90%)</td>
</tr>
<tr>
<td>“Would you volunteer for FitKids360 again?”</td>
<td>5/5 (100%)</td>
<td>9/10 (90%)</td>
</tr>
<tr>
<td>“Did you feel like you were an integral part of the FitKids360 program?”</td>
<td>5/5 (100%)*</td>
<td>8/10 (80%)*</td>
</tr>
</tbody>
</table>

* One participant responded “Yes” and “No” to this question

The one volunteer participant who answered “No” to Questions 1-3 had the following comments to explain his/her responses:

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Question 1: “I do not feel I was involved as much as I wanted to be. The child I was assigned to work with throughout the program did not seem very interested in working with me throughout the eight weeks.”

Question 2: “I will be too busy during med school to participate again in FitKids360.”

Question 3: “I felt separated from the rest of the volunteers and was not as close with my child and family as they were. I do not feel that some of the instructors even knew my name by the end of the program.”

The other volunteer participant who answered “No” to Question 3 did not leave a comment to explain his/her answer to their question. The comment from the one instructor who responded with both “Yes” and “No” to Question 3 was “I don’t feel I was as involved in the program as I was in the previous FitKids360 session.”

Responses to Question 4 (“What did you like about FitKids360?”) were as follows:

- “It’s great that the program caters to the whole family and really promotes lifestyle changes and gives families the tools to make the changes.”
- “I like that there was new physical activity done each week.”
- “I like that the activities are well planned and flows well. The concept of working with the entire family is the best asset.”
- “I loved interacting with the families and being able to do some of the activities with them.”
- “I loved that it involves with the whole family and the different activities that were introduced to the whole family. The information used was very practical the goals were very attainable.”
• “I love the connection with the families. Also, their excitement of learning and experiencing new ideas and habits in order to better their lives.”

• “FitKids360 is an opportunity for kids/teens and parents to be educated and empowered to live healthy lives. It’s a liberty to create interactive/creative activities. There’s also collaboration of three strong disciplines related to weight management (i.e., nutrition, fitness, wellness).”

Responses to Question 5 (“Do you have any suggestions for improving FitKids360?”) were as follows:

• “Given that there is liberty for the instructors to create interactive/creative lessons, it may be helpful to have at least a 2-hour in-service to review the layout of the proposed lessons to gain feedback from fellow instructors.”

• “In general, just making sure mentors are all on the same page and interacting with their families regularly.”

• “We need mentors that are 100% committed to helping the families and not on their phones or competing with each other during the physical activity.”

• “I think it should be renamed FitTeens in order to better represent the teens involved (they would like it too).”

• “The families should spend more time doing exercise activities and not sitting as much and being taught by the instructors.”

• “Make the program longer by a couple weeks.”

• “Less paperwork during the first and last week of the program. It turns the families off from what the program is about.”

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• “Make sure the mentors are more invested into what the program is all about and establishing a good relationship with their assigned child and family.”

In the Spring cohort for the FitKids360 program, all instructors enjoyed being part of the FitKids360 program, would volunteer again for the program, and felt like they were an integral part of the program. There were two volunteer participants in the Spring cohort who did not feel as if they were an integral part of the FitKids360 program.

Summary

When reviewing the responses to what the instructors and volunteers liked about the FitKids360 program, the most highlighted aspect was that the program was family-oriented and not only involved the 9th grade participant, but his/her parents and any attending siblings (n=12). Another aspect of the program for which there were several positive comments was the various group exercise sessions that were held each week throughout different areas of the Genesys Athletic Club (n=8). Instructors and volunteers also liked that the curriculum used in the program was comprised of multiple domains and targeted physical activity, nutrition, and mental health (n=6). Overall, the instructors and volunteers commented positively on many aspects of the FitKids360 program.

Most of the instructors/volunteers provided a suggestion for how to improve the FitKids360 program. One of the most frequent suggestions from the Fall 2014 cohort was better time management with each weekly class session so that each portion of the class did not run late (n=4). Related, a couple of suggestions involved the length of the actual program (i.e., greater number of both contact hours per week and the number of contact weeks of the program; n=4)). Another suggestion from instructors and volunteers was ensuring that program mentors were prepared adequately (n=3), used appropriately in their mentoring roles in the program (n=3), and
should be 100% committed and passionate to the overall objectives of the FitKids360 program (n=1).

**Feasibility and acceptability of the FitKids360 intervention: family participants**

A standard feedback form from the FitKids360 intervention program (Tucker, 2015; Appendix B) was used to assess the feasibility and acceptability of the intervention from the family participants.

**Fall 2014 FitKids360 cohort**

Table 13 highlights the responses of Questions 1-6 from the family participants from the end of program survey from the Fall 2014 cohort.

<table>
<thead>
<tr>
<th>Question</th>
<th>Family Participants: Number Responding “Yes”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Do you feel you learned important information that will help your family be healthier?”</td>
<td>10/10 (100%)</td>
</tr>
<tr>
<td>“Do you feel like you will be able to continue to make improvements to your family’s health by using the strategies you learned in the FitKids360 program?”</td>
<td>10/10 (100%)</td>
</tr>
<tr>
<td>“Would you recommend FitKids360 to a friend or family member?”</td>
<td>10/10 (100%)</td>
</tr>
<tr>
<td>“Did you feel that the instructors treated you and your family with respect?”</td>
<td>10/10 (100%)</td>
</tr>
<tr>
<td>“Did you feel that the instructors were supportive of your family goals?”</td>
<td>10/10 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>“This class included an orientation plus six weeks of instruction – rate your feeling of the length of the class.”</th>
<th>Number Responding “Too Long”</th>
<th>Number Responding “Just Right”</th>
<th>Number Responding “Not Long Enough”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/10 (10%)</td>
<td>3/10 (30%)</td>
<td>6/10 (60%)</td>
</tr>
</tbody>
</table>

From the Fall 2014 cohort, all 10 families responded “Yes” to the five questions asking about how they felt overall about their FitKids360 program experience. With regard to a specific
question about how families felt about the length of the program, three of 10 families felt the program length was just right, while one family felt it was too long, and six of the 10 families felt that the program was not long enough.

Six of the families did not provide any response to Question 7. Responses to Question 7 (“Do you have any suggestions for improving the curriculum?”) were as follows:

- “Shorter classes, but spread out over longer time period.”
- “Do more activities like soccer.”
- “Include a greater variety of group activities to do instead of just circuit training most of the time.”
- “Make the program twice a week instead of just once.”

Table 14 highlights the responses of Question 8-9 from the family participants from the end of program survey from the Fall 2014 cohort.

<table>
<thead>
<tr>
<th>Question</th>
<th>Number Responding “Yes”</th>
<th>Number Responding “No”</th>
<th>Number Responding “Unsure”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Would you be interested in attending another class like this?”</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>“If you had to pay a fee or co-pay, would you still have attended this class?”</td>
<td>4</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

All 10 families responded with “Yes” that they would be interested in attending another class like FitKids360. With regard to the question about the families attending the FitKids360 program if they had to pay a fee or co-pay, four of the families responded with “Yes”, one family responded with “No”, and five families responded that they were “Unsure”. Explanations provided by families that said they would be interested in attending another class like this included:
• “Because it’s a very helpful program!”
• “Because participating again would help our family continue becoming healthier!”
• “It was fun, took up time, and was something for our family to do.”
• “Our family needs the information provided by experts.”
• “Yes, because we get to do something together as a family and our child gets to do something fun and important with their friends.”

Explanations provided by two of the four families that said they would have attended the class if they had to pay a fee or co-pay included:

• “Because it teaches you a healthy lifestyle.”
• “A lot of good information for children and parents.”

Among the six families who responded with “No” or “Unsure” on if they would have attended the class if they had to pay a fee or co-pay, families provided responses that included:

• “It is not in our family’s budget.”
• “Depends on how much it would cost.”

**Spring 2015 FitKids360 cohort**

Table 15 highlights the responses of Questions 1-6 from the family participants from the end of program survey from the Spring 2015 cohort.
Table 15. Spring 2015 FitKids360 family participant survey responses (Questions 1-6).

<table>
<thead>
<tr>
<th>Question</th>
<th>Family Participants: Number Responding “Yes”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Do you feel you learned importance information that will help your family be healthier?”</td>
<td>6/6 (100%)</td>
</tr>
<tr>
<td>“Do you feel like you will be able to continue to make improvements to your family’s health by using the strategies you learned in the FitKids360 program?”</td>
<td>6/6 (100%)</td>
</tr>
<tr>
<td>“Would you recommend FitKids360 to a friend or family member?”</td>
<td>6/6 (100%)</td>
</tr>
<tr>
<td>“Did you feel that the instructors treated you and your family with respect?”</td>
<td>6/6 (100%)</td>
</tr>
<tr>
<td>“Did you feel that the instructors were supportive of your family goals?”</td>
<td>6/6 (100%)</td>
</tr>
<tr>
<td>“This class included an orientation plus six weeks of instruction – rate your feeling of the length of the class.”</td>
<td>Number Responding “Too Long” 1/6 (17%)</td>
</tr>
</tbody>
</table>

From the Spring 2015 cohort, all six families responded “Yes” to the five questions asking about how they felt about their FitKids360 program experience. With regard to a specific question about how families felt about the length of the program, five of six families felt the program length was just right while one family felt it was too long.

Responses to Question 7 (“Do you have any suggestions for improving the curriculum?”) were as follows:

- “Hold the program during a time of the year where we can be outside to do some of the group activities.”
- “Less class time and more time doing sports.”
- “Less paper teaching guides – I just threw them away.”
Table 16 highlights the responses of Question 8-9 from the family participants from the end of program survey from the Spring 2015 cohort.

Table 16. Spring 2015 FitKids360 family participant survey responses (Questions 8-9).

<table>
<thead>
<tr>
<th>Number Responding “Yes”</th>
<th>Number Responding “No”</th>
<th>Number Responding “Unsure”</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Would you be interested in attending another class like this?”</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>“If you had to pay a fee or co-pay, would you still have attended this class?”</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Four families responded with “Yes” that they would be interested in attending another class like FitKids360 and two families responded with they were “Unsure”. With regard to the families attending the FitKids360 program if they had to pay a fee or co-pay, three of the families responded with “Yes” and three families responded with “No”. Explanations provided by families that said they would be interested in attending another class like this included:

- “We really learned a lot and had fun so it be great to do again!”
- “It was fun, active, informative, and great learning new activities. We also learned a lot about better nutrition.”
- “There was lots of great information and great people involved in the program.”

Families that said “No” or “Unsure” if they would be interested in attending another class like this provided no explanations. Explanations provided by families that said they would have attended the class if they had to pay a fee or co-pay included:

- “Because it teaches you a healthy lifestyle.”
- “A lot of good information for children and parents.”

Among the three families who responded with “No” on if they would have attended the class if they had to pay a fee or co-pay, only one family provided a response to their answer:
“After experiencing what FitKids360 is all about I would pay a small fee to be part of it, but if I didn’t know what the program really included or had much info on the program I would not have paid to be a part of it.”

**Summary**

The responses to Questions 1-5 on the FitKids360 Family Participant End of Program Survey from both the Fall 2014 and Spring 2015 cohorts indicated that all the FitKids360 family participants felt that the program provided important healthy lifestyle information. All families also reported that they felt they would be able to continue making healthy lifestyle decisions from the information and strategies they acquired while in the FitKids360 program. Each family felt that the program instructors treated them well and were supportive of their weekly family goals and overall program goals. The families reported they were satisfied with their experience throughout the FitKids360 program.

In terms of how the families felt about the length of the FitKids360 program (Question 6), only three families from the Fall 2014 cohort felt that the seven weeks were just right. One family felt the program was too long and six families felt that the program was not long enough. In the Spring 2015 cohort one family felt it was too long and the remaining five families felt it was just the right length.

Suggestions for the FitKids360 program from the family participants centered around two central themes: including a greater variety of group exercise activities (with emphasis on more sports and less games/group exercises class activities; n=9) and spending more time during weekly sessions on group activities and less time on actual lecturing (n=5). In the Fall 2014 cohort, only 3/10 families had any suggestions for improving the FitKids360 program and in the Spring 2015 cohort only 3/6 of families provided any suggestions.
The vast majority of families in both cohorts reported that they would be interested in attending another program like FitKids360. Explanations for their response centered mainly upon their enjoyment of the program for the family and how helpful FitKids360 was in making the family live an overall healthier lifestyle. Families from both cohorts had mixed responses on if they would have been part of FitKids360 if they had to pay a fee or co-pay. Families that responded that they would pay to be part of the program justified their response by stating how the knowledge provided and the overall experience of FitKids360 would be worth paying for. Families that said they would not or were unsure if they would be part of the program in exchange for a payment or co-payment explained that it would not be financially feasible for them or that it was dependent on how much the charge would be.

**FitKids360 process evaluation (Specific Aim 4)**

Reach was determined via attendance of FitKids360 participants to weekly classes. Dose was assessed via observations of each weekly class and documenting if the particular components of each weekly class were actually delivered by the intervention team. Fidelity was assessed by class observations and recording the step counts of pedometers worn by program participants (parent/guardian & child) during the weekly sessions. This aim was not hypothesis driven.

**Reach**

In the Fall 2014 cohort, 15 families began the FitKids360 program. The program was conducted on a total of seven days over a seven-week period. In the Spring 2015 cohort, 10 families began the FitKids360 program. Compared to the Fall 2014 cohort, an extra week was added to program to include a “Grocery Store Field Trip”, thus, the duration of the program was eight days across an eight-week period.
In the Fall, participants attended the program 4.6 days/7-days or 69 (65.7%) of 105 possible opportunities (7 days x 15 participants). In the Spring, participants attended the program 4.9 days/8-days or 49 (61.3%) of 80 possible opportunities (7 days x 10 participants). In the Fall cohort, 10 of the 15 (~67%) participants attended at least four of the seven days. In the Spring cohort, six of the 10 (~60%) participants attended at least four of the eight days. In both cohorts, not surprisingly, the participants that attended at least four days were the participants who completed the entire program.

The most common reasons for absences throughout the program were having another commitment or responsibility (either school-related or personal-related). Another common attendance barrier was being illness.

**Dose**

Dose was evaluated throughout the FitKids360 program by an evaluator using a documentation form to note which lesson objectives were completed or not completed each week (Appendix C). Table 17 shows the dose delivered (completeness of program delivery) for the FitKids360 program for the Fall 2014 cohort and Table 18 shows the dose delivered for the Spring 2015 cohort. In the Fall 2014 cohort, the completeness of lesson objectives completed for Physical Activity/Exercise was 87.5% (14/16), 88.2% (15/17) for Nutrition/Diet, and 92% (23/25) for Social/Behavioral. Each domain was equal in terms of the number of lesson objectives that were not completed throughout the program (namely, 2); however, due to the disparity in the total number of objectives throughout the program the Physical Activity/Exercise component relatively had the most omitted objectives.
Table 17. Dose delivered for FitKids360 program components (Fall 2014 Cohort).

<table>
<thead>
<tr>
<th></th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity/Exercise Lesson</td>
<td>3/3</td>
<td>2/2</td>
<td>2/2</td>
<td>3/4</td>
<td>3/3</td>
<td>1/2</td>
</tr>
<tr>
<td>Nutrition/Dietary Lesson</td>
<td>4/4</td>
<td>1/2</td>
<td>3/3</td>
<td>4/4</td>
<td>2/3</td>
<td>1/1</td>
</tr>
<tr>
<td>Social/Behavioral Lesson</td>
<td>5/5</td>
<td>4/4</td>
<td>4/4</td>
<td>4/5</td>
<td>4/4</td>
<td>2/3</td>
</tr>
</tbody>
</table>

Lesson Objectives Completed / Total Lesson Objectives

In the Spring 2015 cohort, the completeness of lesson objectives completed for Physical Activity/Exercise was 100% (17/17), 88.2% (22/24) for Nutrition/Diet, and 100% (24/24) for Social/Behavioral. The number of objectives for Physical Activity/Exercise and Social/Behavioral slightly changed from the Fall 2014 after some modifications to the curriculum. Due to the additional week to the Spring 2015 cohort (used for the Grocery Store Field Trip), the number of lesson objectives increased substantially from 17 to 24 for the Spring 2015 cohort. Both the Physical Activity/Exercise and Social/Behavioral domains completed all lesson objectives throughout the Spring.

Table 18. Dose delivered for FitKids360 program components (Spring 2015 Cohort).

<table>
<thead>
<tr>
<th></th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity/Exercise Lesson</td>
<td>3/3</td>
<td>--</td>
<td>2/2</td>
<td>3/3</td>
<td>4/4</td>
<td>3/3</td>
<td>2/2</td>
</tr>
<tr>
<td>Nutrition/Dietary Lesson</td>
<td>4/4</td>
<td>6/7</td>
<td>2/2</td>
<td>3/3</td>
<td>4/4</td>
<td>2/3</td>
<td>1/1</td>
</tr>
</tbody>
</table>

Lesson Objectives Completed / Total Lesson Objectives

**Fidelity**

Fidelity was evaluated throughout the FitKids360 program by a single evaluator using a 23-item survey to interpret the quality of the program delivery (Appendix D). Table 19 shows the fidelity data in both the Fall 2014 cohort and Spring 2015 cohort across the 3 domains of the
FitKids360 program, also including an evaluation of the group exercise component of the program. Results from the process evaluator’s overall assessment of the FitKids360 program showed a perception that the club was delivered with high fidelity. However, when looking at this by program component, in both the Fall 2014 and Spring 2015 cohorts, the Physical Activity/Exercise component of the program was perceived to be delivered with poorer quality compared to the Nutrition/Dietary and Social/Behavioral components. Overall, there was an increase in fidelity rating from Fall 2014 to Spring 2015 (3.4 increased to 3.6).

Table 19. Summary of fidelity scores for FitKids360 program components (Scale 1-4).

<table>
<thead>
<tr>
<th></th>
<th>Fall 2014</th>
<th>Spring 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity/Exercise (6 items)</td>
<td>2.6 (0.6)</td>
<td>2.9 (0.6)</td>
</tr>
<tr>
<td>Nutrition/Dietary (6 items)</td>
<td>3.8 (0.4)</td>
<td>3.6 (0.3)</td>
</tr>
<tr>
<td>Social/Behavioral (6 items)</td>
<td>3.6 (0.6)</td>
<td>3.8 (0.4)</td>
</tr>
<tr>
<td>Group Exercise (5 items)</td>
<td>3.6 (0.7)</td>
<td>3.7 (0.6)</td>
</tr>
<tr>
<td>Average</td>
<td>3.4 (0.8)</td>
<td>3.6 (0.6)</td>
</tr>
</tbody>
</table>

1=None of the time; 2=Some of the time; 3=Most of the time; 4=All of the time

Fidelity was also originally to be assessed by recording the step counts of pedometers worn by program participants (parent/guardian & child) during the weekly sessions throughout the FitKids360 intervention. However, data from this assessment are not reported due to the use of pedometers in the Fall 2014 cohort being very inconsistent among both youth participants and their parents. The use of pedometers in the FitKids360 program was discontinued as a whole for the Spring 2015 cohort (as well as throughout the entire statewide FitKids360 program) due to the cost of the pedometers and complications brought upon by their usage with the families.
FitKids360 pre-post assessments and follow-up (Specific Aim 5)

It was hypothesized that FitKids360 participants would have increases in physical activity, dietary quality, physical activity and dietary self-efficacy, and FNPA score and a significant decrease in screen time from baseline to 7/8-week follow-up and at 3-months follow-up.

A total of 25 overweight or obese (BMI ≥ 85th centile) participants were enrolled in one of the two FitKids360 cohorts. Of these, 16 participants completed the program and the follow-up evaluation (64% retention). Nine participants did not complete the program, with five from the Fall 2014 cohort and four from the Spring 2015 cohort. Among the five participants who did not complete the program in the Fall 2014 cohort, three discontinued after the first week and the other two participants discontinued after the second week. Among the four participants who did not complete the program in the Spring 2015 cohort, two participants discontinued after the first week, one participant after the third week, and one participant after the fourth week. Participants who completed the FitKids360 program were 14.6 ± 0.6 years old at baseline, 60% were male, and 66% were Caucasian with another 19% being black. Among the original 25 participants, eight (32.0%) were overweight, 16 (64.0%) were obese, and one (4.0%) was severely obese.

Table 20 shows means and standard deviations from a repeated measures ANOVA on anthropometric changes among the 16 participants who completed the FitKids360 program and at follow-up assessment time points (i.e., 7/8-weeks post and 3-months post). All 16 families completed follow-up measurements at 7/8-weeks and at 3-months. Participants increased in height from baseline to 7/8-week follow-up (p<0.001) and from baseline to 3-month follow-up (p<0.001). Weight, BMI, BMI z-score, and percent body fat values remained relatively unchanged upon completion of the FitKids360 program and 3-months after the program. A
A decrease in BMI z-score was seen in eight participants from baseline to 7/8-weeks follow-up and a decrease in 11 participants from 7/8-weeks follow-up to 3-month follow-up (Figure 2). A significant difference was found between BMI z-score from post-7/8-week and 3-months follow-up (1.88 vs. 1.84). The difference in baseline BMI z-score and 3-month follow-up neared significance (1.92 vs. 1.84; p=0.065). However, Mauchly’s test of sphericity from the repeated measured ANOVA showed that the assumption of sphericity was violated (p<0.05) and despite using the Greenhouse-Geisser correction to adjust the degrees of freedom in the analyses, the significant difference found in BMI z-score from 7/8-weeks follow-up to 3-month follow-up could be indicative of a Type I error. When comparing the participants who completed the FitKids360 program to those who did not finish, there were no significant baseline differences in age, weight, BMI percentile, or percent body fat (p>0.05).

Table 20. Anthropometric changes from baseline to follow-up (7/8-weeks and 3-months) for participants who completed the FitKids360 program (n=16).

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Follow-up</th>
<th>3-Month Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (cm)</td>
<td>163.8 (7.4)</td>
<td>164.5 (7.5)*</td>
<td>165.1 (7.5)**</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>80.1 (12.8)</td>
<td>80.3 (12.9)</td>
<td>80.6 (12.9)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>29.7 (3.3)</td>
<td>29.6 (3.4)</td>
<td>29.5 (3.5)</td>
</tr>
<tr>
<td>BMI z-score</td>
<td>1.92 (0.36)</td>
<td>1.88 (0.37)</td>
<td>1.84 (0.39)#</td>
</tr>
<tr>
<td>Percent body fat (%)</td>
<td>34.3 (5.9)</td>
<td>34.6 (6.0)</td>
<td>34.5 (6.1)</td>
</tr>
</tbody>
</table>

* Significantly different from baseline
# Significantly different from 7/8-week follow-up
Table 21 shows changes in health behaviors among the 16 participants who completed the FitKids360 program at follow-up evaluation (i.e., 7/8-week post and 3-month follow-up). At baseline, only 12.5% of participants were meeting ST recommendations (ST < 2 hours/day). Based on HEI scores, 50% of participants had “poor” dietary quality (<51) and 50% had “fair” dietary quality (51-<80) at baseline. No participants had “good” (>80) diet quality at baseline. FNPA scores increased by 5.2 points (9.7%) in the overall sample from baseline to 7/8-week post, with 12 of the 16 participants showing an increase in FNPA score from baseline to 7/8-week follow-up (Figure 3). The FNPA score at both 7/8-week follow-up (58.3; p<0.05) and 3-month follow-up (59.2; p<0.05) were significant higher than baseline FNPA score (53.1). No significant differences were found in PAQ-A scores, HEI scores, screen time, physical activity
self-efficacy, or dietary self-efficacy from pre-post measurements; however, from baseline to 7/8-weeks follow-up 11 participants increased their PAQ-A scores, 10 participants increased their HEI scores, 9 participants decreased total screen time, 8 participants increased dietary self-efficacy, and 11 participants increased physical activity-self efficacy (Figures 4-8). From 7/8-weeks follow-up to 3-month follow-up, 6 participants increased their PAQ-A scores, 9 participants increased their HEI scores, 8 participants decreased total screen time, 6 participants increased dietary self-efficacy, and 10 participants increased physical activity self-efficacy (Figures 4-8). Dietary self-efficacy was trending toward a significant increase from baseline to 7/8-week follow-up (p=0.08). When comparing the participants who completed the FitKids360 program to those who did not finish, there were no significant baseline differences in PAQ-A, HEI, PA-self efficacy, dietary self-efficacy, or FNPA score (p>0.05); however, there was a significant difference in baseline screen time with those who didn’t complete the program having higher screen time than program participants (5.9 ± 2.3 vs. 4.5 ± 2.7; p<0.05).

Table 21. Health behavior changes at baseline and follow-up (7/8 weeks) for participants who completed the FitKids360 program.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Follow-up</th>
<th>3-Month Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PAQ-A</strong></td>
<td>2.9 (0.5)</td>
<td>3.1 (0.5)</td>
<td>2.9 (0.3)</td>
</tr>
<tr>
<td><strong>HEI</strong></td>
<td>51.1 (7.1)</td>
<td>53.5 (7.4)</td>
<td>54.1 (6.9)</td>
</tr>
<tr>
<td>Screen time (hr/day)</td>
<td>4.5 (2.7)</td>
<td>4.7 (3.2)</td>
<td>4.4 (2.6)</td>
</tr>
<tr>
<td>PA self-efficacy</td>
<td>39.4 (7.0)</td>
<td>41.6 (5.7)</td>
<td>42.3 (7.7)</td>
</tr>
<tr>
<td>Dietary self-efficacy</td>
<td>9.9 (2.6)</td>
<td>10.6 (2.6)</td>
<td>10.3 (2.1)</td>
</tr>
<tr>
<td>FNPA (total score)</td>
<td>53.1 (8.4)</td>
<td>58.3 (7.8)*</td>
<td>59.2 (5.7)*</td>
</tr>
</tbody>
</table>

* Significantly different from baseline
PAQ-A = Physical Activity Questionnaire for Adolescents
HEI = Healthy Eating Index
FNPA = Family Nutrition and Physical Activity Screening Tool
Figure 3. FNPA score changes from baseline to follow-up (7/8-weeks and 3-month) for participants who completed the FitKids360 program (n=16).
Figure 4. PAQ-A score changes from baseline to follow-up (7/8-weeks and 3-month) for participants who completed the FitKids360 program (n=16).
Figure 5. HEI score changes from baseline to follow-up (7/8-weeks and 3-month) for participants who completed the FitKids360 program (n=16).
Figure 6. Total screen time changes from baseline to follow-up (7/8-weeks and 3-month) for participants who completed the FitKids360 program (n=16).
Figure 7. Dietary self-efficacy changes from baseline to follow-up (7/8-weeks and 3-month) for participants who completed the FitKids360 program (n=16).
Figure 8. Physical activity self-efficacy changes from baseline to follow-up (7/8-weeks and 3-month) for participants who completed the FitKids360 program (n=16).
REFERENCES
REFERENCES

CHAPTER 5: DISCUSSION
**Study 1**

The overall purpose of this portion of the study involved examining the use of the Family Nutrition Physical Activity (FNPA) Screening Tool with physical activity, dietary quality, screen time, and weight status in an adolescent population.

**Participants**

Of the 175 students who participated in the study, 18.3% were overweight and another 11.4% were obese. These rates are similar with national prevalence rates of 31.8% of youth being either overweight or obese and 16.9% being obese [1]; however, when examined by gender only 6% of girls were obese, which is not representative to national prevalence rates. Approximately 72% of participants identified being Caucasian, which, according to 2014 US Census Bureau data, is slightly lower than national (77.7%) and state percentages (80.1%). The mean percent body fat values for males and females of 18.2% and 26.1%, respectively, are lower than national values for males and females of 14.5 years of age (24.7% for males; 32.7% for females) [2]. Approximately 23% of the sample was classified as overfat using FITNESSGRAM cutpoints [3]. In conclusion, the current study sample was representative of the US population.

**Physical activity**

Physical activity was assessed using the Physical Activity Questionnaire for Adolescents (PAQ-A). The mean PAQ-A score for the current study sample was 2.3 (0.8), with both males and females being similarly active (2.3 for males; 2.4 for females). Other studies assessing physical activity using the PAQ-A have reported significantly higher PAQ-A values of 3.1 [4, 5], while one study reported similar PAQ-A values around 2.6 [6]. No significant differences were found in PAQ-A scores between males and females. This is in disagreement with several studies that have reported males to be more physically active than females [7, 8]. A possible explanation
for lack of a gender difference may have been due to whether students were enrolled in Physical Education class or not. Grand Blanc High School requires the majority of the ninth grade students to enroll in one semester of Physical Education during their ninth grade year. Since the total participant pool was initially all students currently enrolled in Health or Physical Education class, it can be assumed that approximately half of the study’s participants were enrolled in Physical Education at the time of the study. Research has shown children to be significantly more active overall when enrolled in physical education compared to when they are not [9]. Another factor that could have affected participants’ PAQ-A scores was whether they were on a school or community sports team at the time of the study.

The current study’s data on adolescents’ physical activity support the continued need for increasing levels of physical activity among children and adolescents. With only 29% of high school students meeting the Physical Activity Guidelines for Americans’ recommendation of 60 minutes of physical activity each day (CDC, 2011), it is imperative that researchers and practitioners promote physical activity for adolescents. The promotion of youth physical activity needs to be achieved through multiple media: schools, communities, families, government bodies, and national health organizations [10].

**Dietary quality**

Dietary quality was assessed by examining dietary behavior using the Block Food Frequency Questionnaire (FFQ). Healthy Eating Index-2010 (HEI-2010) scores reflecting the 2010 Dietary Guidelines for Americans were then determined from the questionnaire data from the FFQ. The mean HEI-2010 score for the current sample was 52.8 (10.4), with similar scores for males (53.4) and females (52.1). None of the current participants met the HEI criterion for
having a “Good” HEI-2010 score. Approximately 58% of the study sample had a “Needs Improvement” HEI-2010 score and 42% had a “Poor” HEI-2010 score.

Few published studies have reported pediatric data for the most recent version of the HEI reflecting the 2010 Dietary Guidelines for Americans. In comparison to the USDA’s national assessment of HEI-2010 data of children ages 2-17 from the 2007-2008 NHANES dataset, the current study’s mean HEI score was similar than that the national sample (52.8 vs. 49.8). Most other studies providing HEI data for children and adolescents have utilized the HEI-2005. Differences between the HEI-2005 and HEI-2010 reflect differences between the 2005 and 2010 US Dietary Guidelines (primarily food groups use in determining the score). A study by Goodwin and colleagues [11] reported a mean HEI score of 61.9 for US adolescents aged from 11 to 18 years old. Another study reporting adolescent dietary quality conducted by Tek [12] reported similar HEI scores of 51.2 for boys and 51.8 for girls, and very similar proportions of adolescents in each HEI classification of dietary quality (42.8% “Poor; 57.2% “Needs Improvement”). One other study [13] reported a higher percentage (74.4%) of adolescents classified as “Needs Improvement”. Overall, as shown with the HEI-2005 and HEI-2010, research findings have highlighted that adolescents have poor diet quality.

These findings, along with other published results utilizing the HEI, support the view that the overall dietary quality of US adolescents needs improvement, with most adolescents having a “Poor” or “Needs Improvement” classification of diet quality. Given that there are associations between an adolescent’s overall health status and health outcomes later in life in adulthood [14], there is a need to improve health behavior, specifically the dietary behaviors, of adolescents to decrease risk of health problems later in life.
**Screen time**

Screen time was determined by self-reported average time spent watching television, playing video games, and using a computer (for non-academic purposes) on both a typical weekday and a typical weekend day. The mean total screen time for the study participants was 4.1 (2.6) hours/day, with similar values between males (4.0 hours/day) and females (4.2 hours/day). Approximately 22% of participants met the screen time recommendation of less than two hours per day. Other studies using this method of assessing screen time have reported similar screen time values and percentage of their sample meeting screen time recommendations [15-17]. Data from 2012 NHANES on screen time behavior in 12-15 year olds, 73% of youth participants sampled did not meet the recommended limit of 2 hours or less of screen time [18]. Results of the current study further support the need for a call of action to reduce excessive screen time behaviors in youth. Excessive screen time has been shown to be associated with high blood pressure, increased blood cholesterol, and increased risk for overweight and obesity among youth [19-21]. With adolescent screen time behaviors tracking into adulthood [22], it is important that efforts be made to reduce excessive screen time in children and adolescents.

**Main findings: FNPA**

This study is the first to report use of the FNPA in an adolescent only population and one of the first to report FNPA scores using the 20-item survey version. Scores on the FNPA range from 20 to 80, with higher scores representing a more favorable home environment (i.e., less obesogenic). The mean FNPA score in this sample was 62.9 (5.1) with similar values between males (62.7) and females (63.1). Reported FNPA scores ranged from 49 to 75. The only other published study reporting FNPA scores from the 20-item survey version examined the first 33 classes of the FitKids360 program, for which a mean baseline FNPA of 57.3 and a mean follow-
up FNPA of 62.7 were reported after seven weeks of intervention [23]. A large proportion of participants were overweight and obese in the low FNPA score group compared to the high FNPA score group. In the current study, a greater proportion of participants were also classified as overfat in the lower FNPA score group compared to the higher FNPA score group; however, this was not statistically significant. In a study by Yee [24] that utilized a previous version of the FNPA, a significantly greater proportion of overweight and obese children were found in the lower FNPA score group compared to the higher FNPA score group. When comparing children’s FNPA score by median split (<63 or ≥63), this study’s logistic regression results showed no significant differences in being overweight/obese or overfat between the lower FNPA score groups and higher FNPA score group. This is not in agreement with that of the initial FNPA study [25], which showed that children who had an FNPA score in the lowest tertile had increased odds of being overweight (OR=1.7; 95% CI=1.07-2.80) compared to children who had a FNPA score in the highest tertile. A possible explanation for not seeing an association between the FNPA score and weight status in this study could be due to genetic effects, gene by environmental effects, and other social factors outside of the family and home environment [89]. Another possible explanation for not seeing significant differences in FNPA scores by weight status could be the limited range of scores seen in our study (49-75). Initially, the logistic regression analyses were conducted with FNPA scores divided into tertiles; however, when doing this the scores representing the middle tertile consisted of a very narrow range of scores on the FNPA. It is possible that a greater range in scores would provide a better basis to answer this research question.

This is also the first study to examine associations among the FNPA with actual measures of health behaviors that comprise some of the 10 constructs that the FNPA assesses in the family
and home environment. Correlation results showed no significant associations among the FNPA total score, PAQ-A score, HEI-2010 score, or total screen time in our sample. The majority of correlations were under ± 0.10, with only the correlation between PAQ-A and total screen time deviating outside of that range (-0.19). Further analysis was conducted using multiple linear regression using sex, race (Caucasian or not), and BMI percentile as covariates. No significant relationships were found between the total FNPA score with PAQ-A score, HEI-2010 score, or total screen time. However, results from analyses between scores from FNPA constructs (physical activity, diet, and screen time) and PAQ-A, HEI scores, and screen time showed a significant association between the FNPA-Diet construct score and HEI scores (p<0.05). These results show that the FNPA Screening Tool, a parental assessment of the family and home environment’s obesogenic risk, does not correlate to the physical activity, dietary quality, or screen time behavior of adolescents in the current study. A possible explanation for these results could be due to the parents completing the FNPA Screening Tool alone (as instructed) and not together with their adolescent child. This proxy assessment of their child’s physical activity, dietary, and screen time behaviors may not have been the best approach to reporting valid behavioral data from participants. The FNPA Screening Tool was initially developed to be completed by the parents of children, who are more likely to know the behaviors and environment to which their child is exposed to compared to an adolescent who has more independence and complexity in his/her life. Thus, the validity of FNPA data with adolescents may not be as valid when completed by parents alone. This suggests that adolescents should complete the FNPA with parents in order to ensure higher validity. Another reason for these results could be that there may be a greater influence on health behaviors of adolescents from outside of the family and home environment (e.g., school, community, time spent with friends,
after-school activities). An additional explanation could be due to the limited range of scores seen in our study (49-75). It is possible that more scores representing greater obesogenic risk from the family and home environment could reveal significant associations among the FNPA and health behaviors. Furthermore, another possible reason no significant association was found was because the FNPA was originally developed with and for families with younger children. It is possible that the FNPA Screening Tool is not a feasible tool to assess overweight and obesity risk in adolescents. Although the total FNPA score did not correlate to any of the measured health behaviors, the score for the FNPA-Diet construct was associated with HEI scores. These results suggest that parents of adolescents are better able to provide a proxy assessment of their child’s dietary behavior compared to their physical activity or screen time behaviors.

**Limitations**

A limitation of this study the cross sectional design. Future studies should further examine the FNPA to identify potential change in physical activity, diet, and screen time behaviors in children and adolescents using a pre-post experimental design or longitudinal design. Another limitation is that no published study has yet examined the reliability and predictive utility of the FNPA despite the screening tool being validated. Further research is needed to address this issue. With the distribution of scores being on the higher end in this study (49-75), evaluation of the higher risk environments (i.e., scores ranging from 20-48) was not possible. An additional limitation was the use of self-report for the assessment of physical activity. We initially attempted to use pedometers as an objective measurement of physical activity concurrently with self-reported physical activity; however, the amount of pedometer data collected was low and the quality of pedometer data was very poor; thus, the use of pedometer data in this study was not able to be used in analyses. The self-reported measure of screen time
was also a limitation; however, this assessment method still remains the best available to
determine screen time behavior. An alternative method to consider in the future would be to
assess sedentary behavior using an objective measurement tool like an accelerometer. Only one
other study has published results using the 20-item FNPA that we used [23]; thus, direct
comparisons of FNPA scores from this study can only be compared directly to that study and
indirectly to the previous FNPA studies [24-26]. Lastly, the use of solely ninth graders to
represent adolescents in this study may limit the application of our results to adolescents of other
ages. Adolescents are those going experiencing a period in human growth and development that
occurs after childhood and before adulthood, from ages 10 to 19 [90]. Although this can
comprise of persons from as young as 10 years old to 21 years old, we generalized our
population of ninth graders as representing adolescents in this study. In the future a sample of
adolescents spanning across many ages and developmental stages of adolescence should be
utilized.

**Future directions**

Future research utilizing the FNPA should examine the reliability of the screening tool
since no reliability study has been conducted. Because there are no criterion-referenced
cutpoints that exist to truly determine if a particular FNPA score is “good” or “bad”, there is a
need to determine FNPA cutpoints for classifying scores. It is the goal of researchers, clinicians,
and health practitioners using the FNPA to be able to interpret scores in a similar manner to BMI
cutoffs representing different levels of risk/weight status. One potential method for doing this
would be the use of receiver operating characteristic (ROC) curves with a large dataset including
FNPA and weight status or other clinical outcomes. This method was similarly done to predict
percent body fat cutpoints for FITNESSGRAM [3]. The replication of this study with
populations that are younger, more ethnically/racially diverse, and of lower socioeconomic status is also warranted.

**Summary**

Overall, results from the first portion of this dissertation showed that the FNPA Screening Tool was not associated with physical activity, dietary quality, or screen time in an adolescent population. Also, the FNPA score did not differ by weight status. Further studies are needed to better understand the association of the FNPA with health behaviors in adolescents and the utility of the FNPA in adolescent populations.

**Study 2**

The overall purpose of Study 2 was to evaluate the FitKids360 intervention program in adolescents. The first objective examined the feasibility and acceptability of the FitKids360 intervention from the perspective of the intervention staff as well as from the family participants. The second objective was to evaluate the reach, dose, and fidelity of the FitKids360 program. The third objective was to explore for any changes in health outcomes from pre- to post-intervention, as well as a 3-month follow-up.

**FitKids360 feasibility and acceptability**

Overall, program instructors and volunteers had a positive experience being part of the program. This finding was in agreement with other pediatric weight management interventions reporting high satisfaction and positive feedback to intervention programming and delivery [27, 28]. A key aspect of the program identified by a fair number of instructors and volunteers as to why they enjoyed their experience was that the program was family-oriented and involved more than just the target youth participants (i.e., parents/guardians and siblings as well). Many family participants in the FitKids360 program shared this same sentiment as to explaining their
enjoyment of the program. The high satisfaction rates among families are in agreement with findings from another community-based child obesity treatment program that found high satisfaction among both parents [29, 30] and pre-adolescent children [31]. These findings are promising since there is growing support for involving families in efforts to reduce obesity [32-34].

Another aspect of the program that was highlighted by instructors/volunteers and family participants was the design of the FitKids360 program as a multi-component intervention to treat obesity. This positive feedback from program instructors/volunteers and family participants strengthens the suggestion of using multi-component interventions to treat obesity in youth. There is strong evidence that multi-component interventions that include educational and behavioral activities such as nutrition education, aerobic/strength training and exercise sessions, and training in behavioral techniques have been shown to improve physical activity [35-37] and weight loss [36, 38] in youth. Coupled with the fact that the literature shows multi-component interventions to be more effective than single component interventions [35, 38, 39], FitKids360 serves as a viable option in terms of treating pediatric obesity. Given that FitKids360 was a positive experience for instructors/volunteers and family participants strengthens support for FitKids360 to continue it as a Stage 2 Weight Management Program in obesity treatment in youth.

A positive comment among family participants was the variety of physical activities performed throughout the program during the group exercise sessions. This highlights the importance of available resources and access to space. The success of this FitKids360 program was largely due to using the Genesys Athletic Club (GAC) as the venue to host the program and having several GAC fitness and wellness center employees serve as volunteers. The majority of
previous FitKids360 classes have been delivered in clinical offices, churches with gymnasium space, and community centers; however, most of these venues are not as large as the GAC nor had a multitude of exercise areas within the it (e.g., indoor track, group exercise studio rooms, indoor swimming pool, basketball courts, conference rooms, tennis courts). Although having such a large and resourceful facility was integral to delivery of the FitKids360 program, it is not a necessity for success to be found from other FitKids360 programs that took place in a different venue type, as highlighted by the pre-post results of the first 33 FitKids360 classes [23]. The availability of a large health and wellness center to deliver FitKids360 may be ideal for delivery of the program due to increased opportunity to utilize larger space for the group exercise sessions and increases opportunity to do a wide variety of physical activities. This is similar to the use of school settings for youth physical activity interventions, which have been shown to benefit children from risks group who have limited or no access to play or exercise areas [40] and through physical education resources provide the development of motor skills and physical fitness [41, 42]. Thus, any large facility that can provide access to play and exercise for youth who would not normally have that access can be very beneficial for implementing a pediatric weight management intervention.

An interesting finding was that among the 16 families who completed the FitKids360 program, six families (37.5%) reported that they felt that the program was not long enough in duration. The FitKids360 intervention model is set up to be seven weeks in duration with a total of 14 intervention hours, with the ability to be slightly modified per intervention site (e.g., our Spring 2015 cohort had an additional week and an additional two intervention hours). The duration of the intervention was chosen based on the fact that FitKids360 was developed to be delivered without grant funding or hired staff as well as to improve compliance with the thought
that a longer program would result in increased drop out. Thus, it was determined that with the
time and resources available for all those involved in the program, seven weeks would be an
adequate amount of time to intervene with families. A meta-analysis evaluating obesity
prevention programs found that interventions which were relatively shorter in duration (<16
weeks) produced significantly larger effects than those that were longer in duration (≥16
weeks)[43]. However, this does not necessarily directly translate over to FitKids360 because the
program is more treatment-based than prevention-based.

Nine of the 16 families reported that they would not or were unsure if they would attend
the class if they had to pay a fee or co-pay. This finding indicates that the FitKids360 program
benefits from being free of cost to participants. A systematic review on the monetary costs of
participating in family-based child weight management interventions found that few families
incur monetary costs from participating in the intervention program [44]. With obese individuals
having substantially higher medical costs compared to normal weight peers [45] it is ideal that
weight management programs be of little to no cost for participants to lessen their economic
burden.

FitKids360 does not charge a monetary fee for family participants because the program is
designed to be as relatively low cost as possible for a FitKids360 site. The cost of the FitKid360
program has been calculated at a cost of about $196 per participating child for a class of 20
children per seven-week session [23]. Given that there is a wide array of interest in pediatric
obesity treatment across some communities, costs for a FitKids360 program may be lower at
some sites. This was true for the current program site in which we had community
 collaborations with Genesys Regional Medical Center, the Crim Fitness Foundation, and the
Genesys Athletic Club. This allowed us to have free donation of facility usage, donation of
items (snacks, incentive prizes, etc.), and hours provided from instructors and volunteers who were part of our program for zero to low monetary cost. Thus, it is important that to be cost effective on the delivery end of the FitKids360 program, community collaboration with the right partners and continued funding from external sources is advised to offset program delivery costs. Although many other childhood obesity programs have provided cost effectiveness data for their intervention [46-49], only one study has published data for the direct cost of a participant being part of a program ($259/participating child) [50]. Most other studies on childhood obesity programs report cost effectiveness as change in BMI z-score divided by total costs of treatment at follow-up (i.e., a measure of improvement per dollar spent). With future FitKids360 sites, perhaps a traditional assessment of cost-effectiveness can be implemented.

**FitKids360 process evaluation**

A total of 16 of 25 (36% attrition rate) families who started the FitKids360 program completed it. This matches closely with the compliance reported (38% attrition rate) for the first 33 FitKids360 program classes [23]. In a review of attrition in 10 pediatric weight management programs reporting attrition data, attrition rates ranged from 27% to 73% with 6 of the 10 studies having attrition rates above 50% [51]. In comparison to these previously reported studies, delivery of the FitKids360 program did fairly well in retaining program participants.

There is a paucity of studies that have reported process evaluation data from pediatric weight management intervention programs. To date, only two studies specifically examined the process evaluation of weight management programs in children [31] or adolescents [27]. The attendance rates for both the Fall 2014 (65.7%) and Spring 2015 (61.3%) FitKids360 cohorts were moderate at best. Despite including weekly phone calls and a reminder e-mail to families to attend class, our attendance rates were not as high as those seen in the Loozit® intervention
In comparison to process evaluation data published from youth school-based physical activity interventions, the attendance rate reported here was similar [52, 53]. Because the intervention was on an established day and time, attendance may have been improved if multiple days and times offering another class were available; however, with limited time and resources from FitKids360 instructors and volunteers this was not feasible.

In terms of dose delivered, the completeness across all three disciplines (i.e., physical activity/exercise, nutrition, and social/behavioral) was at 100% when assessed by lessons delivered. Welsby and colleagues [31] also documented the completeness of lesson/session objectives/plans and reported adherence rates over 90%, while adherence rates were also high (87%) in another study by Nguyen [27]. Typically, dose delivered in behavioral/educational interventions has been assessed by recording the number of planned lessons were delivered. However, a novel approach was used here by documenting how many lesson objectives were completed each week among the three FitKids360 disciplines. When evaluating dose delivered by this method, we found that the completeness of total lesson objectives ranged from 87.5%-100% across the three disciplines. Because this was a novel approach in examining the dose delivered of the intervention program, comparisons to other published studies cannot be determined. The percentage of completed lesson objectives improved from the Fall 2014 cohort (90%) to the Spring 2015 cohort (93%). This was likely due to improvements made in the delivery of the intervention curriculum and refining of the intervention itself.

Fidelity results of the FitKids360 program showed the intervention facilitators delivered the intervention to a degree of high fidelity. From the Fall 2014 cohort to the Spring 2015 cohort, there was an increase in fidelity (3.4 to 3.6). The increase is likely explained by improvements made in the delivery of the intervention curriculum and refining of the
intervention itself. Furthermore, because the intervention instructors and several of the volunteers were involved with FitKids360 for their first time in Fall 2014 and returned for the Spring 2015 cohort, their past experience likely aided them in delivering the intervention to a higher quality/fidelity in the Spring. In both cohorts, the lowest scored component for fidelity was the Physical/Exercise portion (non-group exercise) of the FitKids360 program. This result could possibly be due to the instructor for the Physical Activity/Exercise component not being as adequately as prepared as other instructors or his/her preparedness or interest in the lessons being lower than that of the other instructors. It is important to note that the number of lesson objectives comprising the Physical Activity/Exercise component was less than those of the other two components, especially in the Spring 2015 cohort when the additional week increased the number of Nutrition lesson objectives substantially. This could be explained by the fact that more time of each weekly two-hour session was dedicated towards Nutrition and Social/Behavioral than Physical Activity/Exercise. It is possible that the FitKids360 curriculum needs to be modified so there is equal time spent across all three components. Overall, the high fidelity perception from the intervention evaluator was similar to the fidelity of the Loozit® intervention [27]. In comparison to fidelity data that were evaluated from youth based interventions involving physical activity, our high fidelity finding was consistent with other studies [52]. In conclusion, this study’s delivery of the FitKids360 program was carried out with high fidelity.

**Difference in the current FitKids360 program from standard delivery**

As previously mentioned, the current FitKids360 site was vastly different from other FitKids360 classes in the following ways: 1) The participants were all 9th graders (~14 years of age) and recruited from a single high school; 2) Percent body fat and classification of overfatness
were used in addition to BMI as inclusion criteria to determine overweight/obesity; and 3) Physician referral was not utilized in the recruitment of families, but rather direct invitation via our FitKids360 site staff. Changes were made to the delivery of the program to reflect the older average age of participants as opposed to other FitKids360 sites that had participants ranging from 5-16 years of age, with most being on the younger side (i.e., mean age of 10.5 years). Given the adolescent participants, our intervention facilitators modified pieces of the curriculum that they found to be were “childish” in design/purpose. Examples of these modifications included adjusting both the language and methods of delivering a particular health message and group activities that were more designed for younger children. Also, specific topics in the curriculum had to be delivered/discussed relative to situations found in the lives of the ninth grade population that one would not find in a younger population of children (e.g., soon to be driving a vehicle independently, being part of one or more varsity sports teams, working a job, not having recess or being enrolled in a formal physical education class).

The recruitment of families may have affected this study’s FitKids360 site. It is possible that we did not recruit more families or maintain a higher attendance rate due to lack of a physician referral. It is likely that a family having a direct referral to participate in FitKids360 from their primary care physician or a trusted health care provider would be more willing to join compared to a family receiving a direct call from the FitKids360 program itself that utilized in-school screenings to determine overweight/obesity and not in a clinical setting. This was a limitation to this study’s FitKids360 program. Thus, the importance of having physician referral may be key to maintaining a high attendance rate in the FitKids360 program.

To date, this is the first FitKids360 class to utilize all adolescents as participants and complete a full 7/8-week class. This site will be used as a model by the entire FitKids360
program for addressing how to specifically deliver FitKids360 to an entirely adolescent population. It is possible that our program will serve as the basis for the development of a “FitTeens” program for overweight and obese adolescents.

**Lessons learned and future directions for FitKids360**

Although the FitKids360 program has been in existence for four years with over 40 classes completed, no formal process evaluation has been carried out to evaluate it. The process evaluation in the current study assisted with interpreting the delivery and reception of the program among families with adolescent participants. These evaluation data will be important in the continued development and implementation of the FitKids360 program. The following lessons were learned from this process evaluation of the FitKids360 intervention program and first time delivery of the FitKids360 program to adolescent participants:

- Methods to increase participant attendance and engagement in the program are needed. Although many of the reasons for weekly absences were out of the control of FitKids360 facilitators, techniques to keep families engaged each week throughout the entire duration of the program are important. This may involve using technology that could incorporate interaction between FitKids360 and families without direct face-to-face communication.

- Since the FitKids360 participants in this study were adolescents, it was likely that they had more obligations to academic responsibilities compared to younger children. Also, adolescents may have had more diversified and complex personal and social lives that could lessen their interest in committing time to FitKids360. This needs to be taken into consideration when including adolescent participants in the FitKids360 program. Additional screening with adolescent participants and their families prior to beginning FitKids360 may be required to re-affirm their commitment and capability of attending
most classes. This additional screening could be as simple as further inquiry one-on-one with families about what to expect with the FitKids360 program and any possible detriments from participating in a program (e.g., being seen in a public community venue participating in the FitKids360 program, possible teasing or bullying from peers who know you are in the FitKids360 program) or using a detailed assessment of stages of behavior change to assess participant readiness. The more families know about the FitKids360 program, what to expect in terms of benefits, and any potential risks, the better prepared families will be to address if they are “ready and willing to change” by participating in FitKids360.

• Another important aspect to note is that we made some adjustments in the curriculum to be more targeted toward adolescents. Some activities in the curriculum were deemed to be too “childish” for our adolescents and were thus modified or replaced with more age-appropriate activities. Although the program is called “FitKids360” and aims to include overweight/obese youth from 5-16 years old, the development of a “FitTeens360” class with a curriculum modified for adolescents should be created using information from this study.

• Keeping class sizes to no more than 15-20 families is integral in conducting an efficient FitKids360 class. When one considers that each participating family consists of a child, at least one parent/guardian, and the potential of one or more siblings, a FitKids360 class of 10 participating families could possibly have 30 people in attendance. Most FitKids360 sites only have enough staff, volunteers, mentors, and resources to handle a certain class size, so keeping a class to a feasible, controllable number is ideal in the implementation of a FitKids360 class.
• It is important to ensure that the group exercise session activities are fun, practical, and interactive for all persons involved – instructors, volunteers, participants and siblings, and parents/guardians. These group exercise sessions are very important, as they help with building group support and dynamics and introducing different types of physical activities to families. Although we were fortunate enough to have the GAC as a venue to deliver our FitKids360 class, most FitKids360 locations do not have the luxury of having such a large venue with a vast amount of space and exercise equipment to utilize. Future classes need to be creative with group exercise activities that are still fun and practical, but feasible with the space and resources available for the number of participants in the class.

• Mentors can serve a very important role in the program. The peer mentoring provided from the medical student volunteers was welcomed by most families. Studies have shown peer mentoring to be beneficial to both mentors and mentees in health education programs [54]. Due to some of our mentors being unable to attend for a couple of weeks throughout the program, in the future it will be important to conduct more detailed interviews with potential medical student volunteers to see if they can firmly commit to the FitKids360 program and uphold their responsibilities along with handling their rigorous academic and clinical schedules.

• The weekly communication with each participating family needs extra attention due to the role it plays in developing a good rapport with the families. For the Fall 2014 cohort we had a single FitKids360 facilitator make weekly phone calls to each family, which was well received; however, in the Spring 2015 cohort the decision was made for mentors to make weekly phone calls to their mentees and their families. This was
thought to help strengthen the rapport between mentors and their mentees/families; however, some mentors missed their weekly calls or they struggled in having a positive, empowering communication with their mentee/family. This was the opposite of our phone call facilitator from the Fall 2014 cohort, who was very experienced in conducting follow-up calls with participants in weight loss programs. It is suggested that future FitKids360 classes carefully select an individual to make weekly phone calls who can be positive, empowering, and comfortable with contacting participating families.

• Including physicians in the process of recruitment may help increase the number of eligible/interested participants. Because the standard FitKids360 site utilizes physician referral, sites like in this study should consider utilizing physicians to some degree in the recruitment of FitKids360 participants.

• It is of vital importance that FitKids360 achieve sustainable changes in health behaviors among participants beyond completion of the program. FitKids360 has shown to create positive behavior change in program participants; however, it is ideal that this behavior change is lasting and sustained over time. There is no established protocol for FitKids360 sites to continue promoting healthy behaviors beyond the completion of the program. In order for FitKids360 to have a long term impact on participant and elicit sustainable positive behavior changes, the program needs to develop utilizing some processes or resources to provide healthful tools for participants without direct intervention.
Length of program/intervention hours

Based on the classification categories by Whitlock [55] for behavioral based pediatric weight management interventions, the FitKids360 program is categorized as low treatment intensity (i.e., 10-25 total intervention hours) with weight-based intervention outcomes being short-term (6-12 months since beginning treatment program). In a meta-analysis of lifestyle interventions for pediatric obesity [56], intervention lengths varied from one month to two years with post-intervention follow-ups ranging from 2 months to 4 years from the end of the intervention. All of the intervention programs included in the review by Whitlock [55] and meta-analysis by Ho [56] were randomized controlled trials. We had originally intended to establish a comparison group of non-participating, overweight ninth graders from GBHS; however, the lack of interest from non-participants to allow additional measures to be collected from them hindered the use of a comparison group. It is possible that if we had some monetary incentive to offer to the non-participants that we could have established a comparison group to use in comparison to our FitKids360 participants and strengthen our study.

BMI, BMI z-score, percent body fat

No significant changes were found in BMI, BMI z-score, or BMI percentile from baseline to 7/8-week follow-up during the FitKids360 program. At 3-month follow-up, a significant improvement in BMI z-score was found from 7/8-week follow-up (1.88 vs 1.84; p<0.05). However, this finding was surprising as the mean difference between baseline BMI z-score and 3-month follow-up is greater than that between 7/8-week follow-up and 3-month follow-up (0.07 vs 0.04). Results from the repeated measures ANOVA showed a violation of sphericity (i.e., variance of the differences between all combinations of related groups must be equal). Despite adjusting for this using the Greenhouse-Geisser correction, results still revealed significant
differences. Thus, this result should be interpreted with caution as Type I error might have occurred. With a larger sample size, the expected significant differences might have been seen.

Pre-post comparisons from the first 33 FitKids360 classes showed a significant decrease in both BMI (28.1 to 28.0) and BMI z-score (2.19 to 2.16); however, no longer follow-up data available from these first 33 classes exist. In comparison with another program of similar follow-up length [57], the effects of an eight-week long physical training program in obese children and found significant decreases in BMI and BMI z-score after eight-weeks. However, their program had a greater number of intervention hours (6 hours/week) that predominantly involved physical training. When comparing our study with other pediatric weight intervention programs of similar net intervention hours (i.e., 14-16 net intervention hours) results were similar. A 16-week long Internet based weight intervention program (16 net intervention hours) aimed at adolescents found no significant pre-post differences in BMI z-score or BMI [58]. Further, a study by Golley [29] showed no significant difference in BMI z-score after a 12-month family-focused weight management program in children. The small effect from pre-to-post 7/8-week follow-up (1.92 to 1.88) found in our study was in agreement with a Cochrane meta-analysis [59] regarding the effectiveness of lifestyle interventions in children and adolescent obesity treatment programs, where the mean change in BMI z-score after 12 months of lifestyle treatment was 0.04 and 0.14 for children and adolescents, respectively. Our finding of a significant decrease in BMI z-score after 3-month follow-up from the end of the FitKids360 intervention shows that FitKids360 can be an effective program to support short term healthy weight management efforts in adolescents; however, longer follow-up data are required to know the sustained effectiveness of FitKids360 relative to weight status.
Physical activity

No significant improvement in physical activity was found from pre-to 7/8-week follow-up in our FitKids360 class. This is in contrast to results from the first 33 FitKids360 classes, where researchers observed a significant improvement in moderate-to-vigorous physical activity (MVPA) from 86.4 (72.3) mins/day to 100.3 (74.5) mins/day in pre-post results (Tucker et al., 2014). However, the physical activity question used by the standard FitKids360 lifestyle assessment survey (“How many minutes of moderate-to-vigorous physical activity do you get a day?”) may not elicit valid results. The high level of MVPA among the overweight/obese FitKids360 from the first 33 FitKids360 classes should be cautiously accepted. Three other studies have examined changes in physical activity following obesity treatment delivered exclusively to adolescents [60-62]. One of the three studies found that after an eight-week exercise therapy intervention, overweight/obese adolescent participants increased their physical activity levels (as measured by the PAQ-A) from 60.9 to 70.2 at eight-week follow-up [62]; however, it should be noted that this study determined PAQ-A scores differently from the standardized protocol. Studies by Saelens [60] and Tsiros [61] found no significant improvements in self-reported physical activity at any follow-up time points. In a systematic review by Cliff and colleagues [63] on the impact of youth obesity treatment interventions on physical activity, they identified 20 studies that examined pre-treatment and post-treatment free-living physical activity. Of the 20 studies examined, 15 reported an increase in at least one physical activity outcome at post-test or follow-up; however, most of these studies were rated as low quality and most of the studies used self-reported or parent reported child physical activity. It is possible that with longer follow-up one could potentially see significant changes in physical activity due to FitKids360. This was the first FitKids360 site to directly assess physical activity.
at a follow-up beyond the immediate post-measurement. Future FitKids360 classes should consider assessing physical activity at a later follow-up either with an objective or subjective measurement of physical activity that is both feasible and valid. These data would help determine if FitKids360 has any long-term effects on the physical activity of participants.

**Dietary quality**

The HEI score of the FitKids360 participants increased from 51.1 (7.1) to 53.3 (7.4) from pre-to-7/8-week follow-up and further to 54.1 (6.9) at 3-month follow-up; however, these increases were not statistically significant. Although results were not statistically significant, this finding is of clinical significance. An improvement in diet quality over such a short period of time shows promise that FitKids360 can improve diet quality in adolescents. It is possible that with a larger sample size a statistically significant improvement could have been found.

Although the standardized lifestyle assessment survey for FitKids360 does not utilize a detailed food frequency questionnaire like our study, it does inquire about consumption of 100% fruit juices, fruit, vegetables, whole grains, sugar-sweetened beverage, sweets/desserts, and dairy (reported as times consumed per day over the last week). Results from the first 33 FitKids360 classes found significant increases in whole grain and fruit & vegetable consumption and a significant decrease in sweets/desserts consumption; however, a significant increase in sugar soft drinks consumption and a significant decrease in dairy were also found [23]. In the literature, there are only a few adolescent, obesity interventions that have reported on changes in dietary behavior/intake. Several studies have shown reductions in total calories consumed [64, 65], sugar consumption [66], and total fat intake [65, 67]. Results from a systematic review [68] focusing on overweight children identified five studies that examined seven family-focused interventions to increase daily fruit and vegetable consumption, a strong indicator of diet quality,
with three studies (reporting on four interventions) producing an increase in fruit and vegetable consumption from pre-to-post 12-month follow-up [69-71]. However, only in one of the three studies was the increase statistically significant [71]. The results from the other two studies (reporting on three interventions) showed no change in fruit or vegetable consumption [72, 73]. The results from our study as well as existing literature highlight the difficulty in improving dietary quality in both children and adolescents. Adolescents may have a more difficult time adjusting their diet in response to an intervention in comparison to children. Like with physical activity, we are the first FitKids360 class to directly assess diet/dietary quality at a follow-up beyond the immediate post-measurement. Future FitKids360 classes should consider assessing diet at a later follow-up either with a measurement of diet that is both feasible and valid. This data would help determine if FitKids360 has any long-term effects on the diet of participants.

**Screen time**

No significant changes were found in total screen time from pre-post 7/8-week follow-up or at 3-month follow-up. Our finding of no improvement in screen time from pre-post 7/8-week follow-up is in disagreement with results from the majority of other FitKids360 classes. Tucker and colleagues reported a decrease in total screen time from 4.7 hours/day to 4.0 hours/day among the first 418 FitKids360 participants [23]. It is possible that with the average age of these participants being 10.5 years old and our subjects being 14-15 years in age, that our older subjects were not affected as strongly by the FitKids360 intervention on screen time behavior.

Our results are consistent with those found in the literature. A meta-analysis on interventions aimed at reducing sedentary time (TV viewing, video games and computer use) in children pooled data from nine studies that showed a mean pre-post change in screen time of -0.90 hours/week (p=0.49; approximately -0.12 hours/day when converted to our unit of screen
time [74]. The lack of effect seen in our study as well as in the literature may be due to the difficulty in the measurement of screen time. With our subjects, we consistently had to correct them on their responses of reported television viewing and video game and computer use on weekdays and weekends. Often we found subjects had reported implausible responses (e.g., ≥ 24 hours of total amount of time spent watching television and using video games and computer). It is possible that instead of having our adolescent participants self-report screen time alone, that parents should have assisted with the self-reporting or provided a parent-reported measurement of their child’s screen time. Research has shown that parents reporting screen time of their children is fairly accurate (r=0.70) when compared to videotaped observation [75]. To date, there is no published outcome measurement of screen time that has been validated and thus the measurement of screen time will always be difficult, especially in intervention studies, until such a valid measurement exist. Our results perhaps show that the FitKids360 program needs to develop a different approach in intervening on screen time behavior specifically for adolescents.

**Physical activity self-efficacy**

No significant changes were seen in physical activity self-efficacy from baseline to pre-post 7/8-week follow-up or to 3-month follow-up; however, there was an observed increase in physical activity self-efficacy from baseline to 7/8-week follow-up (39.4 to 41.6) and further at 3-month follow-up (42.3). To date, there are very few studies exist that have specifically examined physical activity self-efficacy as an outcome measure in a weight management program in obese youth. A study by Walpole [76] found that their intervention with overweight and obese adolescents, which included a treatment group utilizing motivational interviewing and a control group utilizing social skills training, elicited improvements in health-related self-efficacy in both the treatment and control group. Another study that utilized a web-based family
intervention for overweight children showed improvements in self-efficacy after four weeks of utilizing the web-based tool [77]. In adults, change in physical activity self-efficacy has been examined to a much greater extent. A meta-analysis identifying behavior change interventions to increase self-efficacy and physical activity in obese adults reported a small effect of 61 interventions on self-efficacy (d=0.23, 95% CI: 0.16-0.29, p<0.001)[78]. Although there is limited research on changes in self-efficacy in pediatric obesity treatment programs, there is much more research that exists with physical activity interventions in youth. A systematic review by Cataldo [79] identified 10 studies examining the impact of a physical activity intervention on self-efficacy among youth. Six of these 10 studies identified an improvement in post-self-efficacy compared to baseline. Although results from this current study did not show significant improvements in physical activity self-efficacy, existing literature suggests that lifestyle health interventions, whether just focused on physical activity or multi-disciplinary in nature like FitKids360, may improve health-related self-efficacy (specifically physical activity self-efficacy with our study). The FitKids360 program is not designed to specifically increase physical activity self-efficacy. This may explain why significant improvements in physical activity self-efficacy were not seen. The instrument used in this study also may not have been the most appropriate to use with this adolescent population; however, several of the factors comprising the assessment tool utilized in this study are covered in the FitKids360 curriculum (e.g., attitudes, perceived behavioral control). Research identifying physical activity self-efficacy as an important correlate of physical activity during childhood and adolescence [80, 81], pediatric obesity interventions in both children and adolescents should target self-efficacy as a behavioral change measure. These potential improvements in health-related self-efficacy (including physical activity self-efficacy) could be key determinants in increasing physical
activity behavior to help with long term treatment of being overweight/obese. However, the challenge remains to identify a standardized approach in classifying and measuring physical activity self-efficacy. Future research is needed to provide additional information on how pediatric obesity treatment programs change physical activity self-efficacy.

**Dietary self-efficacy**

Like physical activity self-efficacy, no significant change was seen in dietary self-efficacy (specifically fruit and vegetable self-efficacy) from baseline (9.9) to pre-post 7/8-week follow-up (10.6); however, this increase trended towards significance (p=0.08). At 3-month follow-up dietary self efficacy decreased to 10.3. A few studies have examined dietary self-efficacy as an outcome measure in interventions with overweight/obese youth. One study studying the effects of a six-month weight management program supported by social cognitive theory showed increases in nutrition self-efficacy from baseline to 6-month follow-up; however, this increase was not statistically significant [82]. Another study using a combined web-based and classroom educational nutritional intervention found significantly higher self-efficacy for fruits and vegetables, lower fat consumption, usual food choices, and knowledge of fat compared to the control group [83]. Results from studies involving children that have examined nutrition education with children have showed significant improvement in dietary self-efficacy [71, 84]. The results from the current study did not show that a pediatric weight management intervention could increase dietary self-efficacy in adolescents; however, existing literature highlights the impact that interventions, whether dietary focused or multi-disciplinary can have on the dietary self-efficacy of children and adolescents. Like with physical activity self-efficacy, the FitKids360 program is not designed to specifically increase dietary self-efficacy. This may be an explanation as to why significant improvements in dietary self-efficacy were not seen The
instrument used in this study also may not have been the most appropriate to use with this adolescent population; however, several of the factors comprising the assessment tool utilized in this study are covered in the FitKids360 curriculum (e.g., attitudes, perceived behavioral control). Although our dietary self-efficacy instrument only assessed fruits and vegetables, other studies have shown that fruit and vegetable intake is highly correlated to overall diet quality and health in youth [85-87]; thus, targeting fruits and vegetables consumption in behavioral interventions can affect overall diet and health. Because dietary self-efficacy may mediate fruit and vegetable consumption as well as a youth’s diet quality, weight management interventions should target dietary self-efficacy as a means of improving the diet of intervention participants. As with physical activity self-efficacy, determining a standardized approach to classify and measure dietary self-efficacy is needed in future research. Future research is needed to provide additional information on how pediatric obesity treatment programs change dietary self-efficacy.

**FNPA**

Significant improvements were found in total FNPA score from baseline to pre-post 7/8-week follow-up and from baseline to 3-month follow-up. The pre-post improvement (53.1 to 58.3) in this study is similar in magnitude to the significant improvement seen (57.3 to 62.7) in the first 33 FitKids360 classes [23]. To date, these are the only known two works that have published pre-post comparisons specifically with the FNPA. A 12-week pilot study of a community-based family intervention for obese youth utilizing the Family Eating and Activity Questionnaire (FEAQ), an instrument assessing obesogenic factors in the overall home environment [88], found significant improvements in FEAQ total score from baseline at both 3-month follow-up and 9-month follow-up. Our study further affirms that the FitKids360 intervention positively affects the family and home environment as indicated by the
improvement in FNPA score. Since the family and home environment is important to a child’s physical activity, dietary, and screen time behaviors, being able to assess this component should be an essential part of pediatric weight management programs. As of now, the majority of FitKids360 sites only do pre-post FNPA comparison after the seven-week program. Future FitKids360 sites should implement conducting longer term follow-up assessment of the family and home environment using the FNPA Screening Tool.

**Strengths and limitations**

This is the first study to conduct a formal process evaluation of the FitKids360 intervention. It is also the first study to evaluate the effects of the FitKids360 intervention on just an adolescent population. An additional strength of the study was having 3-month follow-up data for our FitKids360 participants. No other FitKids360 site has done extensive follow-up beyond the post-seven-week assessment. Some of our health behavior assessments (PAQ-A, Healthy Eating Index) used in this study were thought to be of greater validity than those normally used in the standard FitKids360 assessment. We also introduced measures of physical activity and dietary self-efficacy into our FitKids360 assessment, which is not normally done with FitKids360.

A limitation of this study was not having a comparison group. With many of the health behaviors assessed via self-report (child or parent-reported), there is potential for social desirability bias. Other limitations that could have affected our pre-post and follow-up evaluation were the small sample size of our FitKids360 cohort and the length of the FitKids360 program. It is possible with a greater sample size and a longer intervention (or at least a substantial increase in net intervention hours) more significant findings would have been found. Another limitation of this study is the fact that the FitKids360 program is not theoretically-based
and thus any changes in behavior cannot be explained by particular mechanisms within the design of the program. FitKids360 was developed primarily by clinicians and healthcare providers and framed using the Chronic Care Model. Although there was no underlying theoretical framework to FitKids360, the strategy behind the development of FitKids360 was to improve health outcomes by connecting primary care best practices with a community-based program.

**Future directions**

The development of an official version of FitKids360 to intervene solely with adolescent populations is needed (in the works as “FitTeens360”). More research is needed to assess longer term (3-month, 6-month, 1-year and longer) impact of FitKids360 on health behavior and changes in body size. The evaluation of the FitKids360 intervention also needs to be conducted with the use of a control/comparison group in order to truly determine if changes due participants are due to FitKids360.

**Summary**

In summary, the process evaluation of the FitKids360 intervention with an adolescent population in Grand Blanc showed many positive results including high satisfaction of the intervention among program instructors/facilitators, volunteers, and family participants. Feedback provided from those involved in the program will help with improving potential areas that are associated with the success of the intervention. The process evaluation also revealed that the delivery of the FitKids360 intervention was implemented with high dose delivered and fidelity, which shows that the intervention was implemented well. Pre-post results showed that the FitKids360 improved physical activity and dietary self-efficacy as well as FNPA scores.
3-month follow-up a significant decrease in BMI z-score was observed. The findings from this study will be used to enhance the quality and delivery of the FitKids360 intervention.
REFERENCES
REFERENCES


CHAPTER 6: SUMMARY AND RECOMMENDATIONS FOR FUTURE RESEARCH
Overall dissertation summary

This dissertation consisted of a study with two overall objectives:

1) To examine the association of the Family Nutrition and Physical Activity (FNPA) Screening Tool with physical activity, dietary quality, and screen time in adolescents and to see if the FNPA differed by weight status

2) To conduct a formal process evaluation of the FitKids360 intervention and examine pre-post and 3-month follow-up changes in health behaviors and anthropometric measurements in FitKids360 participants.

This study showed that the FNPA Screening Tool was not associated with physical activity, dietary quality, or screen time in adolescents. Also, compared to what has been shown previously in published literature, the FNPA was not associated with weight status in the study’s adolescent population. These findings suggest the FNPA Screening Tool may not be appropriate to assess the family and home environment of adolescents in order to determine adolescent obesity risk.

Results from this study showed that the FitKids360 intervention implemented with an all adolescent population (first time ever) was received by instructors, volunteers, and family participants to be a very positive and educational experience. Process evaluation results showed that the FitKids360 intervention in this study was delivered with high fidelity. Pre-post comparisons from baseline to 7/8-week follow-up and 3-month follow-up showed improvements in several health outcomes that neared statistical significance. The FNPA score increased significantly from baseline to 7/8-week follow-up. This highlights that the FitKids360 program can improve the family and home environment of overweight/obese adolescents and their
families. However, nearly a third of families that started the program did not finish. It is possible that with a great sample size, more significant improvements might have been seen.

Even though the FNPA Screening Tool was not found to be associated with obesity risk in adolescents, results from this study’s FitKids360 intervention showed that the program had a significant, positive impact on families’ FNPA scores. FitKids360 aims to be family-oriented in its design to involve the family to help provide support for healthy behaviors both in the program and at home. Pediatric obesity treatment programs, like FitKids360, need to include the family in order to maximize the effectiveness of treatment. Being able to screen the family and home environment would also be useful to identify what family and home constructs may need to be focused on in interventions. Although the FNPA Screening Tool has only been shown to be associated with obesity risk in children, with additional research and refinement, it may one day be able to successfully screen the family and home environment in adolescents.

**Recommendations for future research**

Although this dissertation has contributed further to the scientific literature about the FNPA Screening Tool and the FitKids360 intervention, additional research is needed in the following areas:

- Research on the reliability of the FNPA is warranted since this has not yet been conducted. It is also recommended that research on determining cutpoints for the FNPA is warranted in order to interpret FNPA scores better and to determine good vs. bad FNPA scores.
- Given that this is the first study to examine if the FNPA is associated with weight status in an adolescent population, further research is needed to see if these results are in
agreement when the FNPA is examined with other adolescent populations, specifically those of more diverse races and from low-socioeconomic backgrounds.

• A potential recommendation for future use of the FNPA Screening Tool with adolescents is for parents to complete them together with their adolescent child in order to determine the most valid of responses to each of the constructs addressed with the tool.

• Using feedback data provided by this FitKids360 site and other FitKids360 sites, further development and improvement of the FitKids360 program should be implemented to continue improving the program’s overall goal of providing an evidence-based approach to treating pediatric overweight and obesity.

• Since there is no standard follow-up procedure for FitKids360 beyond the pre-post 7-week assessment, development of a standard method to conduct long term follow-up is warranted for the FitKids360 program.

• Lastly, research evaluating the effectiveness of the FitKids360 intervention needs to be conducted with the use of a control/comparison group. Being able to control for other factors not related to the intervention to explain pre- and post-assessments is vital in evaluating if an intervention had the intended effect on program participants.