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Predictors of Health Knowledge and Behaviors in Middle School Age Girls

Mary K. Clennan
University of Miami, marykateclennan@gmail.com

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PREDICTORS OF HEALTH KNOWLEDGE AND BEHAVIORS IN MIDDLE
SCHOOL AGE GIRLS

By

Mary Kate Clennan

A THESIS

Submitted to the Faculty
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Mary Kate Clennan

Approved:

_____   _____
Patrice G. Saab, PhD.   Maria M. Llabre, Ph.D.
Professor of Psychology   Professor of Psychology

_____   _____
Neena Malik, Ph.D.   Guillermo Prado, Ph.D.
Scientist, Department of Pediatrics   Dean of the Graduate School

CLENNAN, MARY KATE   (M.S., Psychology)
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<u>Predictors of Health Knowledge and Behaviors</u>
<u>in Middle School Age Girls.</u>

Abstract of a thesis at the University of Miami

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The promotion of healthy weight behaviors in youths is crucial. Furthermore,

health knowledge is important for children to possess as increased knowledge may lead

to positive attitudes toward healthy behaviors, and instill the desire to avoid the risks of

being unhealthy. The goal of the present study was to identify the predictors of health

behaviors and health knowledge in a sample of ethnically diverse middle school age girls

(N = 288) enrolled in a health promotion program, *Get in the GROOVE!.* It is important

to examine the predictors of healthy behaviors and knowledge so effective strategies and

interventions within health promotion programs can be identified. Participants' health

knowledge, self-efficacy, and health behaviors were assessed at the beginning and end of

the three-week program. To examine the relationships between these constructs, two

structural models (a dietary model and a physical activity model) were tested. Results

indicated that both the dietary [(χ2 (109) = 134.12, p =.052); RMSEA = .03 (90% CI =

[.00, .05]); CFI = .97] and the physical activity [(χ2 (18) = 26.05, p = .099); RMSEA =

.04 (90% CI = [.00, .08]); CFI = .98] structural models fit the data. Path estimates show

that health behaviors may not be predicted by two commonly assessed cognitive

variables, self-efficacy and health knowledge. However, path estimates indicate that

baseline self-efficacy predicts nutrition (B = .02, SE = .01, p = .041) and physical activity (B = .10, SE=.04, p =.005) health knowledge scores at the end of the program. This study is one of the first studies to provide evidence for a significant prospective relationship between health self-efficacy and health knowledge in children. These unique findings suggest that improving self-efficacy *before* implementing a health education intervention may be advantageous.

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Introduction

Over the last few decades, the prevalence of overweight and obesity has risen substantially among Americans of all races, backgrounds, and ethnicities (Flegal, Carroll, Ogden, & Curtin, 2010). Children and adolescents are not invulnerable to this epidemic; reports indicate that a third of youth aged 2-19 have been diagnosed as overweight or with obesity (Ogden, Carroll, Kit, & Flegal, 2014). Further, unhealthy weight in childhood is associated with serious comorbidities such as diabetes mellitus, high blood pressure and orthopedic problems (Deckelbaum & Williams, 2001; Freedman, Dietz, Srinivasan, & Berenson, 1999). Childhood obesity can also lead to more serious comorbidities later in life such as cardiovascular disease, stroke, asthma, chronic pain, and cancer (Guh et al., 2009). In addition to these physical problems, childhood overweight and obesity is linked to psychological problems including low self-esteem, depression, anxiety, and social withdrawal (Williams, 2001). As obesity is likely to track onto adulthood, concerns have been raised about the future and wellbeing of our nation's children (Deckelbaum & Williams, 2001). Obesity has been established as the second leading preventable cause of death in the United States, next to tobacco use (US Department of Health and Human Services, 2001).

Health promotion efforts amongst school age children are of particular importance. Some evidence suggests that, starting at adolescence, healthy weight-related behaviors are likely to decrease with age, particularly among girls. For example, a 2007 study showed that children significantly decreased their fruit and vegetable consumption as they age (Larson, Neumark-Sztainer, Hannan, & Story, 2007). In addition to poorer

nutrition, children's physical activity levels have been shown to decrease with age. (Caspersen, Pereira, & Curran, 2000; Sweeting, 2008). As research shows that eating and exercise behaviors in childhood and adolescence are likely to develop into lifelong habits, it is crucial that these deteriorating health behavior trends be addressed.

The current study examined health behaviors in middle school age girls. Obesity rates in girls are exceptionally concerning due to increased behavioral and biological risks that are associated with obesity in girls. Obesity in girls also causes worry given the increased pressure to be thin and the unhealthy behaviors that may be associated with this social burden (Neumark-Sztainer et al., 2006). Given the association of obesity with the occurrence of puberty in girls, girls ages 8-14 are more at risk for weight gain, compared to girls at a younger age (Wang & Beydoun, 2007). Bearing this evidence in mind, researchers suggest that greater attention should be focused on improving health behaviors in preadolescent and adolescent girls.

Poor nutrition habits and low physical activity levels are two lifestyle behaviors that contribute to obesity. Consumption of nutrient poor foods that contain excess levels of calories, sugar, sodium and saturated fat in conjunction with sedentary behaviors and decreased physical activity results in excess body weight (WHO, 2003). Therefore, proper dietary behaviors and energy expenditure through physical activity are important mechanisms to maintain and modify body weight. Recent systematic reviews conclude that exercise has a favorable effect on overweight and obese weight status in children and adults (Oude Luttikhuis et al., 2009; Shaw, Gennat, O'Rourke, & Del Mar, 2006). However, weight has been shown to only decrease slightly when physical activity alone is executed in overweight populations; the inclusion of diet modification reduces weight

more substantially (Douketis, Macie, Thabane, & Williamson, 2005; McTigue et al., 2003; Miller, Koceja, & Hamilton, 1997; Shaw et al., 2006). Thus, research suggests that instilling these healthy behaviors in youths is the best course of action in ensuring healthy futures. By targeting both poor diet and physical activity behaviors, obesity in children has the potential to be prevented and treated effectively.

The inclusion of psychoeducation seems to be a crucial component in obesity prevention efforts (Stice, Presnell, Shaw, & Rohde, 2005). Not only was a significant intervention effect found in all programs that included an educational component, no significant effect was found in any program that did not include this element (Cook‐Cottone, Casey, Feeley, & Baran, 2009). However, studies that examine the direct effect of *operationalized* health knowledge, as opposed to merely exposure to health education, on behaviors are limited, particularly in pediatric populations. In this study, 'operationalized health knowledge' will refer to heath knowledge as quantified by a score on a test. Further study of the relationship between health knowledge and behavior is warranted.

While health education may be essential, a 2008 review demonstrated that self-efficacy was the most commonly assessed cognitive variable in health intervention studies (Lubans, Foster, & Biddle, 2008). In fact, self-efficacy has been shown to be one of the strongest predictors of healthy eating and active behaviors (Lubans et al., 2008). However, very little is known about the relationship between objective health knowledge and self-efficacy. What is known concerns the relationship between self-efficacy and general knowledge. Specifically, greater self-efficacy is associated with higher academic achievement and has shown to be the greatest predictor of learning and motivation

(Pajares & Schunk, 2001; Zimmerman, 2000). Clearly, further research is needed to establish the link between health knowledge and health self-efficacy.

While extensive research on the individual variables of health knowledge, self-efficacy, and health behaviors has been conducted, little research has explored the relationships among these three variables. The following literature review will serve as a foundation for the current study. The review will discuss literature that has investigated how health knowledge is related to healthy eating behaviors and physical activity. Next, the research that has been done to examine the relationship between self-efficacy and healthy eating behaviors and physical activity will be summarized. Finally, the limited research on health knowledge and self-efficacy will be reviewed.

Health Behaviors and Health Knowledge

According to Bandura's Social Cognitive Theory (SCT), knowledge acquisition and behavior change is related to the knowledge needed to perform the behavior, social factors, and environmental factors (Bandura, 1986). This theory is a central theory in understanding behavior change and has universally stood true for people of all ages, races, and backgrounds. Based off of this theory, Bandura makes the postulation that increased awareness and knowledge of health information and risks are important factors in health behavior change (Bandura, 1986). Alternatively, the Knowledge-Attitude-Behavior Model (Bettinghaus, 1986) hypothesizes that, as knowledge is accumulated, the attitudes toward a behavior changes, making the behavior more likely to occur (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003). However, Baranowski et al notes that scientific evidence for this model's expansion to health behaviors in youths is limited and weak (Baranowski et al., 2003).

These theoretical models are a foundation for the implementation of health behavior interventions that provide children with health education. Many studies have been conducted throughout the past few decades to examine health education's effects on behaviors in youth. Generally, findings show that interventions that contain a health education component are shown to increase healthy behaviors (Baranowski et al., 2000; Contento, Randell, & Basch, 2002; Luepker et al., 1996). However, studies that examine the direct effect of operationalized health knowledge on behaviors are scarce. Given that health education is a fundamental component of most obesity prevention programs, this relationship between acquired knowledge and healthy behaviors is in crucial need of investigation.

A review of the literature indicates that there is a wide body of research that examines health education, health knowledge and behaviors simultaneously; however, these variables are rarely proposed to be related to one another (Contento et al., 2002; Sallis, Prochaska, & Taylor, 2000; Stice et al., 2005; Taylor, Evers, & McKenna, 2005; Waters et al., 2011). In fact, most studies only include health knowledge as an outcome variable and do not hypothesize it to be associated with healthy eating or exercise behaviors. The review below will discuss the limited research that has examined health knowledge and behavior.

Health knowledge and eating behaviors. Despite the fact that an extensive review (Contento et al., 2002) included 41 articles that measured nutritional knowledge and eating behavior, none of these studies investigated the direct effect of nutritional knowledge on eating behavior. However, a 1996 study not included in the aforementioned review found that while nutritional knowledge did not significantly

predict eating patterns, it did predict the variation of foods consumed (Gracey, Stanley, Burke, Corti, & Beilin, 1996). A later study found a significant yet weak correlation between nutritional knowledge and healthy eating in second and third grade students that participated in a nutritional education program (Powers, Struempler, Guarino, & Parmer, 2005). Furthermore, a positive correlation was found between nutrition knowledge and behavior in Asian youths following a health curriculum (Shah et al., 2010). A study conducted by Pirouznia indicated that a significant association may exist between nutritional knowledge and eating behaviors in seventh and eighth grade students; however, this relationship did not exist in sixth grade students, suggesting that this relationship may differ with age (Pirouznia, 2000). When parental nutritional knowledge was investigated in a similar study, the relationship between parental knowledge and dietary behavior was more robust. In a study investigating mother and children's nutritional knowledge and dietary behavior; it was found that maternal nutritional knowledge, but not the child's knowledge score, was strongly related to child dietary behavior (Gibson, Wardle, & Watts, 1998).

However, not all literature is in agreement. A 2001 study found that even those adolescents with high levels of knowledge of healthy foods have little regard for eating healthy (Croll, Neumark-Sztainer, & Story, 2001). Findings of a study conducted in Tehran showed that 75% of boys and 82% of girls received a high score on a nutritional knowledge assessment, but only 25% of boys and 15% of girls reported to have good nutritional practices (Mirmiran, Azadbakht, & Azizi, 2007). Similarly, a negative correlation was found between nutritional knowledge and healthy eating in younger adults (Räsänen et al., 2001; Taylor et al., 2005). However, the knowledge variable

measured in the unsupportive studies operationalized *general* nutritional knowledge, as opposed to acquired nutritional knowledge following a health education curriculum. Moreover, inconsistent results may not imply a lack of a relationship between nutrition knowledge and behavior; instead, these null results may indicate methodological problems or differences as well as the improper use of additional social cognitive predictors as controls (Taylor et al., 2005).

Health knowledge and physical activity. Only a few studies were found that included physical activity related knowledge to be associated or predictive of active behaviors. For example, a 1991 study found that higher rates of general health knowledge predicted increased activity in children at the end of the program (Kenkel, 1991). A 1993 study that found only enjoyment of physical activity, peer modeling, and exercise equipment at home were shown to be significantly associated with exercise in boys and girls, also indicated that exercise knowledge may play a significant role in exercise behavior implementation (Stucky-Ropp & DiLorenzo, 1993). Interestingly, a later study showed that children's exercise knowledge accounted for 9% of the variance in girls' physical activity, and 5% of the variance for boys' physical activity (DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998). However, these findings were only found longitudinally (3 years after the baseline data was collected), suggesting that there may have been a 'years in schooling' effect (DiLorenzo et al., 1998; Stucky-Ropp & DiLorenzo, 1993). A recent review suggests that, apart from DiLorenzo's work, many widely cited articles investigating the determinants of exercise in children do not examine health knowledge's influence (Park & Kim, 2008).

Clearly, the development and expansion of research probing the knowledge-behavior relationship is necessary; moreover, the inclusion of physical activity constructs in this context is essential as the exploration of these variables is lacking. Nevertheless, from the existing research, it seems that the general consensus is that health knowledge may be a predisposing factor for healthy behaviors in children. However, it does not instill behavior change alone; other psychological and social variables should be considered when investigating the mechanisms of health behavior change.

Self-Efficacy and Behavior

Dietary self-efficacy and eating behavior. Self-efficacy refers to the beliefs that one has about their capabilities of changing and maintaining a behavior (Bandura, 1986, 1997). According to Bandura's Social Cognitive Model, those who demonstrate higher levels of general self-efficacy are hypothesized to be more likely to change eating habits (Bandura, 1986). Most measures of children's dietary self-efficacy assess children's confidence in their ability to choose foods lower in fat and sodium, eat different types of fruits of vegetables, prepare them on their own, and ask their parents (or other adults) to prepare/buy fruits and vegetables (Baranowski et al., 2000; Reynolds et al., 1990; Saunders et al., 1997).

A 1997 review of literature that examined dietary self-efficacy and eating behavior concluded that self-efficacy plays a major role in healthy eating behavior engagement in adults, adolescents, and young children; thus, methods to increase self-efficacy are essential when planning dietary interventions (Abusabha & Achterberg, 1997). A similar review conducted in 2002 summarized evaluative measures in school-based nutrition education interventions (Contento et al., 2002). Findings of the 16 studies

reviewed by Contento et al that assessed self-efficacy indicate that, generally, higher levels of self-efficacy predict post-intervention healthier eating in school age children (Contento et al., 2002). These findings have been replicated across various ages, races, ethnicities, and both genders (Cusatis & Shannon, 1996; Lubans et al., 2008; Luszczynska, Tryburcy, & Schwarzer, 2007). Since then, findings have been generally consistent. An internet-based health promotion trial conducted in 2004 found that adolescents that endorsed higher levels of self-efficacy engaged in significantly healthier eating behaviors than those adolescents with lower self-efficacy (Long & Stevens, 2004). A related intervention showed that those individuals in a self-efficacy enhancing condition showed a significantly higher rate of consumption of fruits and vegetables than did the control group (Luszczynska,et al., 2007). In fact, higher self-efficacy has consistently shown to be associated with fruit and vegetable consumption in children of all ages (Gallaway, Jago, Baranowski, Baranowski, & Diamond, 2007). A more recent intervention study provided evidence that higher self-efficacy beliefs were associated with healthy food intake in high school students; similarly, lower self-efficacy was associated with ingestion of unhealthy food (Fitzgerald, Heary, Kelly, Nixon, & Shevlin, 2013).

It is important to note, however, that that self-efficacy may only be associated with healthy behavior implementation only if people want to improve the behavior (Abusabha & Achterberg, 1997). And, interestingly, a more recent study indicated that dietary self-efficacy was unrelated to BMI in girls suggesting that self-efficacious thinking may not affect actual body weight (Glasofer et al., 2013).

Physical activity self-efficacy and physical activity. Similar to dietary behaviors, higher self-efficacy has also been shown to be related to exercise behaviors in children. In fact, self-efficacy has been found to be one of the most important correlates of moderate to vigorous physical activity among youths (Biddle, Whitehead, O Donovan, & Nevill, 2005; DiLorenzo et al., 1998; Glasofer et al., 2013). Examining self-efficacy levels in middle school age children is particularly important as physical activity decreases during this period of life (Caspersen et al., 2000). A 1990 study found that higher physical activity specific self-efficacy was related to higher levels of activity in adolescent boys and girls (Reynolds et al., 1990). Dishman and colleagues (Dishman et al., 2004), were among the first researchers who provided evidence that self-efficacy is related to activity levels in adolescent girls specifically. The relationship was so strong in this study that the authors suggested that self-efficacy be used as a mediator in any intervention study designed to increase physical activity in girls (Dishman et al., 2004). Research also shows that there is also a significant relationship between self-efficacy and the ability to overcome barriers to physical activity (Trost et al., 1997). Nevertheless, studies indicate that the relationship between physical activity and self-efficacy may be mediated by self-management strategies, enjoyment or thoughts, goals, plans regarding a behavior, and previous exercise experience (Dishman et al., 2005; Kane et al., 2013).

Though the majority of literature is in agreement that higher levels of self-efficacy results in higher activity levels in children and adolescents, some studies have found null effects (Bungum & Vincent, 1996). Moreover, some research has indicated that increasing children's activity levels actually decreases their self-efficacy (Kane et al., 2013). Some have proposed that this phenomenon may exist because, as children increase

the intensity of their workouts, they become less confident that they can engage in the behavior further (i.e., as things get harder, they realize they may have overestimated their ability) (Kane et al., 2013).

While the specific direction of the relationship between self-efficacy and behavior has not been completely established, the present study assumed self-efficacy to be a casual variable (predicting healthy behaviors longitudinally), as the majority of the previously mentioned longitudinal studies used behavior as an outcome variable and self-efficacy as a predictor variable.

Overall, methods designed to increase self-efficacy seem to be crucial in interventions seeking to increase healthy eating and activity levels. Furthermore, many other correlates such as enjoyment, thoughts, goals, plans regarding a behavior, reinforcement history, learning, and perceived exertion can influence self-efficacy and behavior. Thus, additional psychological correlates need to be considered in models attempting to explain physical activity engagement (Bandura, 1997).

Self-Efficacy and Health Knowledge

Contento et al's (2002) review paper showed that self-efficacy is a very common outcome measure used to assess the effectiveness of nutrition education programs. Many of the reviewed studies found that nutrition education programs significantly increased children's dietary self-efficacy (Contento et al., 2002). However, "operationalized" nutritional knowledge acquired from these nutrition education programs was not discussed in any of the studies (Contento et al., 2002).

Despite the fact there is an adequate amount of evidence supporting knowledge and self-efficacy's role in healthy behavior engagement, the relationship between

"objective" health knowledge and self-efficacy is not well established. While health knowledge and self-efficacy are common variables measured in health promotion studies, these variables are not often proposed to predict each other. For example, the Gimme 5 Knowledge, Attitudes and Practices (KAP) questionnaire is a common instrument used to assess children's knowledge about fruits and vegetables, frequency of fruit and vegetable consumption, stages of change and self-efficacy. However, these constructs are usually only utilized to evaluate the effectiveness of interventions (Beech, Rice, Myers, Johnson, & Nicklas, 1999; Day, Strange, McKay, & Naylor, 2008; Mirmiran et al., 2007; Nicklas et al., 1997; Nicklas, Johnson, Myers, Farris, & Cunningham, 1998; Shah et al., 2010). After searching the literature, of the seven articles that utilized the Gimme 5 KAP questionnaire or a similar instrument, none of the articles examined the relationship between the children's nutrition knowledge and self-efficacy (Beech et al., 1999; Day et al., 2008; Mirmiran et al., 2007; Nicklas et al., 1997; Nicklas et al., 1998; Shah et al., 2010). These articles mostly utilized these KAP constructs as separate, evaluative outcome measures. Clearly, despite the fact that many researchers have appropriate data to analyze this relationship, there is very limited published evidence investigating the relationship between self-efficacy and health knowledge in children.

The very limited research on this relationship that has been implemented indicates that a significant relationship between nutritional knowledge and dietary self-efficacy in children may exist (Rabiei, Sharifirad, Azadbakht, & Hassanzadeh, 2013; Reynolds et al., 2002; Rimal, 2000). Rimal (2000) utilized data from the Stanford-Five-City Project. He found that self-efficacy mediated the knowledge and behavior relationship. Rimal's results indicated that those with higher levels of self-efficacy also had higher nutritional

knowledge and healthy eating scores compared to those with lower levels of self-efficacy (Rimal, 2000).This article is perhaps one of the most relevant to the current study's postulation that self-efficacy may affect acquired health knowledge following a health education curriculum. This study, however, was not limited to children (age 12 and older) but also included adults. Therefore, the present study would be a contribution to the scarce research as it could further investigate the relationship between efficacy and health knowledge in children alone. Further, the Rimal study did not examine this relationship in other health behaviors (for example, physical activity). The author concluded that future work was needed to investigate whether the findings can be generalized to other behaviors. Interestingly, since Rimal's paper was published more than 15 years ago, few succeeding studies have addressed this issue. Among the few studies, Long and Stevens showed that adolescents enrolled in an internet-based health promotion program who endorsed higher levels of dietary self-efficacy were likely to perform better on a nutritional knowledge assessment (Long & Stevens, 2004). However, the examination of this relationship was not the primary goal of the study and, therefore, this finding was not discussed at length. Similarly, a 2002 study reported a significant correlation between self-efficacy and nutrition knowledge in a table; however, this relationship was not mentioned within the text (Reynolds et al., 2002). A more recent cross-sectional study examined the relationship between self-efficacy, health knowledge, and self-concept in 140 overweight Iranian children (Rabiei et al., 2013). Results indicated that self-efficacy was associated with nutritional knowledge score and accounted for 18% of the variance in the knowledge score (Rabiei et al., 2013). However,

Rabiei's measure of self-efficacy did not assess self-efficacy in the context of healthy eating; rather, it evaluated general self-efficacy scores (Rabiei et al., 2013).

While the directionality of this relationship in a *health-behavior-specific* context has not been established, educational literature suggests that not only is self-efficacy associated with higher academic achievement, it has been shown to be the greatest predictor of learning and motivation (Linnenbrink & Pintrich, 2003; Pajares & Schunk, 2001; Zimmerman, 2000). It is postulated that as self-efficacy increases, value, interest and motivation increases which, in turn, promotes learning and achievement. Moreover, efficacy is expected to increase further as more knowledge is acquired (Linnenbrink & Pintrich, 2003). Thus, those with higher levels of self-efficacy are likely to be more motivated to learn. Despite this well studied theory, sometimes referred to as motivation theory, research examining the link between self-efficacy and health-specific knowledge in children is virtually non-existent. Furthermore, a review of literature indicates that there is a complete lack of studies that investigate the relationship between physical activity specific health knowledge and efficacy. The present study contributes to existing research as one of its primary objectives was to investigate this little-researched relationship in children in the context of both eating and exercise behaviors.

Rationale and Hypotheses

In summary, middle school age children are particularly at risk for overweight and obesity as the frequency of healthy weight behaviors are likely to decrease with age. Health promotion efforts in children have shown generally optimistic results; however, the mechanisms by which health behaviors and health knowledge are adopted by children in health promotion programs are unconfirmed.

Overall, there is strong evidence that higher health self-efficacy is associated with the engagement of healthy eating and physical activity in children. These findings have been found in children of various ages, races and ethnicities. Similar findings are expected in the current study. Investigating this relationship will further address the theory that greater self-efficacy is associated with healthy behaviors. Moreover, by investigating this relationship in girls, the unique and important role self-efficacy plays in middle school girls' health will be able to be further established.

The relationship behind health knowledge and healthy behaviors has been less researched. Research shows that health knowledge acquired through controlled promotion and intervention programs is associated with improved dietary habits and activity levels. However, studies that examine the direct effect of *operationalized* health knowledge are scarce, particularly in children. The very limited literature on this topic suggests that higher health knowledge may be associated with the engagement in healthy behaviors. But, given that health education is a fundamental component of most obesity prevention programs, the relationship between acquired knowledge and healthy behaviors warrants further investigation.

The relationship between objective health knowledge and self-efficacy in children is not well established. Greater general self-efficacy is associated with higher academic achievement, learning and motivation (Pajares & Schunk, 2001; Zimmerman, 2000). However, the relationship between health self-efficacy and health knowledge requires investigation as virtually no studies were found that explored the relationship between these two constructs.

Promoting healthy behaviors in girls is crucial as research shows that physical activity steeply declines in girls following puberty, and unhealthy eating behavior is associated with binge eating in adulthood (Kimm et al., 2002; Stice, 2002; Stice et al., 2005). Studies also indicate that puberty in girls is more strongly associated with fat accumulation than puberty in boys (Dietz, 1998). Furthermore, obesity and overweight in childhood is likely to track into adulthood and recent reports indicate that obesity rates are higher for adult women than men (Ogden et al., 2014).

The purpose of the current study was to 1) investigate the relationship between health knowledge and healthy behaviors, 2) investigate the relationship between self-efficacy and healthy behaviors, and 3) investigate the relationship between health self-efficacy and health knowledge in a sample of diverse middle school age girls who were enrolled in a three week health promotion program. Baseline values of knowledge, self-efficacy, and healthy behavior were also used to predict subsequent knowledge, self-efficacy, and healthy behavior, respectively. To explain the proposed relationships, two models (a dietary model and a physical activity model) were proposed based off of Bandura's Social Cognitive Theory and existing literature. The goal of the models was to better conceptualize the process by which health behaviors are acquired and implemented in girls.

Hypothesis 1: Those girls with higher baseline nutritional knowledge scores will engage in healthier eating behaviors.

Hypothesis 2: Those girls with higher levels of baseline dietary self-efficacy will engage in healthier eating behaviors.

Hypothesis 3: Those with higher baseline dietary self-efficacy will learn health information throughout the program, and thus have higher subsequent (week 3) nutritional knowledge scores.

Hypothesis 4: Those girls with higher baseline physical activity-specific knowledge scores will be more active.

Hypothesis 5: Those girls with higher levels of baseline physical activity specific self-efficacy will be more active.

Hypothesis 6: Those with higher baseline physical activity-specific self-efficacy will learn health information throughout the program and this will lead to higher subsequent (week 3) physical activity knowledge scores.

Chapter 2: Methods

Participants

Participants of the current study were 288 girls between the ages of 11 and 14 (M=11.8) years old who were enrolled 3-week summer camp program emphasizing a healthy lifestyle in Miami-Dade County and Queens, New York (it should be noted that an IRB exception was made in 2013 to include 4 10-year old girls). They were part of a larger study, *Get in the GROOVE!* All students attended the summer camp free of cost. Girls were eligible for participation if 1) their age was between 11 - 14 years old, 2) they did not have any limitations to their physical activity and 3) they did not have any type of learning disability or other condition that would prevent them from being able to complete weekly measures. The study was approved by the University of Miami Institutional Review Board.

Procedures

Only the procedures relevant to the current study are described in this manuscript. In order to apply for the program, the parents of the participants completed an application, a Family Background and Habits questionnaire (see below) and a written informed consent form. A written assent was also obtained from their daughters. After it was determined that a child was eligible, she was randomized into either a health and wellness education condition or an interactive technology plus health and wellness education condition. While both groups received the same curriculum, the interactive technology plus health and wellness education condition engaged in virtual activities and lectures to reinforce and apply learned health information. Although the larger study

included two conditions, the effects of the intervention was not the focus of the current study, and condition was controlled for at all participants at the Week 3 time point.

The 3-week summer camp was held five days per week, for six hours a day. The girls completed questionnaires upon arriving at camp each day. The current study focused on the data from the baseline surveys completed during the first week of camp as well as data from surveys from the third (final) week of the program. The girls received a wireless activity tracker, Fitbit, within the first few days of camp. The girls were instructed to wear it each day, all day. The girls were instructed to "sync" their Fitbit each morning so their activity data from the prior day could be uploaded to the database. Fitbit progress was monitored by GROOVE staff and by research assistants. The girls were aware of the other GROOVE location (Miami or New York) and were in "competition" with one another to get the most amount of activity by the end of camp.

Health Education

Throughout the program, the girls in both conditions were taught about a healthy lifestyle, healthy diet, and physical activity behaviors through the implementation of a health curriculum. The curriculum included lectures, age and gender appropriate activities, weekly educational field trips, weekly guest speakers, and student-led, interactive presentations. The girls were also fed a healthy lunch and engaged in "Lunch and Learn" which instructed them how to build a healthy meal.

Measures

The measures that were used in the current study were the Family Background and Habits Questionnaire (completed by the parents as part of the application process), baseline (Week 1), and Week 3 measures. The children's questionnaires could be

completed either online or on paper. Dietary self-efficacy, physical activity self-efficacy, health knowledge, and dietary behavior, were assessed by self-report questionnaires. Physical activity was objectively assessed by an activity tracker device, Fitbit. The girls completed the diet and physical activity self-efficacy questionnaires as well as the Health Knowledge assessment on the first day of the program and at the end of third week. They also completed the Eating Behavior Survey on the third day of the program and at the end of the third week.

Family Background and Habits Questionnaire (see Appendix A). The Family Background and Habits Questionnaire is 38- item measure developed by University of Miami researchers. The parents of the participants completed the questionnaire before randomization. The parent-reported items assessed the participants' demographic information (for example, age, grade, ethnicity, country of birth, and parental education), family eating behaviors, parental eating behaviors, child health behaviors, and parental perception of their child's weight. The five specific items used in the current study as covariates were age, maternal education, ethnicity, parental eating behavior, and parental physical activity behavior. Level of maternal education was coded as a continuous variable (number of years of schooling), with the choices ranging from '1' to '23+'. Parents were given 14 ethnicity categories to select from to describe their child's background/heritage, and were asked to choose all that applied (White, non-Hispanic, African-American, Asian, Dominican, Cuban American, Mexican American, Puerto Rican, Central American, South American, Other Hispanic/Latino background, American Indian, Caribbean Black, Haitian American, Other ethnic background). Ethnicity was recoded for the current study into the following categories: Hispanic, White non-

Hispanic, Black non-Hispanic, Asian non-Hispanic, Mixed non-Hispanic, and Other non-Hispanic. Ethnicity was dummy coded (dummy coded variable 1: Black= 1, Hispanic=0, non-Hispanic=0; dummy coded variable 2: Black=0, Hispanic=0, non-Hispanic=1), and Hispanics were the referent group. Parental physical activity was dummy coded (0= less than 30 minutes of activity per day; 1= at least 30 minutes of activity per day).

Parental fruit and vegetable consumption was assessed using 4 of the parent items on the Family Background Questionnaire. The parent healthy eating score was quantified as a sum of the daily frequency of: fruits or 100% fruit juice, vegetables (not including white potatoes), fast food, and soda consumed. The fast food and soda items were reverse scored. In 2013, instead of asking the parents about *daily* frequency, the Family Background Questionnaire asked for the frequency of fruits or 100% fruit juice, vegetables (not including white potatoes), fast food, and soda consumed *each week*. To scale these responses to the 2014 and 2015 version of the survey (daily consumption), each participant's response was divided by 7.

Eating Asking and Preparing Survey (see Appendix A). Dietary self-efficacy was measured by the Eating Asking and Preparing Survey (Reynolds et al., 2002), which assesses children's confidence in eating and preparing fruits and vegetables, and asking their parents to buy or prepare fruits and vegetables. The "eating" items assess the girls' confidence in eating fruits and vegetables in different situations (for example, "*How sure am I that I can snack on fruits I like (such as grapes or bananas) instead of foods like cake or cookies*."). The "asking" items assess the girls' confidence in their ability to ask their parents and/or guardians to prepare healthy foods for meals and snacks, and purchase meals and snacks (for example, "*How sure am I that I ask my mom or dad to fix*

my favorite vegetables at dinner"). The "preparing" items assess girls' confidence in preparing different types of fruits and vegetables in varying situations (for example, "*How sure am I that I can cook a vegetable (like corn on the cob) for dinner.*"). Seventeen of the 18 items were taken from the Reynolds et al measure that assessed children's self-efficacy to consume fruits and vegetables (Reynolds et al., 2002). University of Miami researchers added an eighteenth item, "*How sure am I that I can fill half of my plates with fruits and vegetables.*" Items were rated on a 3-point Likert scale (1 = "not sure;" 2 = "I think so;" 3 = "very sure"). In the current study, dietary self-efficacy was calculated by summing participants' responses of the 18 items. Higher scores indicate higher dietary self-efficacy. The 18-item scale was shown to have good internal consistency reliability at both time points (Week 1 Cronbach's alpha = 0.87; Week 3 Cronbach's alpha = .91). Although this measure assessed self-efficacy for fruit and vegetable consumption specifically, this construct will be referred to as dietary self-efficacy throughout the manuscript.

Physical Activity Self-Efficacy Questionnaire (see Appendix A). Self-efficacy for physical activity was measured by a 13-item survey. Eleven of the 13 items were from the Physical Activity Self-Efficacy Support Seeking and Barriers questionnaire (Saunders et al., 1997). Two additional items were added to the measure- "I think I can be physically active for 60 minutes each day" and "I think I can walk 11,000 steps each day", which were consistent with the goals of the summer program. The measure assessed the children's' confidence in their ability to engage in various physical activity (for example, "*I think I can be physically active most days after school.*"), and to ask their parents and peers to help them become more physically active (for example, "*I think I*

can ask my parent or other adult to sign me up for a sport, dance, or other physical activity program"). Items were rated on a dichotomous scale (Yes=1, No=0), and the 13 items were summed to generate a total score where higher scores indicate higher self-efficacy for physical activity.

The 13-item scale was shown to have good internal consistency reliability (Week 1 Cronbach's alpha = 0.77; Week 3 Cronbach's alpha = .81) at both time points.

Health Knowledge Questionnaire (see Appendix A). The "Tell Us What You Know!" Health Knowledge questionnaire was comprised of 21 curriculum-specific items, developed by University of Miami researchers (for example, "*Pick the choice that is lowest in fat.*"). Of the 21 items, 8 were related to healthy eating behaviors and 6 were related to physical activity. The Health Knowledge questionnaire was shown to have adequate internal consistency reliability (Week 1 Cronbach's alpha = 0.45; Week 3 Cronbach's alpha = .69) at both time points.

The 8 nutrition-related items were summed to create a nutritional knowledge variable (Week 1 Cronbach's alpha = 0.25; Week 3 Cronbach's alpha = .41). The 6 physical activity-related items were summed to create a physical activity knowledge variable (Week 1 Cronbach's alpha = 0.15; Week 3 Cronbach's alpha = .51). These scales' relatively lower internal consistencies a limitation of the current study. All of the Week 1 Cronbach's alphas are exceptionally low as the questionnaire was curriculum specific; the participants had not been exposed to any of the curriculum when they took the Week 1 measure.

Eating Behavior Survey (see Appendix A). The Eating Behavior Scale (EBS) assesses self-reported dietary intake. The EBS is a 28-item questionnaire that evaluates

the frequency of both healthy and unhealthy foods eaten by children the previous day (for example: "*Yesterday, how many times did you eat a salad made with lettuce or any green vegetable?*"). Twenty of the 28 items were taken from a questionnaire that was concluded to produce reliable and valid indices in a sample of 387 eighth grade minority students (Fahlman, McCaughtry, Martin, Garn, & Shen, 2012). Vegetables (3 items) and fruits (1 item) were included as indicators of a healthy eating latent variable, 'fruit and vegetable consumption' as studies indicate that fruit and vegetables help maintain a healthy body weight, protect against certain types of cancers in adulthood, and reduce the risk of chronic disease (Harnack, Walters, & Jacobs, 2003; US Department of Health and Human Services, 1990; World Health Organization 2002).

FitBit Activity-Tracking Device. The Fitbit Zip, which was used to objectively measure the participants' activity levels throughout the program, is a wireless activity tracker used to track steps, distance, calories burned, and active minutes. Overall, researchers have shown that the Fitbit Zip is a valid measure of physical activity in children and adults (Adam Noah, Spierer, Gu, & Bronner, 2013; Tully, McBride, Heron, & Hunter, 2014). Moreover, compared to similar activity-tracking devices and accelerometers, the Fitbit Zip has been shown to be particularly accurate in tracking activity in children and adults (Giannini, 2013). In the current study, *baseline* Fitbit scores were operationalized as the average distance walked during the first three days of wearing the device. The *Week 3* Fitbit scores were operationalized as the average distance walked during the last three days of wearing the Fitbit. Three days of Fitbit data has been shown to be a reliable measure of activity in children (Rowe, Mahar, Raedeke, & Lore, 2004). On the days participants did not wear the activity-tracking device, the distance

was coded as missing instead of zero. In addition, on the days the participants did not wear the device the entire day (i.e. only wore the Fitbit for two hours), the distance was also be coded as missing as these days are not representative of their daily activity. This data was confirmed to be missing at random, as there was not a relationship between missingness and self-reported physical activity (as measured by the participants' response to the following item: "*During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?*").

Chapter 3: Statistical Analyses Plan

Descriptive analyses (see Tables 1-7) were performed using Statistical Package for the Social Sciences Version 22 (SPSS 22) and all other analyses were performed using Mplus v7 (Muthén & Muthén, 2007). The full information maximum likelihood (FIML) estimation method was used to account for missing data, assuming data were missing at random. As suggested by Kline (2015), model fit was evaluated based on the following fit indices: a non-significant ($p< 0.05$) chi-square value (χ^2), a comparative fit index (CFI) value above 0.95, and a root-mean-square residual (RMSEA) value below 0.06. All parameter estimates were tested for statistical significance ($\alpha < .05$, two-tailed). Significant ($p<0.05$) parameter estimates (β) indicate a significant relationship between the variables. Unstandardized coefficients controlling for other predictors in the model are reported in the text. First, a measurement model was proposed for Healthy Eating Behavior (see Figure 1). Then, two structural models were tested- a diet model and physical activity model (see Figure 2 and 3). Each model had the same proposed paths and directionality.

Covariates

Age was included as a covariate as evidence suggests age differences in health self-efficacy, knowledge (due to more years in schooling), and health behaviors (Beech et al., 1999; Cooke & Wardle, 2005; Eccles, Wigfield, Harold, & Blumenfeld, 1993; Gordon-Larsen, Harris, Ward, & Popkin, 2003; Larson, Neumark-Sztainer, Hannan, & Story, 2007). Highest level of education completed by the mother was also included as a covariate as mother's education is shown to effect child health knowledge, self-efficacy and healthy behaviors (Campbell, Hesketh, Silverii, & Abbott, 2010; Crawford et al.,

1995; He et al., 2013; Nelson, Lytle, & Pasch, 2009; Saxton, Carnell, Van Jaarsveld, & Wardle, 2009). In addition, ethnicity and BMI were included as covariates as prior research indicates that there are differences in children's health knowledge and healthy weight behaviors across ethnicities and weight classifications (Brodersen, Steptoe, Boniface, & Wardle, 2007; Burdine, Chen, Gottlieb, Peterson, & Vacalis, 1984; Nayga, 2000; Videon & Manning, 2003). Parental healthy weight behaviors was also included as a covariate as past research shows that parental healthy eating and physical activity are related to their children's healthy weight behaviors (Campbell, Crawford, & Ball, 2006; Larsen et al., 2015; Sallis, Prochaska, & Taylor, 2000). The analyses controlled for site at both time points to control for location differences. Furthermore, condition and attendance were included as covariates for the three variables in each model measured at Week 3. Although the intervention included an additional virtual component, both conditions received the same curriculum.

Chapter 4: Results

Baseline and Demographic Characteristics

Demographic and baseline characteristics for participants (N=288) are reported in Table 1, Table 2, Table 3, and Table 4. The girls ranged in age from 10-14 (M=11.8, SD=.9). The ethnically diverse sample consisted of 159 Hispanic girls (55.6%), 53 Black non-Hispanic girls (18.5%), 39 Asian non-Hispanic girls (13.6%), 24 White non-Hispanic girls (8.4%), 9 Mixed non-Hispanic girls (3.2%), and 2 other non-Hispanic girls (.7%). Study variable means, grouped by ethnicity are displayed in Table 5, 6, and 7. Overall, most mothers of the girls had obtained at least a high school degree (maternal years of education M= 15.5, SD= 3.9). During the first week of the program, the participants' BMIs were calculated after measuring height and weight. The girls' BMIs were then sorted into the following CDC weight classifications: underweight (3%), average (55.9%), overweight (21.1%), and obese (20%). Compared to results from the YRBS 2015 survey on United Stats high school students, a greater proportion of participants in this study were overweight as YRBS 2015 results indicated that 16% of United States participants were overweight and 13.9% were obese (CDC, 2015).

Week 3 variables for participants are reported in Table 3 and 4. Independent t-tests revealed that the following variables significantly increased from Week 1 to Week 3 of the program: nutritional knowledge, physical activity self-efficacy, and physical activity knowledge (see Table 3). Chi-square analyses indicate that frequency of healthy eating behaviors actually decreased from Week 1 to Week 3 (see Table 4). There was no significant change in the following variables: dietary self-efficacy and physical activity (see Table 3).

Dietary Results

    Aim1: Fruit and Vegetable Consumption measurement model. To test whether four 'healthy' items on the Eating Behavior Survey at Week 1 and Week 3 share a common variance that can be explained by the latent construct, fruit and vegetable consumption, a Confirmatory Factor Analysis (CFA) model was run. Week 1 and Week 3 latents were run together. The model, including correlations of the error of each Week 1 fruit and vegetable consumption indicator to its corresponding indicator across time (i.e., Item 4 on the Week 1 EBS and Item 4 on the Week 3 EBS) and correlation of error of item 5 ("*Yesterday, how many times did you eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?")* and item 6 ("*Yesterday, how many times did you eat any other vegetables like peppers, tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes?"*) at Week 1 and Week 3, had good fit [($\chi2$ (13) = 10.05, p =.690); RMSEA = .00 (90% CI = [.00, .05]); CFI = 1.0; see Figure 4]. All four items (#1, 4, 5, and 6) loaded significantly onto the factor, at both time points suggesting that the four EBS items were consistently measuring the same construct, fruit and vegetable consumption. Standardized and unstandardized factor loadings for each indicator at Week 1 and Week 3 can be seen in Tables 8 and 9.

    Aim 2: Overall Model fit for the Dietary Structural Model. To determine if the proposed relationships between dietary self-efficacy nutrition knowledge, and fruit and vegetable consumption was consistent with the data, a structural model was tested (see Figure 2). Fit indices showed that the initial proposed structural model fit the data [($\chi2$ (109) = 134.12, p =.052); RMSEA = .03 (90% CI = [.00, .05]); CFI = .97; see Figure 5].

Fruit and vegetable consumption, dietary self-efficacy, and nutrition knowledge at Week 3 were predicted by their corresponding variables at Week 1 (i.e., the path from dietary self-efficacy at Week 1 to dietary self-efficacy at Week 3). Thus, these variables showed stability over time. Standardized and unstandardized path coefficients for direct effects are discussed below and can be seen in Table 10.

Aim 2a: Investigate the relationship between nutritional knowledge and eating behaviors. This aim tested Hypothesis 1. Results indicated that baseline dietary nutritional knowledge significantly predicted fruit and vegetable consumption at the end of the program (B = -.06, SE = .03, p = .045; see Table 10 and Figure 5). Interestingly, model estimates indicated that higher baseline nutritional knowledge predicted less fruit and vegetable consumption at the end of the program. This was in contrast to hypothesis 1, which proposed that greater health knowledge would predict fruit and vegetable consumption. For every one point increase in nutrition health knowledge, the daily frequency of fruits and vegetables decreases by .06 times. While this value may be statistically significant (p<.05), this has no practical application. The correlation between nutrition knowledge and healthy eating was non-significant at baseline (B = -.03, SE = .06, p = .818; see Figure 5) and, and the partial correlation at Week 3 was also non-significant (B = .03, SE = .05, p =.496; see Figure 5).

Aim 2b: Investigate the relationship between dietary self-efficacy and eating behaviors. This aim tested Hypothesis 2. Results indicated that baseline dietary self-efficacy did not significantly predict fruit and vegetable consumption at the end of the program (B = .01, SE=.01, p =.252; see Table 10 and Figure 5). The association between dietary self-efficacy and fruit and vegetable consumption was statistically significant at

Week 1 (B = 1.45, SE=.37, *p* <.001; see Figure 5); however, the partial correlation

between dietary self-efficacy and fruit and vegetable consumption was not statistically

significant at Week 3 (B = .11, SE=.26, *p* =.665; see Figure 5).This may be due to the

fact that fruit and vegetable consumption significantly decreased from Week1 to Week 3

(see Table 4).

Aim 2c: Investigate the relationship between dietary self-efficacy and nutritional

knowledge. This aim tested Hypothesis 3. The results indicated that nutrition knowledge

was significantly predicted by baseline dietary self-efficacy (B = .02, SE = .01, *p* = .041;

see Table 10 and Figure 5). These results indicate that, controlling for covariates, for

every one-point increase in average baseline dietary self-efficacy item score, week 3

nutritional knowledge score increased by .02 points (.25%). Results also showed that this

association between dietary self-efficacy and nutrition knowledge was also significant at

Week 1 (B = 1.45, SE = .73, *p* = .045; see Figure 5); the partial correlation was not

significant at Week 3 (B = .82, SE = .57, *p* = .15; see Figure 5).

Physical Activity Results

Aim 3: Overall Model fit for the Physical Activity Structural Model. It was

then determined whether the overall structural model investigating the relationships

between self-efficacy for physical activity, physical activity knowledge, and physical

activity behavior was consistent with the data (see Figure 3). The same model fit indices

suggested by Kline (2015) as outlined above was used to test for model fit. The model fit

the data [($\chi2$ (18) = 26.05, p = .099); RMSEA = .04 (90% CI = [.00, .08]); CFI = .98; see

Figure 6]. All variables at Week 3 were predicted by all corresponding variables at Week

1, showing stability over time (i.e., the path from self-efficacy for physical activity at

Week 1 to self-efficacy for physical activity at Week 3). Standardized and unstandardized path coefficients for direct effects can be seen in Table 11.

Aim 3a: Investigate the relationship between physical activity knowledge and physical activity. This aim tested Hypothesis 4. Results indicated that baseline physical activity knowledge scores did not significantly predict activity at the end of the program (B = -.02 SE=.09, p =.804; see Table 11 and Figure 6). Furthermore, the correlation between physical activity knowledge and activity was non-significant at baseline (B = .26, SE=.16, p =.100; see Figure 6) as was the partial correlation at Week 3 (B = .104, SE=.14, p =.462; see Figure 6).

Aim 3b: Investigate the relationship between physical activity self-efficacy and physical activity. This aim tested Hypothesis 5. Results indicated that baseline self-efficacy scores did not significantly predict physical activity at the end of the program (B = -.04, SE=.05, p =.417; see Table 11 and Figure 6). Similarly, the association between physical activity self-efficacy and physical activity was not statistically significant at Week 1 (B = .22, SE=.34, p =.523; see Figure 6); the partial correlation was also non-significant at Week 3 (B = .23, SE=.23, p =.316; see Figure 6).

Aim 3c: Investigate the relationship between physical activity self-efficacy and physical activity knowledge. This aim tested Hypothesis 6. The results indicated that physical activity knowledge at Week 3 was significantly predicted by baseline physical activity self-efficacy (B = .10, SE=.04, p =.005; see Table 11 and Figure 6). These results indicate that, controlling for covariates, for every one-point increase in average baseline physical activity self-efficacy item score, Week 3 physical activity knowledge score increased by .1 points (1.7%). However, results showed that the association between

physical activity self-efficacy and physical activity knowledge at Week 1 (B = .13, SE=.20, p =.506; see Figure 6) was non-significant. Further, the partial correlation at Week 3 (B = -.22, SE=.18, p =.206; see Figure 6) was also non-significant.

Dietary Model Covariates

Results indicate that, despite expectations, parental eating behavior and BMI were not significant covariates in the dietary model at Week 1 or Week 3. Results also indicate that there were no condition differences for any of the Week 3 dietary variables. The significant dietary model covariates are described in detail below.

Age. Similar to related literature, the relationship between age and healthy eating behavior was significant at Week 1 (B = -.1, SE= .05, p = .038), suggesting that younger girls ate healthier at baseline. However, this relationship was not significant at the end of the program. While the relationship between age and nutrition knowledge at baseline was not significant at Week 1, older girls scored significantly higher on the nutrition knowledge assessment at Week 3 (B = .24, SE = .10, p = .021).

Maternal Education. Contrary to expectations, lower maternal education predicted healthier child eating behaviors at Week 1 (B = -.02, SE = .01, p = .027). However, the relationship between maternal education and child healthy eating behavior was not significant at Week 3. Higher level of maternal education also predicted higher child nutrition knowledge at Week 1 (B = .06, SE = .03, p = .014), however, this relationship was not significant at Week 3.

Ethnicity. Non-Hispanic girls scored significantly higher on the nutrition knowledge scale at Week 1 (B = .48, SE = .23, p = .037) and at Week 3 (B = .70, SE = .21, p = .001), compared to Hispanic girls. Meanwhile, compared to non-Black girls,

Black girls scored significantly lower on the nutrition knowledge questionnaire at baseline (B = -69, SE = .26, *p* = .007;), but did not score significantly lower on the questionnaire at Week 3, as the average score for this group improved over the course of the three-week program (see Table 7).

Attendance. Results indicate that those who had lower attendance reported eating healthier at Week 3 of the program (B = -.06, SE = .02, *p* = .003).

Site. Site had a significant effect on dietary self-efficacy at the end of the program (B = 2.16, SE = .97, *p* = .026). Participants located in New York tended to have higher dietary self-efficacy, compared to the participants in Miami at Week 3.

Physical Activity Model Covariates

As observed in the dietary model results show that parental eating behavior and BMI were not significant covariates in the physical activity model at Week 1 or Week 3. Ethnicity was also not a significant covariate at either time point. Further, attendance and condition did not have a significant effect on any of the Week 3 variables. The significant physical activity model covariates are described below.

Age. While the relationship between age and physical activity knowledge at baseline was not significant, older girls scored significantly higher on the physical activity knowledge assessment at Week 3 (B = .33, SE = .11, *p* = .002).

Maternal Education. The relationship between maternal education and child physical activity was non-significant at Week 1. However, this relationship was significant at Week 3 (B = -.08, SE = .02, *p* = .001). And, while the relationship between maternal education and child physical activity knowledge was not significant at Week 1,

higher level of maternal education predicted child physical activity knowledge at Week 3 (B = .08, SE = .02, p = .001).

Site. Not surprisingly, the participants in New York were more active than the participants in Miami at both time points (B = .99, SE = .30, p = .001; B = .69, SE = .27, p = .009).

Summary

In summary, results indicate that both the dietary and the physical activity structural models fit the data. Path estimates show that health behaviors may not be predicted by self-efficacy and health knowledge; however, path estimates indicate that baseline self-efficacy predicts nutrition and physical activity health knowledge scores at the end of the program.

Results also showed that younger girls ate healthier at baseline, and older girls scored significantly higher on the nutrition and physical activity knowledge assessment at the end of the program. Furthermore, contrary to expectations, lower maternal education predicted healthier child eating behaviors at the beginning of the program. However, higher maternal education predicted higher levels of children's physical activity at the end of the program. Higher level of maternal education also predicted higher child health knowledge. Findings also show ethnic differences in health knowledge. Non-Hispanic girls scored significantly higher on the nutrition knowledge scale at both time points, compared to Hispanic girls. And, compared to non-Black girls, Black girls scored significantly lower on the nutrition knowledge questionnaire at baseline; however, their score significantly improved over the course of the three-week program. Results also indicate that those who had lower attendance reported eating healthier at the end of the

program. Finally, participants located in New York tended to have higher dietary self-efficacy, compared to the participants in Miami at the end of the program. New York participants were also more active.

Chapter 5: Discussion

This study investigated health knowledge, self-efficacy and health behaviors in middle school age girls of diverse ethnic backgrounds. The study posited that self-efficacy would predict health knowledge and that health behaviors would be predicted by health knowledge and self-efficacy longitudinally. Primary findings of the current study show that baseline dietary and physical activity self-efficacy predict their corresponding health knowledge score at the end of the program. This study is one of the first studies to provide evidence for a significant prospective relationship between health self-efficacy and health knowledge in children. Secondary findings included a significant correlation between baseline dietary self-efficacy and baseline fruit and vegetable consumption. Findings also included significant effects of age and maternal education on child health behaviors, as well as an effect of ethnicity, maternal education, and age on knowledge at baseline and at the end of the program. Contrary to expectations, this study showed that healthy behaviors at the end of the program were not significantly predicted by higher health knowledge or self-efficacy at baseline. Thus, in this population, other factors may have predicted health behaviors. Although hypotheses were only partially supported, this was the first study to investigate these relationships in a sample of girls who were from predominately minority backgrounds. A detailed discussion of the current study's findings, strengths, limitations, and implications is provided below.

Self-Efficacy and Health Knowledge

While virtually no study has explored the relationship between health self-efficacy and health knowledge, more general educational theories suggest that self-efficacy may be the strongest predictor of learning (Pajares & Schunk, 2001; Zimmerman

2000). Linnenbrink and Pintrich (2003) posited that, those with higher self-efficacy have more behavioral engagement, cognitive engagement, and motivational engagement in a learning environment. Thus, one might speculate that the girls who began the GROOVE program with higher dietary and physical activity self-efficacy were more likely to have interest in the topics taught in the program (motivational engagement), process more of what they learn (cognitive engagement), and put in more effort to learn the topic covered by paying closer attention and asking the instructor questions (behavioral engagement). Therefore, according to this theory, those girls with higher incoming self-efficacy then produce higher health knowledge scores at the end of the program. Heath knowledge is important to possess as increased knowledge may lead to positive attitudes toward healthy behaviors, and instill fear of the risks of being unhealthy.

Longitudinal findings. Results indicate that baseline dietary and physical activity self-efficacy predicted nutritional and physical activity health knowledge at the end of the program, respectively (controlling for baseline knowledge, maternal education, BMI, age, program attendance, condition, and by holding Hispanic ethnicity constant). These findings, especially within a health specific context, are unique. Self-efficacy and health knowledge are often utilized as outcome variables to measure the effectiveness of health interventions. However, these variables are rarely proposed to be related themselves. Only a few studies have explored the relationship between self-efficacy and health knowledge (Long & Stevens, 2004; Rabiei et al., 2013; Reynolds et al., 2002; Rimal 2000; Rimal 2001). Rimal (2000; 2001) found a significant longitudinal relationship between self-efficacy and health knowledge in adults. However, of these studies, only three investigated this relationship in children specifically. A recent study found that

students' self-efficacy was related to nutritional knowledge score (Rabiei et al., 2013). However, unlike the current study, the Rabiei study was cross-sectional, utilized a general self-efficacy measure (as opposed to a dietary self-efficacy measure), limited its assessment to dietary variables, and was conducted within a sample of overweight high school students. Additionally, Reynolds et al (2002) showed a significant correlation between dietary self-efficacy and health knowledge within a primarily white elementary school age sample (however, this significant correlation was only displayed within a table, and was not discussed in the text). A similar study also showed a significant association between dietary self-efficacy and nutritional knowledge of lower fat in male and female adolescents (Long & Stevens, 2004). In contrast to these studies, the current study contributes to the literature as it is the first to ever to show a significant relationship between self-efficacy and knowledge in children longitudinally. These findings are of importance as they may suggest that by targeting self-efficacy, before health knowledge may optimize the impact of a health curriculum.

Baseline findings. In addition to the prospective relationships, the results also indicated that dietary self-efficacy and nutritional knowledge were significantly correlated at baseline. More specifically, higher dietary self-efficacy was associated with higher nutrition knowledge. Thus, the significant longitudinal relationship may be somewhat explained by this significance at baseline. These findings are in line with the three other studies previously mentioned that investigated this relationship in children (Long & Stevens, 2004; Rabiei et al., 2013; Reynolds et al., 2002). Conversely, physical activity self-efficacy was not related to physical activity knowledge at baseline in the current sample. Less is known about this relationship, as this is the first study to

investigate these variables within a physical activity context, so little assumptions can be made about the relationship at baseline. The average physical activity health knowledge score in the current sample was also particularly low at baseline, 38% correct (see Table 4). The health knowledge items were based on the curriculum. The items may have been particularly difficult for the girls at baseline, as they had not been exposed to any curriculum at the time of measurement. Perhaps a more reliable physical activity knowledge assessment with less difficult questions would elicit a significant relationship between baseline physical activity self-efficacy and knowledge.

Previous work also indicates that minorities tend to score lower on health knowledge assessments. More specifically, studies have shown that Black non-Hispanic and Hispanic children score significantly lower than White non-Hispanic students on such assessments (Beech et al., 1999; Fitzpatrick, 2011). Similarly, the current study shows that Black and Hispanic girls tended to score lower on the nutritional knowledge scale at baseline. In the current study, White non-Hispanic girls scored approximately 14% higher than Black non-Hispanic girls, and 8% higher than Hispanic girls on the nutritional knowledge scale at the beginning of the program (see Table 7). This difference may be related to socioeconomic status differences across ethnicities, as quality of schools, and thus health education, tends to vary by SES levels (Currie & Thomas, 2012).

Furthermore, in line with previous research, higher levels of maternal education were related to higher child nutrition knowledge at baseline. While this difference may be partly explained by genetics, as research shows that intelligence and, thus, school achievement is heritable (Plomin & Petrill, 1997), it may also suggest that those mothers with more education and knowledge share more information about health behaviors with

their daughters. Thus, it may be the case that children of mothers with low levels of education are exposed to less health information at home.

End of program findings. Although this study showed a significant longitudinal relationship between health self-efficacy and knowledge, the partial correlations between diet and physical activity self-efficacy and nutritional and physical activity knowledge were non-significant at the end of the program, respectively. These results are interesting as they demonstrate the importance of the uniquely proposed direction between these two variables. Thus, the order in which these social cognitive constructs are acquired may be important. The significant longitudinal relationship suggests that those who enter the health promotion program with higher levels of self-efficacy may be more motivated to learn throughout the program, and thus produce higher health knowledge scores. This significant causal relationship may also underscore important clinical implications, such as the need to intervene on children's self-efficacy *before* a health education curriculum is implemented.

The current study's findings were in line with previous research that showed that age was significantly related to health knowledge and healthy behaviors. More specifically, older girls tended to have higher scores on the nutrition and physical activity knowledge assessment at the end of the program, suggesting that older girls may have benefited more from the GROOVE curriculum. Although the GROOVE curriculum was developed to be appropriate for middle school girls of all ages, older girls might have more advanced vocabulary, and more critical thinking skills than younger middles school age girls. These factors may explain the age related differences in this sample. Also

similar to previous research, higher level of maternal education was significantly related to child physical activity knowledge at the end of the program (see above).

Results also show that Hispanic girls also scored lower on the post-program nutritional knowledge scale compared to girls of other ethnicities. This may be attributed to the fact that the curriculum did not contain any culturally specific health lessons.

Self-Efficacy and Health Behavior

Those with higher levels of self-efficacy are more confident in their capability to change and maintain a behavior (Bandura, 1986, 1997). The Social Cognitive Theory posits that those who demonstrate higher levels of general self-efficacy are hypothesized to be more likely to change unhealthy behaviors. There is a large body of research in children that supports this theory. This research suggests that those children with higher levels of self-efficacy engage in healthier eating habits and more physical activity. Thus, increasing self-efficacy may improve health. The findings of the current study are discussed below and compared to related literature.

Longitudinal findings. The results indicate that healthy weight behaviors were not significantly predicated by baseline dietary or physical activity self-efficacy. These findings are in contrast to most of the previous work that has investigated this relationship longitudinally. Luszczynska et al (2007) showed that a self-efficacy enhancing intervention predicted healthier eating behaviors; however, the study's sample included only adults, and included both genders, compared to the current study which was conducted only in girls. Fitzgerald, Heary, Kelly, Nixon, and Shevlin (2013) also showed that dietary self-efficacy predicted healthy eating behaviors longitudinally, however the study's sample was limited to adolescent boys, who were primarily White.

Also contrary to the current study's findings, there are several studies that suggest self-efficacy predicts physical activity in children. DiLorenzo et al. (1998) indicated that self-efficacy for physical activity was an important predictor of physical activity in a predominantly White sample of adolescent boys and girls. Reynolds et al. (1990) also investigated self-efficacy and activity. Two multiple regression models (one for boys and one for girls) showed that physical activity was significantly predicted by self-efficacy in boys. Self-efficacy was the only variable in the regression model for boys that significantly predicted behavior longitudinally. In contrast, the regression model for girls showed that intention, stress, and social influence were all significant predictors of physical activity but that self-efficacy was not. This suggests that other social factors may be more predictive of physical activity in girls specifically, and that gender composition should be taken to into account when designing similar studies and health promotion programs.

Utilizing the data from Lifestyle Education for Activity Program (LEAP) intervention, Dishman and colleagues (Dishman et al., 2004; Dishman et al., 2005) reported several findings that are relevant to the current study. It was shown that physical activity was predicted by physical activity self-efficacy in a sample of ethnically diverse adolescent girls. However, there are a few key differences between Dishman's research and the current study. A major difference is that the intervention described by Dishman lasted close to a year, compared to the GROOVE program, which was three weeks long. And, the Dishman studies were comprised of a predominately minority sample, though most of the girls were African American and only 14% were Hispanic (Dishman et al., 2005), compared to the current study where more than half of the sample was Hispanic.

Trost et al. (1997) found a significant relationship between self-efficacy and behavior in African American fifth graders. Trost et al (1997) also utilized the same self-efficacy measure as the current study. However, only one of the physical activity self-efficacy subscales, self-efficacy for overcoming barriers (to being active), predicted physical activity behavior. This study suggests that believing that one is capable of overcoming barriers to physical activity may lead to higher activity levels. It is important to note, however, while the current study utilized pedometer determined average daily activity as the outcome variable, the Trost study utilized self-reported moderate to vigorous activity as the outcome variable. Thus, this may indicate that self-efficacy for overcoming physical activity barriers may be most predictive of self-reported strenuous activity and may not generalize to objectively determined activity.

While the majority of the literature suggests a significant direct relationship between health self-efficacy and behavior, some previous work has proposed that self-efficacy may only predict healthy behavior implementation only if people *want to change the behavior* (Abusabha & Achterberg, 1997). Intention to change behavior, however, was not assessed in the current study. Relatedly, it has also been shown that that higher self-efficacy levels in children predicted behavioral intention more than behavior implementation (Povey, Conner, Sparks, James, & Shepherd, 2000). These findings may suggest that locus of control and attitude, both components of the social cognitive theory, may be moderators to health behavior engagement and self-efficacy. Moreover, related studies also imply that the relationship between healthy behaviors and self-efficacy may be mediated by self-management strategies, stress, social influence, enjoyment, thoughts, and previous behavior experiences (Dishman et al., 2005; Reynolds et al., 2002). While

these constructs were not assessed in the current sample, future studies may benefit from investigating these relationships with the previously mentioned variables as possible mediators.

Baseline Findings. After reviewing the literature, it was found that a majority of the studies that explored the relationship between self-efficacy and healthy behaviors in children were cross-sectional studies. Of these studies, most suggest a positive relationship between self-efficacy and healthy behaviors (Gallaway, Jago, Baranowski, Baranowski, & Diamond, 2007; Glasofer et al., 2013; Long & Stevens, 2004; Lubans et al., 2011).

The current study found a significant correlation between dietary self-efficacy and fruit and vegetable consumption at baseline. More specifically, those with higher levels of dietary self-efficacy tended to eat healthier at the beginning of the program as evidenced by a positive parameter estimate at baseline. This finding is in line with many other studies that suggest a positive association between efficacy and healthy eating in children (Gallaway et al., 2007; Glasofer et al., 2013; Long & Stevens, 2004). Conversely, the association between physical activity self-efficacy and activity levels was not significant. This contradicts previous research that suggests a significant positive relationship between these two variables. For example, Reynolds et al. (1990) study showed a significant correlation between self-efficacy and physical activity in high school boys and girls.

Previous studies also indicate that, as children age, their frequency of healthy eating behavior and physical activity decreases (Caspersen, Pereira, & Curran, 2000; Larson et al., 2007; Sweeting, 2008). Similarly, the current study found that younger girls

tended to eat healthier at baseline, however, there were no age differences in healthy eating behavior at the end of the program. Unexpectedly, fruit and vegetable consumption decreased for both age groups, but more so for younger girls. There were no age differences in physical activity at the beginning or end of the program. Yet, not surprisingly, the girls at the New York site tended to be more active at both time points. Furthermore, the participants at the New York site also tended to have higher dietary self-efficacy scores at the end of the program. This may be due to instructor or classroom differences.

The current study found that lower levels of maternal education were related to healthier eating behavior at baseline. These findings contradict previous work that shows children of mothers with higher levels of education tend to engage in healthier behaviors (He et al., 2013; Saxton et al., 2009). However, these related studies lacked ethnic diversity (He et al., 2013; Saxton et al., 2009). As these findings contradict previous literature, further research on this relationship within predominantly Hispanic families is warranted. These findings also conflict with the findings that higher maternal education is related to higher child health knowledge scores (Crawford et al., 1995; He et al., 2013; Saxton et al., 2009). This may suggest that, though educated mothers share more health information with their daughters, they are not necessarily encouraging healthy habits at home.

End of Program Findings. The current study's findings also show that the partial correlation between self-efficacy and healthy behaviors was non-significant at the end of the program. These results are in contrast with previous work, described above (Gallaway, Jago, Baranowski, Baranowski, & Diamond, 2007; Glasofer et al., 2013;

Long & Stevens, 2004; Lubans et al., 2011; Reynolds et al., 1990). It is important to note that dietary self-efficacy, healthy eating behaviors, and physical activity did not significantly improve throughout the program (See Table 3 and 4). In fact, the frequency of eating fruits and vegetables significantly decreased across time (See Table 4). The relationship between health self-efficacy and healthy behaviors may be more pronounced in a more intensive program with a greater effect on efficacy and behaviors.

Moreover, these non-significant findings may be in line with some research that has shown that increasing children's healthy behaviors actually lowers their self-efficacy (Kane et al., 2013). Though the current study does not show a significant decrease in self-efficacy, the GROOVE participants' dietary self-efficacy did not increase (see Table 3). Perhaps, the participants over estimated their ability to eat healthy at baseline. As they realized how difficult changing eating habits might be, they may have recognized that they overestimated their ability at baseline; thus, their self-efficacy did not improve as their behaviors improved. This phenomenon may have weakened the relationship between efficacy and behavior over time.

Health Knowledge and Health Behavior

The Knowledge-Attitude-Behavior Model (Bettinghaus, 1986) hypothesizes that, as knowledge is accumulated, the attitudes toward a behavior changes, making the behavior more likely to occur (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2003). Theoretical models such as this serve as a foundation for health education interventions. Generally, findings show that health education's interventions are shown to increase healthy weight behaviors (Baranowski et al., 2000; Contento, Randell, & Basch, 2002; Luepker et al., 1996). Although, there are very few studies that examine the direct

effect of *operationalized* health knowledge on behaviors, generally, these studies show

that higher operationalized health knowledge is related to healthy behaviors (DiLorenzo

et al., 1998; Gracey et al., 1996; Kenkel, 1991; Pirouznia, 2000; Powers et al., 2005;

Shah et al., 2010; Stucky-Ropp & DiLorenzo, 1993). As mentioned above, assessing an

actual health knowledge score is important as increased knowledge may result in positive

attitudes toward being healthy, and may lead to a fear of the risks associated with

unhealthy habits.

   Longitudinal Findings. This study's results indicate that greater knowledge at

baseline may not necessarily lead to positive behavior change over the course of the

three-week health promotion program, which contradicts findings from two similar

studies. Specifically, physical activity at the end of the program was not predicted by

health knowledge at baseline. Interestingly, results from the dietary model indicated that,

controlling for covariates, those with greater health knowledge actually had poorer

dietary habits at the end of the program. However, as noted in the results, the path

estimate was not practically significant (see Table 10). Furthermore, Hispanic was the

referent group for ethnicity, which was controlled for when this relationship was tested.

Therefore, the estimate may be negative as Hispanics tended to have lower health

knowledge scores at Week 1, compared to non-Hispanics (see Table 9).

   The two related studies that were found suggest a significant relationship between

these two variables longitudinally. For example, Gracey et al. (1996) found that higher

scores on a health knowledge assessment predicted more variation in foods consumed in

a sample of predominantly White high school boys and girls. DiLorenzo et al. (1998)

found a significant causal relationship between physical activity knowledge and physical

activity in a predominately White sample of boys and girls. The lack of diversity in these studies may explain the current study's contradictory results as studies show racial disparities in physical activity (Brodersen et al., 2007).

While the relevant literature suggests that those with higher health knowledge are more likely to engage in healthier behaviors, this relationship may be affected by many environmental, social, and behavioral factors that were not assessed by the current study. Behavioral capability may affect the knowledge-behavior relationship. Behavioral capability is defined as the knowledge or skills needed to learn and perform a behavior of interest (Glanz, Rimer, & Lewis, 2002). In other words, a person should know what a behavior entails before engaging in it. Behavioral capacity may not have been achieved in the current sample. In the current study, the participants' average nutritional and physical activity knowledge scores were low (56% of nutritional items correct and 38% of physical activity items correct at baseline; 62% of nutritional items correct and 53% of physical activity items correct at the end of the program, see Table 3). Furthermore, as mentioned above, the Knowledge-Attitude-Behavior model suggests that as knowledge about a behavior is gained, the attitudes toward that behaviors changes; thus, the behavior is more likely to occur (Baranowski et al., 2003). While intensive, the three-week program may not have been long enough to ensure mastery of health topics and create attitude change. Although these scores significantly improved over the program (see Table 3), the relationship between knowledge and behavior may be more pronounced following a longer intervention.

Nonetheless, a few studies have reported results similar to those of the current study showing that there might be a gap in health knowledge and behavior in children

(Räsänen et al.,2001; Taylor et al., 2005). For instance, adolescents with high levels of knowledge of healthy foods have little regard for eating healthy (Croll et al., 2001). Thus, children may not always apply all the knowledge that they have. Investigating possible mediators, as well as long-term behavioral outcomes following a more intensive health education intervention may show to be more effective in changing behaviors. Further development and expansion of research exploring knowledge's effect on health behavior is necessary.

Baseline findings. The associations between health knowledge and behaviors were not statistically significant. As no similar cross-sectional studies examining the knowledge-physical activity relationship were found, it is unclear how the current study's findings compare to the literature. Clearly, further research on this relationship in children is warranted. The present study's finding of a non-significant relationship between knowledge and eating behavior, however, is in contrast to past research that examined the association of nutrition knowledge and behavior (Pirouznia 2000; Powers et al., 2005; Shah et al., 2010). Powers et al (2005) found a significant, albeit, weak correlation between nutritional knowledge and eating behaviors in a sample younger elementary boys and girls who were mostly White. Shah et al. (2010) also assessed nutritional knowledge's association with healthy weight behaviors. It was found that Asian Indian children (ages 8-18) with higher knowledge were more likely to monitor their weight and steam their food. Furthermore, Pirouznia (2000) found a significant association between nutritional knowledge and healthy food choices in a sample of predominantly White middle school students. Though the current study's findings differ from these findings, Pirouznia's sample was comprised of both boys and girls, and lacked

minority students; so, factors related to gender and ethnicity may help explain this discrepancy.

End of the program findings. Similar to baseline results, there was a non-significant relationship between health knowledge and healthy behaviors at the end of the program. This non-significant partial correlation may be due to the relatively low knowledge scores obtained on both the nutrition knowledge scale (62%) and the physical activity knowledge scale (53%) at the end of the program. Perhaps, in a longer program with a stronger effect on health knowledge, this relationship might be significant. And, as mentioned above, this knowledge-behavior relationship may be affected by many environmental, social, and behavioral factors that are not assessed by the current study. Future studies would benefit from investigating the effect of mediating factors such as attitude, intention, and motivation on this relationship.

Novel Findings

The current study expands upon prior research investigating the relationships between health self-efficacy and health behaviors and between health knowledge and health behaviors. The study contributes to the literature as it is the first to ever investigate the efficacy-knowledge relationship in children longitudinally, it is also the first ever to explore this relationship within the context of physical activity, and was conducted in a sample of middle school age girls of various ethnic backgrounds and weight classifications.

In addition, to my knowledge, the current study is the first to examine the efficacy-behavior as well as the knowledge-behavior relationship in a sample of middle school age girls, where more than half of the sample was Hispanic. And, it is the first

study to show a significant association between dietary self-efficacy and eating behavior in a sample of ethnically diverse middle school age girls.

Study Strengths

This study's unique sample is a strength of the current study. This sample is largely at-risk for an unhealthy weight and decreased healthy habits. Middle school age children are particularly at risk for overweight and obesity as the frequency of healthy weight behaviors are likely to decrease with age (Caspersen et al., 2000; Larson et al., 2007; Sweeting, 2008). Furthermore, focusing on health behaviors and health behavior correlates in minority groups is important as research shows that these groups are at a higher risk for obesity (Wang & Beydoun, 2007). And, although Hispanics are the largest minority group in the United States (Passel, Cohn, & Lopez, 2011), data on the health behaviors, self-efficacy, and health knowledge in this group is relatively scarce.

As discussed above, while a number of studies have found a significant relationship between self-efficacy and health behavior in middle school age girls (Dishman et al., 2004; Dishman et al., 2005; Glasofer et al., 2013; Lubans et al., 2011; Motl et al., 2002; Motl et al., 2005), only a few of these studies were mostly comprised of minority participants (Dishman et al., 2004; Dishman et al., 2005; Motl et al., 2002; Motl et al., 2005). Most of these minority samples were predominantly Black non-Hispanic. As the relationships between self-efficacy, health knowledge and behavior have not been confirmed in a sample of predominately Hispanic middle school age girls, the findings from the current study serve as a basis of comparison for future research.

An additional strength of the current study was its usage of several covariates that similar studies failed to control for. For example, Dishman et al. (2004) investigated the

relationship between health self-efficacy and healthy behaviors, but only controlled for baseline behavior. The current study controlled for age, ethnicity, maternal education, and BMI and baseline measures were covariates for their respective Week 3 measures. Comparing the present study to related studies is difficult, as it cannot be assumed that prior significant findings were not explained by uncontrolled for variables.

This study is also distinct as it utilized an operationalized health knowledge variable. Many studies have investigated health education programs' effects on behavior change (Baranowski et al., 2000; Contento et al., 2002; Luepker et al., 1996). However, most of these studies do not quantitatively measure health knowledge gained from these programs. Thus, it cannot be assumed that children actually learn from these programs.

Finally, a strength of this study is its use of objective data to measure physical activity. Using self-report methods to measure physical activity may introduce response bias, especially in children. Studies show that children have a tendency to over report their health behaviors on health behavior assessments, especially in a health promotion study, as they may be fearful of being seen as 'unhealthy' (Reilly, Penpraze, Hislop, Grant, & Patton, 2008; Sirad & Pate, 2001). Thus, it has been recommended to use accelerometry devices such as the Fitbit to measure physical activity in children as it avoids this reporting bias (Reilly et al., 2008). The current study provided every girl with a Fitbit Zip at the beginning of the program, and encouraged the participants to wear it regularly. Researchers have shown that the Fitbit Zip is a valid measure of physical activity in children and adults (Adam Noah, Spierer, Gu, & Bronner, 2013; Tully, McBride, Heron, & Hunter, 2014). Despite all of this evidence, all of the related studies previously citied utilized a self-report assessment to measure activity in children (i.e.,

physical activity interviews, questionnaires). For example, DiLorenzo et al (1998), Dishman et al (2004; 2005), Reynolds et al (1990), and Trost et al (1997), who all reported a significant relationship between self-efficacy and physical activity, utilized self-report methods to measure physical activity. Thus, the use of subjective data may have affected the previously discussed significant relationships that similar studies have found.

Study Limitations

The current study's limitations also require acknowledgement. First, factors that have been shown to affect these relationships such as behavioral control, behavioral intention, enjoyment in health behaviors, attitudes towards being healthy, and stress were not measured by the current study. Future work should explore these relationships while also controlling for these relevant variables. In addition, the GROOVE summer camp program was only three weeks long. While the camp was accelerated (90 total contact hours), three weeks may not have been a long enough time for knowledge to be engrained, self-efficacy to be established, or health behaviors to be mastered. Lastly, there are a few limitations to the current study that do not make it completely generalizable. First, those girls with learning disabilities that would impede their ability to take weekly measures were excluded. Any girls with limits to their physical activity were also excluded. This study's sample was unique. It was comprised of female middle schoolers (ages 10-14), and more than half of the sample was Hispanic. This also limits the generalizability of the findings. Finally, though, nearly half of the participants were overweight or obese, the other half of the sample were not at an at-risk weight. Therefore, the results may not generalize to an entirely at-risk, overweight population. That being

said, these results may generalize to a broader population, with a variety of weight classifications.

Measurement Limitations

The current study also has certain limitations due to its measurement method of a few of the study variables. First, it is important to note that the nutrition and physical activity knowledge scales' Cronbach alpha reliability coefficients were low at both time points. Thus, it cannot be assumed that the items used to measure health knowledge consistently deliver the same scores. Furthermore, the items on the knowledge assessment were curriculum based. Though attendance throughout the program was controlled for, other factors (program schedule changes, instructor variations, lesson technical difficulties) may have affected the dissemination of the curriculum, and, thus, may have affected these health knowledge scores.

Further, eating behavior was quantified as the frequency of fruit and vegetable consumption *the day before the measure was taken*. Thus, this data may not be illustrative of girls' average diets. Overall, previous studies' assessments of dietary behavior also have limitations. Luszczynska et al (2007) showed a significant longitudinal relationship between dietary self-efficacy and eating behavior. The 2007 study utilized one item on a questionnaire to quantify healthy eating behavior ("*Within the last two weeks, how often have you eaten a portion of fruit and/or vegetables [excluding potatoes]?*"). Although the current study asked more detailed questions about fruit and vegetable consumption, Luszczynska's healthy eating measure asked about eating behaviors *over the past two weeks*. While Luszczynska's item may have been more representative, unlike the current study, the Luszczynska study did not report

psychometrics for their measures. Thus, it cannot be assumed that the measures used were reliable or valid. On the other hand, Fitzgerald et al.'s (2013) study utilized a Food Frequency Questionnaire (FFQ), which has been shown to be a consistent and valid measure of eating behavior, to assess eating habits over the last month. A measure such as the FFQ may provide a more accurate representation of normal eating habits, and thus, a stronger relationship between efficacy and eating behavior. This is not to say that the EBS completely misrepresented girls' eating behaviors. Though the measure only assessed foods eaten the day before, these foods may have been typical for the girl to eat. However, if a girl's eating habits were abnormal the day before taking the measure, the results may be skewed.

In addition, while the EBS (Fahlman et al., 2012) questionnaire was designed to be used in minority youth, the original sample the measure was validated in was almost entirely African American. The EBS was not sensitive to foods from the Hispanic culture (i.e., plantains, ropa vieja, sofrito). As over half of the sample was Hispanic, it may have been difficult for girls to appropriately categorize cultural foods into the EBS food groups.

Finally, the construct of healthy eating behavior was comprised of four items from the EBS, one item assessing fruit consumption, and three items assessing vegetable consumption. The current study's construct of healthy eating behavior was only limited to the fruit and vegetable items as the dietary self-efficacy measure only assessed self-efficacy for fruit and vegetable consumption. The latent variable did not capture unhealthy eating habits. As mentioned previously, the participants did not increase healthy eating behavior over the course of the three-week program (see Table 4).

However, unhealthy behaviors (i.e., soda, candy, and chips consumption) decreased over the three-week period (t (235) = 4.0, $p < .001$). Thus, the current study's results may have been different if the construct of eating behavior was defined by unhealthy habits. All of these measurement differences stated above have contributed to the current study's findings pertaining to eating behavior.

Future Directions and Clinical Implications

As this study is the first to ever explore self-efficacy's longitudinal effect on health knowledge, future research is needed to replicate the findings. Future studies should also explore self-efficacy and health knowledge's effect on health behaviors in more diverse samples such as the current study's sample. While this study did not show a significant positive effect of self-efficacy and health knowledge on health behaviors, the current study was brief and may not have been long enough for behavior change to be observed. Further research should confirm that these relationships exist in a longer, more intensive intervention.

The current study is unique as it measured objective health knowledge. Many previous studies have investigated the effects of health education interventions, but rarely measure the actual knowledge acquired; thus, further research on operationalized health knowledge is needed. Finally, the relationships between health knowledge, self-efficacy, and health behaviors should be further investigated while controlling for other variables the current study did not assess, such as behavioral intention, attitude towards health behaviors, and stress levels.

Overall, implications of this study's findings suggest that it may be advantageous to direct efforts at increasing self-efficacy *before* targeting health knowledge in children.

Research shows that effective methods to increase self-efficacy include assisting individuals in setting realistic goals, creating health behavior 'action plans', educating individuals on resources available to them to become healthy (i.e., navigating the internet to find health information), discussing strategies to deal with barriers to being healthy, and improving problem solving skills (Long & Stevens, 2004; Luszczynska et al., 2007). The findings show that by applying this type of intervention first, children may have more motivation to learn about health behaviors. Thus, children may be more engaged throughout a health education curriculum following a self-efficacy enhancing intervention. Ensuring children are motivated and engaged during health knowledge interventions is critical as this study show that, generally, health knowledge scores are low, especially in minorities. Therefore, cultural adaptions of self-efficacy and health knowledge interventions are warranted. And, as the current study shows that older girls tend to have higher health knowledge scores following a health curriculum, future health education interventions should consider age differences, and adapt variations of the curriculum, to ensure it is age-appropriate. By targeting self-efficacy first, and by making cultural and age-appropriate adaptations, researchers can assure that children can maximize the benefits of health education interventions. This is important as research shows higher health knowledge promotes healthy behaviors by instilling fear of the risks of being unhealthy.

Conclusions

In conclusion, this study found that self-efficacy significantly predicted health knowledge in a sample of ethnically diverse middles school age girls. Very few studies have explored the relationship between these two variables, let alone shown that they are

significantly related over time. These unique findings suggest that improving self-efficacy *before* implementing a health education intervention may be advantageous. Self-efficacy and health knowledge, on the other hand, were not shown to predict healthy behaviors. This finding contradicts previous research; however, this was one of the first to explore these relationships in minorities, and the very first study to investigate these relationships in a middle school age, entirely female, minority sample that is predominately Hispanic. Thus, in this sample, other factors not measured by the current study may predict health behaviors. Further research on these relationships in this unique population is warranted.

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Figures

Figure 1. Proposed measurement model of healthy eating behavior for Week 1 and Week 3.
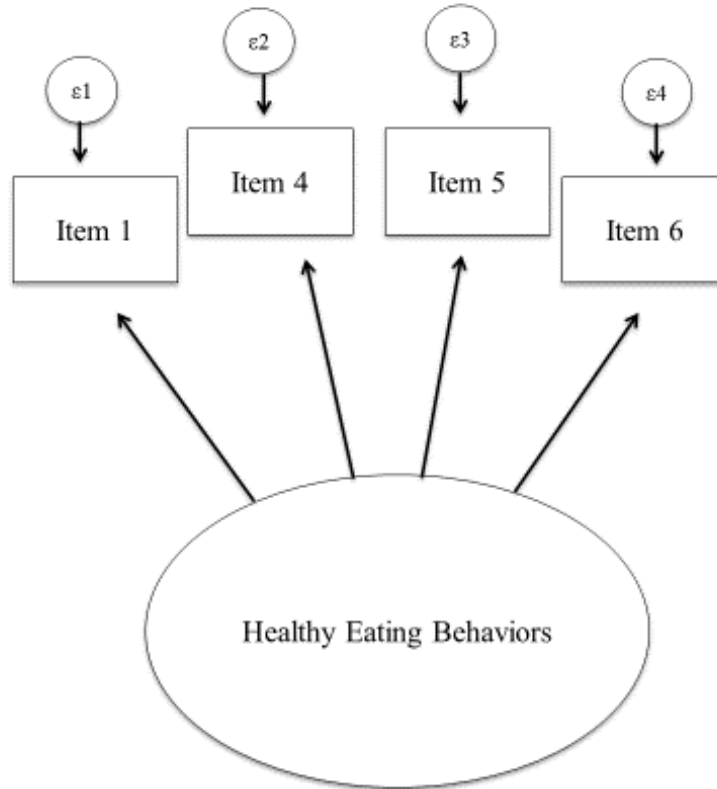
Note. Full item questions not included for the purpose of visual simplicity.
Item 1= "Yesterday, how many times did you eat fruit?", Item 4= "Yesterday, how many times did you eat orange vegetables like carrots, squash or sweet potatoes?", Item 5 = "Yesterday, how many times did you eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?", Item 6= " Yesterday, how many times did you eat any other vegetables like peppers tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes?"

Figure 2. Proposed Structural Dietary Model, baseline and Week 3.
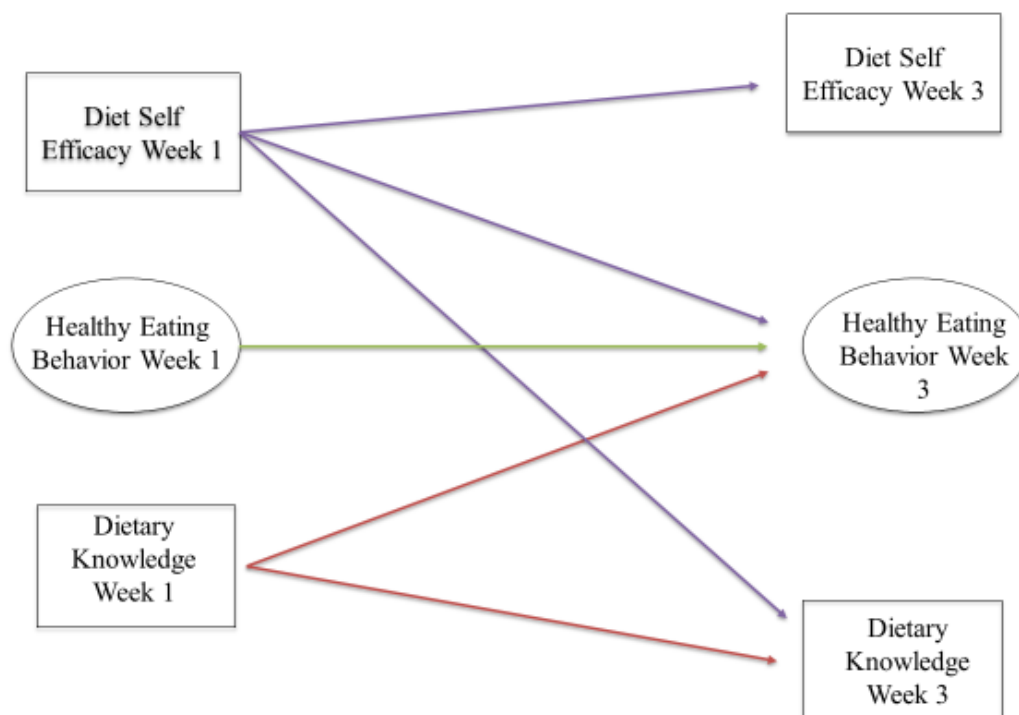
Note. Indicators of latent variables are not included for the purpose visual simplicity. Covariates are not included for the purpose of visual simplicity. Eating covariates: age, maternal education, parental eating behaviors, ethnicity, BMI and attendance and condition (week 3 covariates). Self-efficacy covariates: age, maternal education, and attendance and condition (week 3 covariates). Knowledge covariates: age, maternal education, ethnicity, BMI and attendance and condition (week 3 covariates).

Figure 3. Proposed Structural Activity Model, baseline and Week 3.

Note. Covariates are not included for the purpose of visual simplicity. Physical activity covariates: age, maternal education, parental physical activity behaviors, BMI, ethnicity, and attendance and condition (week 3 covariates). Self-efficacy covariates: age, maternal education, and attendance and condition (week 3 covariates). Knowledge covariates: age, maternal education, ethnicity, BMI and attendance and condition (week 3 covariates).

Figure 4. Measurement Model with Healthy Eating Behavior at Week 1 and Week 3.
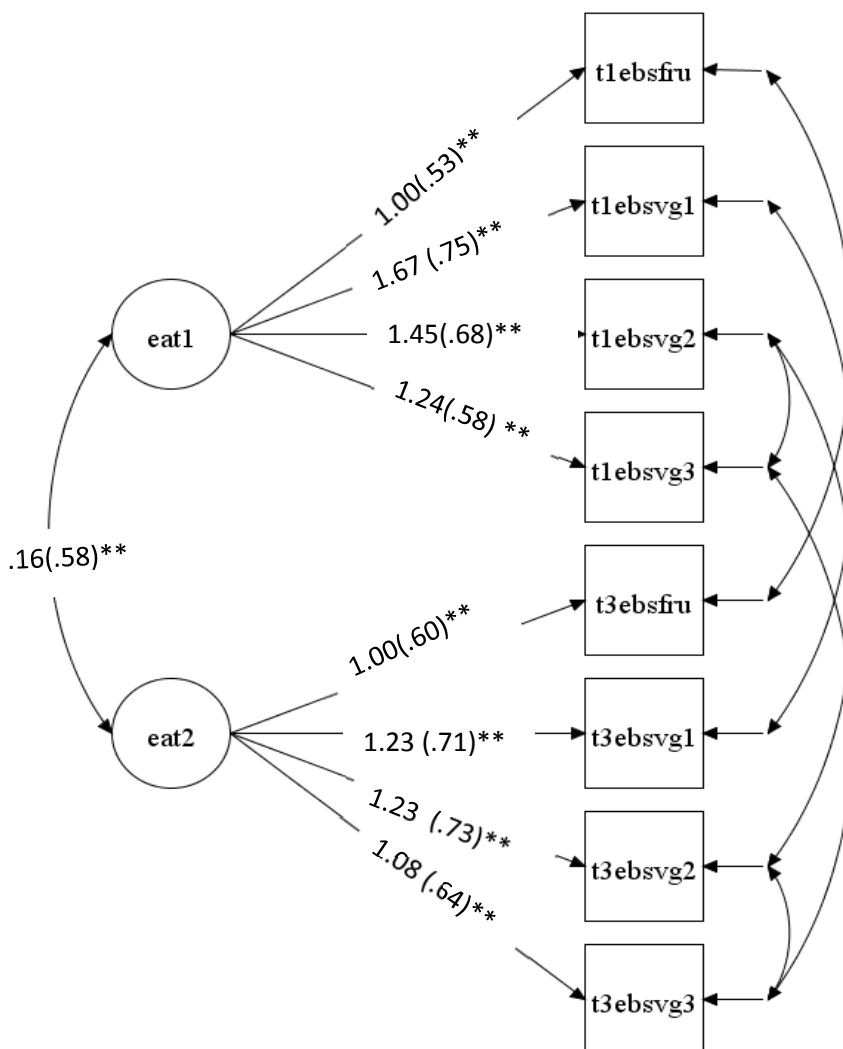
Note. All values represent unstandardized coefficients, standardized coefficients are in parenthesis. eat1= Healthy Eating Behavior at Week 1; eat2= Healthy Eating Behavior at Week 3; ebsfru= daily fruit consumption at Week 1; ebsvg1= daily consumption of orange vegetables like carrots, squash or sweet potatoes; ebsvg2= daily consumption of salads made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens; ebsvg3= daily consumption of any other vegetables like peppers tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes. **p<.001
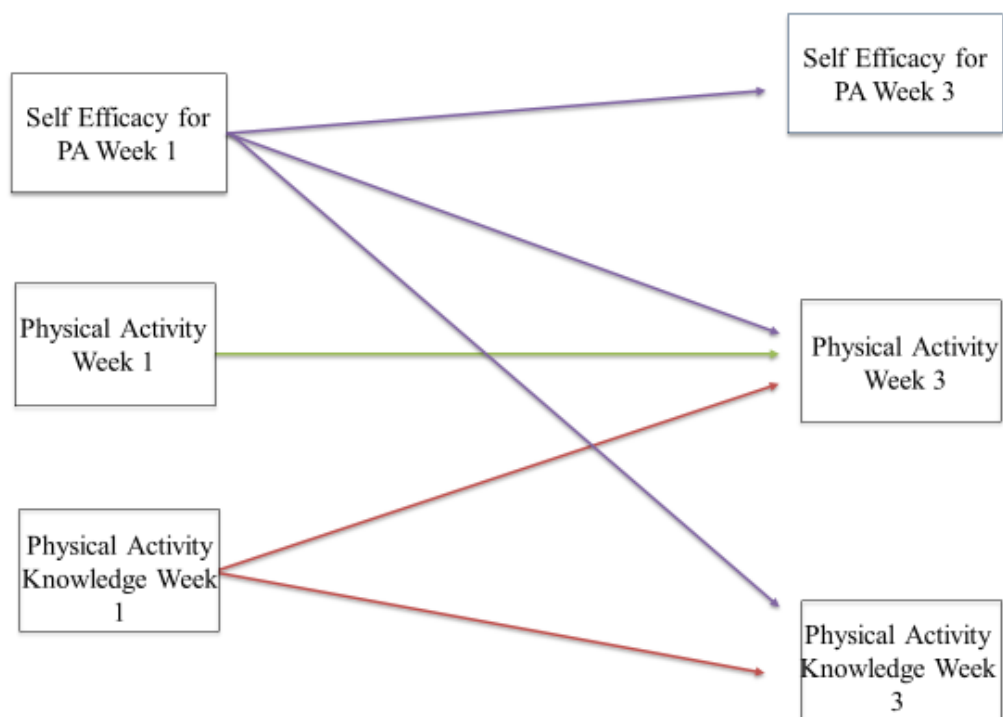
Figure 5: Structural Dietary Model, baseline and week three.
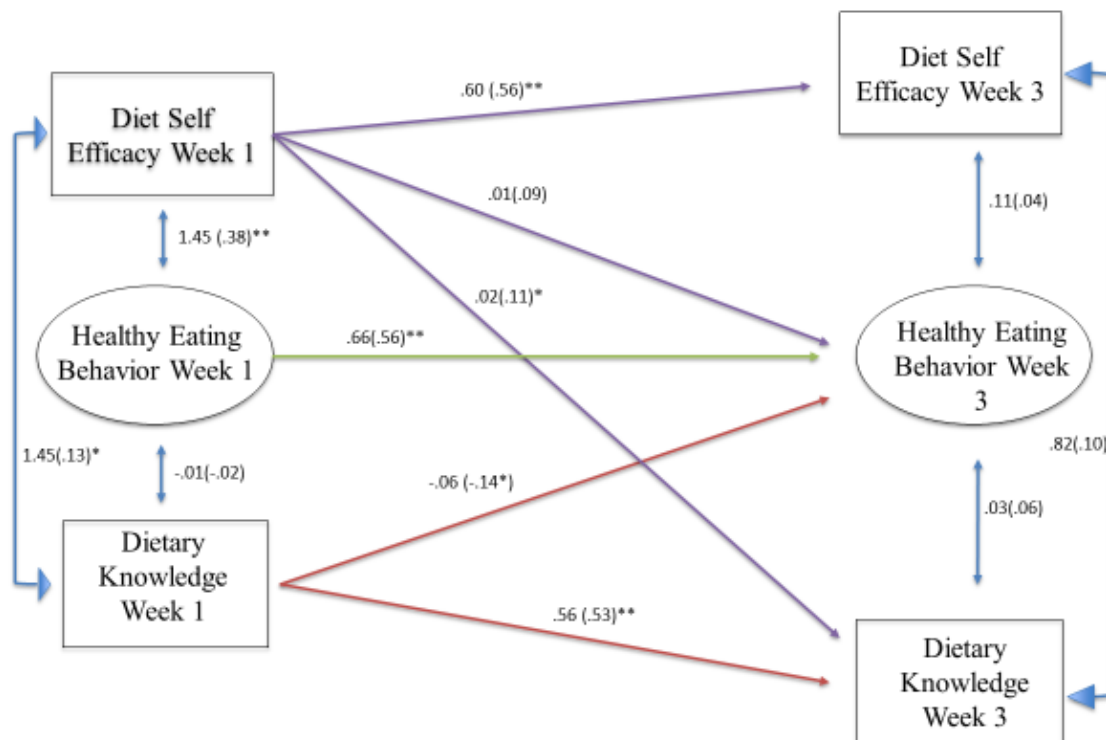
Note. All values represent unstandardized coefficients, standardized coefficients are in parenthesis. Indicators of latent variables are not included for the purpose visual simplicity. Covariates are not included for the purpose of visual simplicity. Eating covariates: age, maternal education, parental eating behaviors, ethnicity, BMI, and attendance and condition (week 3 covariates). Self-efficacy covariates: age, maternal education, attendance and condition (week 3 covariates). Knowledge covariates: age, ethnicity, BMI, maternal education and attendance and condition (week 3 covariates). *p <. 05,** p <. 01.

Figure 6: Structural Physical Activity Model, baseline and week three.
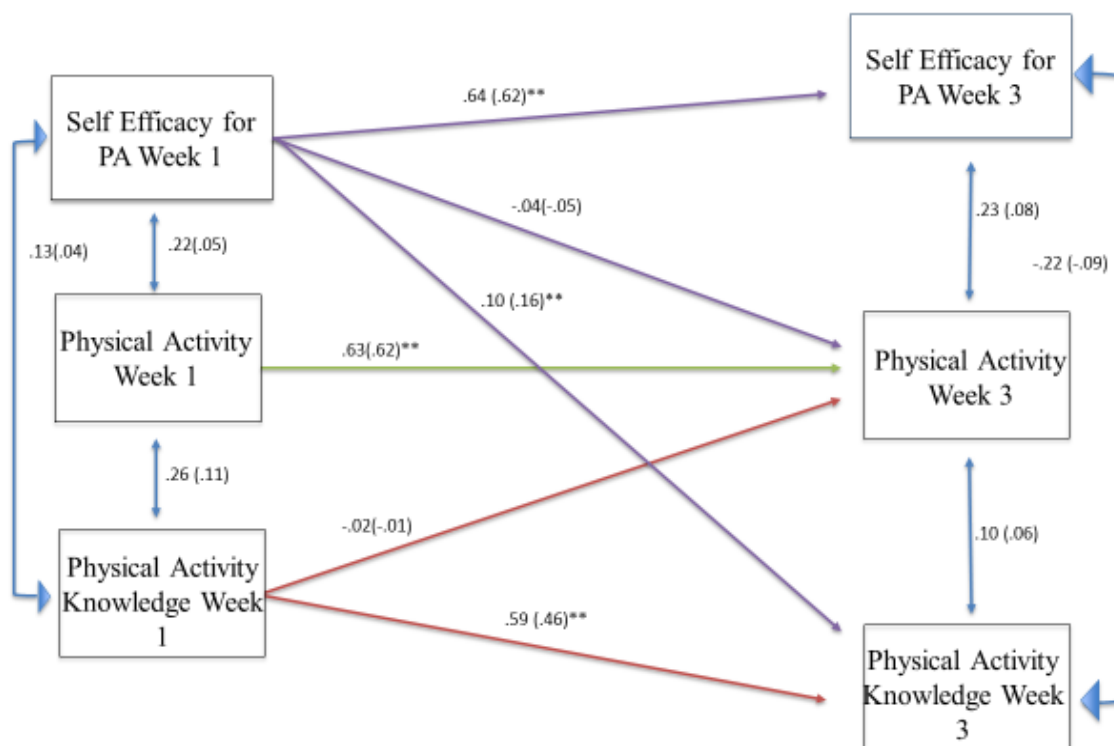
Note. All values represent unstandardized coefficients, standardized coefficients are in parenthesis. Covariates are not included for the purpose of visual simplicity. Physical Activity covariates: age, maternal education, parental physical activity, ethnicity, BMI, and attendance and condition (week 3 covariates). Self-efficacy covariates: age, maternal education, and attendance and condition (week 3 covariates). Knowledge covariates: age, maternal education ethnicity, BMI, and attendance and condition (week 3 covariates). *p <. 05,** p <. 01.

Tables

Table 1.

Demographics/Covariates at Baseline

	N	M (SD)	Range
Age (years)	288	11.8 (.93)	10-14
Maternal Education (years)	275	15.5 (3.85)	6-23
Parent Eating Behavior Score	267	5.8 (1.55)	1-8
BMI (kg/m^2)	270	21.3 (4.9)	12.2-40.4

Note. N's range from 267 to 288 due to missing data.

Table 2.

Categorical Baseline Demographic/Covariate Variables

	N	%
Ethnicity	**286**	
Hispanic	159	55.6%
White non-Hispanic	24	8.4%
Black non-Hispanic	53	18.5%
Asian non-Hispanic	39	13.6%
Mixed non-Hispanic	9	3.2%
Other non-Hispanic	2	.7%
Parent Physical Activity	**265**	
30 minutes or more/day	159	60%
Less than 30 minutes/day	106	40%

Note. Ns range from 265 to 286 due to missing data.

Table 3.

Study Variables at Week 1 and Week 3.

		Week 1			Week 3		
	N	M (SD)	Range	N	M (SD)	Range	*t*-Statistic
Fruit & Vegetable Self-Efficacy	286	42.9 (7.5)	18-54	238	43.8 (8.2)	18-54	1.54
Physical Activity Self-Efficacy	279	10.4 (2.5)	0-13	237	10.8 (2.6)	0-13	2.35*
Nutritional Knowledge	288	4.4 (1.5)	1-8	244	5.0 (1.6)	0-8	5.37**
Physical Activity Knowledge	288	2.3 (1.2)	0-6	245	3.2 (1.6)	0-6	9.17**
Average Miles Walked/Day	249	4.0 (2.0)	0-14.5	219	3.8 (2.1)	.2-13.3	1.67

Note. N's range from 219 to 288 due to missing data. *p<.05 **p<.01

Table 4.

Healthy Eating Behavior Measurement Model Items at Week 1 and Week 3.

Eating Behavior Survey Item	Week 1 N	Week 1 %	Week 3 N	Week 3 %	χ^2
Item 1	**266**		**236**		**47.98****
0 Times	21	7.9%	16	6.8%	-
1 Time	41	15.4%	64	27.1%	-
2 Times	86	32.3%	84	35.6%	-
3 or More Times	118	44.4%	72	30.5%	-
Item 4	**266**		**236**		**52.47****
0 Times	115	43.2%	120	50.8%	-
1 Time	60	22.6%	72	30.5%	-
2 Times	49	18.4%	24	10.2%	-
3 or More Times	42	15.8%	20	8.5%	-
Item 5	**266**		**236**		**76.45****
0 Times	52	19.9%	67	28.4%	-
1 Time	103	38.7%	103	43.6%	-
2 Times	45	16.9%	41	17.4%	-
3 or More Times	65	24.4%	25	10.6%	-
Item 6	**266**		**236**		**49.24****
0 Times	71	26.7%	96	40.7%	-
1 Time	87	32.7%	88	37.3%	-
2 Times	54	20.3%	34	14.4%	-
3 or More Times	54	20.3%	18	7.6%	-

Note. Ns range from 236 to 266 due to missing data. Item 1= "Yesterday, how many times did you eat fruit?", Item 4= "Yesterday, how many times did you eat orange vegetables like carrots, squash or sweet potatoes?", Item 5 = "Yesterday, how many times did you eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?", Item 6= " Yesterday, how many times did you eat any other vegetables like peppers tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes?" **p<.01.

Table 5.

Ethnic/Racial Differences: Healthy Eating Behavior Measurement Model Items at Week 1.

Eating Behavior Survey Item	Hispanic	White non-Hispanic	Black non-Hispanic	Asian non-Hispanic	Mixed non-Hispanic	Other non-Hispanic
Item 1						
0 Times	7.5%	4.5%	6.4%	10.3%	12.5%	50%
1 Time	13.0%	18.2%	21.3%	15.4%	25.0%	0%
2 Times	32.9%	36.4%	23.4%	38.5%	37.5%	0%
3 or More Times	46.6%	40.9%	48.9%	35.9%	25.0%	50%
Item 4						
0 Times	42.5%	36.4%	40.4%	46.2%	62.5%	100%
1 Time	22.6%	40.9%	10.6%	25.6%	37.5%	0%
2 Times	21.2%	13.6%	14.9%	17.9%	0%	0%
3 or More Times	13.7%	9.1%	34.0%	10.3%	0%	0%
Item 5						
0 Times	23.3%	13.6%	12.8%	17.9%	25%	50%
1 Time	36.3%	50.0%	42.6%	30.8%	62.5%	50%
2 Times	15.8%	18.2%	14.9%	25.6%	12.5%	0%
3 or More Times	24.7%	18.2%	29.8%	25.6%	0%	0%
Item 6						
0 Times	30.1%	13.6%	34.0%	12.8%	25%	0%
1 Time	32.2%	27.3%	38.3%	28.2%	37.5%	50%
2 Times	17.1%	36.4%	6.4%	35.9%	37.5%	50%
3 or More Times	20.5%	22.7%	21.3%	23.1%	0%	0%

Note. Item 1= "Yesterday, how many times did you eat fruit?", Item 4= "Yesterday, how many times did you eat orange vegetables like carrots, squash or sweet potatoes?", Item 5 = "Yesterday, how many times did you eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?", Item 6= " Yesterday, how many times did you eat any other vegetables like peppers tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes?"

Table 6.

Ethnic/Racial Differences: Healthy Eating Behavior Measurement Model Items at Week 3.

Eating Behavior Survey Item	Hispanic	White non-Hispanic	Black non-Hispanic	Asian non-Hispanic	Mixed non-Hispanic	Other non-Hispanic
Item 1						
0 Times	7.1%	0%	16.3%	0%	0%	0%
1 Time	22.8%	31.6%	30.2%	38.9%	0%	50%
2 Times	40.9%	31.6%	16.3%	41.7%	42.9%	0%
3 or More Times	29.1%	36.8%	37.2%	19.4%	57.1%	50%
Item 4						
0 Times	48.8%	52.6%	53.5%	52.8%	57.1%	50%
1 Time	33.9%	21.1%	23.3%	30.6%	28.6%	50%
2 Times	9.4%	26.3%	9.3%	8.3%	0%	0%
3 or More Times	7.9%	0%	14.0%	8.3%	14.3%	0%
Item 5						
0 Times	28.3%	21.1%	30.2%	25.0%	57.1%	50%
1 Time	42.5%	63.2%	37.2%	47.2%	28.6%	50%
2 Times	18.1%	15.8%	16.3%	19.4%	0%	0%
3 or More Times	11.0%	0%	16.3%	8.3%	14.3%	0%
Item 6						
0 Times	40.2%	31.6%	55.8%	27.8%	42.9%	0%
1 Time	35.4%	52.6%	27.9%	50.0%	28.6%	50%
2 Times	15.0%	15.8%	11.6%	16.7%	14.3%	0%
3 or More Times	9.4%	0%	4.7%	5.6%	14.3%	50%

Note. Item 1= "Yesterday, how many times did you eat fruit?", Item 4= "Yesterday, how many times did you eat orange vegetables like carrots, squash or sweet potatoes?", Item 5 = "Yesterday, how many times did you eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?", Item 6= " Yesterday, how many times did you eat any other vegetables like peppers tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes?"

Table 7.

Ethnic/Racial Differences: Study Variables at Week 1 and Week 3

Variable	Hispanic M (SD)	White nH M (SD)	Black nH M (SD)	Asian nH M (SD)	Mixed nH M (SD)	Other nH M (SD)
Fruit & Vegetable Self-Efficacy						
Week 1	42.4 (7.6)	43.1 (6.8)	44.5 (6.7)	43.0 (8.0)	40.6 (10.1)	41.5 (6.4)
Week 3	43.7 (8.4)	44.7 (6.2)	44.6 (6.3)	43.4 (8.9)	43.4 (13.4)	40.0 (15.6)
Physical Activity Self-Efficacy						
Week 1	10.4 (2.5)	10.4 (2.4)	10.5 (3.0)	10.2 (2.3)	10.6 (2.2)	13.0 (0.0)
Week 3	10.6 (2.7)	11.1 (2.3)	11.4 (2.3)	10.4 (2.5)	11.3 (1.0)	12.5 (0.7)
Nutritional Knowledge						
Week 1	4.4 (1.4)	5.0 (1.6)	3.9 (1.5)	4.6 (1.6)	5.1 (1.6)	5.0 (1.4)
Week 3	4.6 (1.6)	5.6 (1.3)	5.0 (1.6)	5.7 (1.7)	5.3 (1.1)	5.0 (2.8)
Physical Activity Knowledge						
Week 1	2.2 (1.3)	2.2 (1.1)	2.1 (1.1)	2.5 (1.1)	2.9 (1.4)	2.5 (0.7)
Week 3	3.0 (1.6)	3.4 (1.5)	3.0 (1.6)	3.8 (1.4)	3.6 (1.7)	2.5 (0.7)
Average Miles Walked/Day						
Week 1	4.1 (2.2)	3.7 (1.7)	3.3 (1.7)	4.5 (1.7)	3.3 (0.7)	4.9 (2.8)
Week 3	3.8 (0.8)	4.2 (2.2)	3.4 (2.0)	4.3 (1.7	3.6 (0.8)	4.4 (1.8

Note. *nH= non-Hispanic

Table 8.

Healthy Eating Behavior Measurement Model Week 1 Item Loadings

Item	Unstandardized Values		Standardized Values		
	β	SE	β	SE	*p*
Item 1	1.00	.00	.53	.06	<.001**
Item 4	1.67	.24	.75	.05	<.001**
Item 5	1.45	.22	.68	.05	<.001**
Item 6	1.24	.20	.58	.06	<.001**

Note. Item 1= "Yesterday, how many times did you eat fruit?", Item 4= "Yesterday, how many times did you eat orange vegetables like carrots, squash or sweet potatoes?", Item 5 = "Yesterday, how many times did you eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?", Item 6= " Yesterday, how many times did you eat any other vegetables like peppers tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes?" ** *p<.01*

Table 9.

Healthy Eating Behavior Measurement Model Week 3 Item Loadings

Item	Unstandardized Values		Standardized Values		
	β	SE	β	SE	*p*
Item 1	1.00	.00	.60	.05	<.001**
Item 4	1.23	.17	.71	.05	<.001**
Item 5	1.23	.17	.73	.05	<.001**
Item 6	1.08	.16	.64	.06	<.001**

Note. Item 1= "Yesterday, how many times did you eat fruit?", Item 4= "Yesterday, how many times did you eat orange vegetables like carrots, squash or sweet potatoes?", Item 5 = "Yesterday, how many times did you eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?", Item 6= " Yesterday, how many times did you eat any other vegetables like peppers tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes?" ** *p<.01*

Table 10.

Dietary structural model path coefficients, standard errors, and significance for direct effects

Path	Unstandardized Values		Standardized Values		
	β	SE	β	SE	*p*
Eating Behavior Week 1 => Eating Behavior Week 3	.66	.14	.56	.08	<.001**
Nutrition Knowledge Week 1 => Nutrition Knowledge Week 3	.56	.06	.53	.05	<.001**
Dietary Self-Efficacy Week 1 => Dietary Self-Efficacy Week 3	.60	.06	.56	.05	<.001**
Nutrition Knowledge Week 1 => Eating Behavior Week 3	-.06	.03	-.14	.07	.045*
Dietary Self-Efficacy Week 1 => Eating Behavior Week 3	.01	.01	.09	.08	.245
Dietary Self-Efficacy Week 1 => Nutrition Knowledge Week 3	.02	.01	.11	.06	.041*

Note. * p<.05. ** p<.01

Table 11.

Physical Activity structural model path coefficients, standard errors, and significance for direct effects

Path	Unstandardized Values		Standardized Values		
	β	SE	β	SE	*p*
Physical Activity Week 1 => Physical Activity Week 3	.63	.06	.66	.04	<.001**
Physical Activity Knowledge Week 1 => Physical Activity Knowledge Week 3	.59	.07	.45	.05	<.001**
Physical Activity Self-Efficacy Week 1 => Physical Activity Self-Efficacy Week 3	.64	.06	.62	.04	<.001**
Physical Activity Knowledge Week 1 => Physical Activity Week 3	-.02	.09	-.02	.06	.804
Physical Activity Self-Efficacy Week 1 => Physical Activity Week 3	-.04	.05	- .04	.06	.417
Physical Activity Self-Efficacy Week 1 => Physical Activity Knowledge Week 3	.10	.04	.16	.06	.005*

Note. * p<.05. ** p<.01

Appendix A

GROOVE

Family Background and Habits Questionnaire

1. What is **today's date?** _____

2. **Adult** completing this form. *Choose one of the following answers:*
   ☐ Mother　　☐ *Father*　☐*Guardian*

3. What is your **child's age**? *Choose one of the following*
   answers:
   ☐11　☐12　☐13　☐14

4. What **grade is your child** in? *Choose one of the following answers:*
   ☐5ᵗʰ　☐6ᵗʰ　☐7ᵗʰ　☐8ᵗʰ

5. Country where the **child's grandparents** were born:
   _____

6. Country where your **child** was born: _____

7. If born outside the USA, how many years has your **child** lived in the USA?
   _____

8. What is your child's background/heritage? *Choose all that apply:*
   A.　White, non-Hispanic
   B.　African-American
   C.　Asian
   D.　Dominican
   E.　Cuban American
   F.　Mexican American
   G.　Puerto Rican
   H.　Central American
   I.　South American
   J.　Other Hispanic/Latino background　*(fill in below)*

   _____
   K.　American Indian
   L.　Caribbean Black
   M.　Haitian American
   N.　Other ethnic background　*(fill in below)* _____

9. What is **your** marital status? *Choose one of the following answers:*
   A.　Single
   B.　Married
   C.　Divorced
   D.　Widowed

10. Circle the highest year of school completed by the **Father** of the child: *Choose one of the following*
    answers:
    1　2　3　4　5　6　7　8　　　9　10　11　12

    13　14　15　16　　　17　18　19　20　21　22
    23+

11. Circle the highest year of school completed by the **Mother** of the child: *Choose one of the following answers:*

1 2 3 4 5 6 7 8   9 10 11 12

13 14 15 16   17 18 19 20 21 22

23+

12. How many people live in your home? _____

13. How many children are in the family? _____

14. How many days a week does the **family** usually **eat dinner together**? *Choose one of the following answers:*
0 1 2 3 4 5 6 7

15. How many days a week does your **child** usually **eat fast food**? *Choose one of the following answers:*
0 1 2 3 4 5 6 7

16. How many days a week does your **child** usually eat breakfast? *Choose one of the following answers:*
0 1 2 3 4 5 6 7

17. Does your **child** eat fruit every day? *Choose one of the following answers:*
A. Yes
B. No

18. Does your **child** eat vegetables *(do not count white potatoes)* every day? *Choose one of the following answers:*
A. Yes
B. No

19. Rate your **child's** eating habits: *Choose one of the following answers:*
A.   Poor
B.   Fair
C.   Good
D.   Very Good

20. How physically active is your **child**? *Choose one of the following answers:*
A.   Not active
B.   Somewhat active
C.   Active
D.   Very active

21. Describe your **child's** weight: *Choose one of the following answers:*
A.   Very underweight
B.   Slightly underweight
C.   About the right weight
D.   Slightly overweight
E.   Very overweight

22. During the past 12 months, how many sports teams has your **child** played on? *(Include any school or community sports teams.) Choose one of the following answers:*

0 1 2 3 4 5 6 7
(Sports teams played on)

23. How many hours a night does your child usually sleep? *Choose one of the following answers:*
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15$^+$
(Hours per night)

24. How many days a week is your **child** usually physically
active for a total of at least 60 minutes? *(Add up all the time she spent in any kind of physical activity that would increase her heart rate and make her breathe hard some of the time.) Choose one of the following answers:*
0 1 2 3 4 5 6 7
(Days per week)

25. On an average school day, how many hours a day does
your **child** usually play video or computer games or use a computer for something that is not schoolwork? *(Include activities such as Nintendo, Game Boy, PlayStation, Xbox, computer games, and the Internet.) Choose one of the following answers:*
0 1 2 3 4 5 6 7 8 9 10
(Hours per day)

26. How many hours a day does your **child** usually watch
TV? *Choose one of the following answers:*
0 1 2 3 4 5 6 7 8 9 10
(Hours per day)

27. How would you describe your **child's** health? *Choose one of the following answers:*
A. Poor
B. Fair
C. Good
D. Very Good
E. Excellent

28. How interested is your **child** in learning about health topics? *Choose one of the following answers:*
A. Not interested
B. Somewhat interested
C. Interested
D. Very interested

29. How interested is your **child** in learning about science? *Choose one of the following answers:*
A. Not interested
B. Somewhat interested
C. Interested
D. Very interested

30. Does your child have any learning accommodations? *Choose one of the following answers:*
A. No
B. Yes

31. If your child has any learning accommodations, please
describe them below:

_____

For each question below, please answer what is true for YOU *(the ADULT completing this questionnaire).*

On a typical day, do **YOU**:	*Choose one of the following below:*		
32. drink a can, bottle, or glass of SODA or POP, such as Coke, Pepsi, or Sprite? (*Do not include diet soda or diet pop.*)	NO	ONCE	TWICE OR MORE
33. eat VEGETABLES? (*Do not count white potatoes.*)	NO	ONCE	TWICE OR MORE
34. eat FRUIT or drink 100% FRUIT JUICE?	NO	ONCE	TWICE OR MORE
35. eat FAST FOOD?	NO	ONCE	TWICE OR MORE
36. eat CANDIES or SWEETS such as Cookies, Doughnuts, Pie, or Cake?	NO	ONCE	TWICE OR MORE
37. eat DINNER that is COOKED by you or someone else in the family?	NO	YES	
38. take part in physical activity for at least 30 minutes? (*Add up all the time YOU spent in any kind of physical activity that would increase your heart rate and make you breathe hard some of the time*).	NO	YES	

SE Survey – Eating, Asking, Preparing FVs
Instructions: Please read each statement below and <u>MARK an "X"</u> in the column that best describes how sure you are that you can do the following.

How sure am I that I can:	Not sure	I think so	Very Sure
1. Eat fruits I like (such as bananas or raisins) at BREAKFAST			
2. Eat vegetables I like (such as green peppers or tomatoes) at BREAKFAST			
3. Drink a glass of my favorite juice (such as orange juice or apple juice) with my BREAKFAST			
4. Eat fruits I like (such as applesauce or fruit cocktail) at LUNCH			
5. Eat vegetables I like (such as salad or a plain baked potato) at LUNCH			
6. Drink a glass of my favorite juice (such as grape juice or V-8 juice) with my LUNCH			
7. Eat fruits I like (such as apples or oranges) for dessert at DINNER			
8. Eat vegetables I like (such as corn or beans) at DINNER			
9. Drink a glass of my favorite juice (such as tomato juice or orange juice) with my DINNER			
10. Snack on fruits I like (such as grapes or bananas) instead of on foods like cake or cookies			
11. Snack on vegetables I like (such as carrot or celery sticks) instead of foods like potato or corn chips			
12. Drink a glass of my favorite juice (such as apple juice or grape juice) with my snack			
13. Ask my mom or dad to buy fruits for snacks			
14. Ask my mom or dad to fix my favorite vegetable dishes at DINNER			
15. Ask my mom or dad to keep 100% juice in the refrigerator			
16. Help my mom or dad fix a fruit or vegetable snack			

17. **Cook a vegetable (like corn-on-the-cob) for DINNER**			
18. **Fill half of my plate with fruits and vegetables when I eat a meal**			

SE Physical Activity

Instructions: Please read each statement below and <u>MARK an "X"</u> in either the 'Yes' or 'No' column. "Yes" means that <u>you agree</u> with the sentence. "No" means that <u>you do not agree</u> with the sentence. Remember that physical activity can be any play, game, sport, or exercise that gets you moving and breathing harder. There are no wrong answers.

PHYSICAL ACTIVITY (I THINK)	Please choose your answer.	
	No	Yes
1. I think I can be physically active most days after school.		
2. I think I can ask my parent or other adult to do physically active things with me.		
3. I think I can ask my parent or other adult to sign me up for a sport, dance, or other physical activity program.		
4. I think I can be physically active even if it is very hot or cold outside.		
5. I think I can ask my best friend to be physically active with me.		
6. I think I can ask my parent or other adult to get me the equipment I need to be physically active.		
7. I think I can ask my parent or other adult to take me to a physical activity or sport practice.		
8. I think I can be physically active, even if I have a lot of homework.		
9. I think I have the skills I need to be physically active.		
10. I think I can be physically active no matter how busy my day is.		
11. I think I can be physically active no matter how tired I may feel.		
12. I think I can be physically active for 60 minutes each day.		
13. I think I can walk 11,000 steps each day.		

Tell Us What You Know!

Select the **best** answer for each question below:

1. The body mass index (BMI) is a way to estimate body size and shows _____
      a. if your weight is in a healthy range for your height.
      b. how much fat you have around your waist.
      c. how much fat versus muscle you have.
      d. how your body uses energy when you are physically active.

2. Which contains fewer calories than 1 gram of fat?
      a. 1 gram of protein
      b. 1 gram of fiber
      c. 1 gram of carbohydrate
      d. all of the above

3. Martha watches 3 hours of TV every day. Based on expert recommendations, Martha _____
      a. can continue to watch 3 hours of TV each day.
      b. should watch TV less than 2 hours each day.
      c. can watch up to 4 hours of TV each day.
      d. should only watch TV on the weekend.

4. When you eat a meal, experts recommend that you _____
      a. make half your plate protein, like meat or beans.
      b. make half your plate dairy, like cheese or yogurt.
      c. make half your plate fruits and vegetables.
      d. make half your plate grains, like brown rice or whole wheat bread.

5. People who are overweight are more likely than people who are NOT overweight to _____.
      a. want to sleep in a cold room.
      b. sleep more hours a night.
      c. eat more times a day.
      d. eat fewer times a day.

6. Aerobic activity is a type of physical activity that_____
      a. gets the heart pumping and the lungs working harder.
      b. children should do 3 times a week.
      c. makes bones stronger if you exercise for at least 10 minutes.
      d. all of the above

7. Your body runs on energy called calories. If you lose weight, it means that _____
      a. you have reached calorie balance.
      b. you are in calorie excess.
      c. you burned fewer calories.
      d. you are in a calorie deficit.

8. Having bad health habits when you are young _____

    a. means you will have bad health habits when you grow up.
    b. is something that you can change.
    c. is NOT related to school grades.
    d. makes it likely that you will have a heart attack when you are older.

9. Being physically active_____

    a. lowers the risk of getting high blood pressure, heart disease, and diabetes.
    b. can improve mental health.
    c. may improve grades.
    d. all of the above

10. Think of a pint-sized container of ice cream (like Ben & Jerry's). Which sentence is WRONG?

    a. Most of the calories in regular ice cream come from fat and sugar.
    b. If you ate the whole container for a snack, you ate 1 serving of ice cream.
    c. Low-fat ice cream is a better choice than regular ice cream.
    d. Ice cream is a low-fiber food.

11. If you want to be more physically active, you could help with chores. Which chore would burn up the MOST calories if you did it for 15 minutes?

    a. vacuuming
    b. dusting and straightening up the bedroom
    c. making the beds
    d. washing dishes

12. If you want to do an activity that can make your bones, heart, and lungs stronger, you could _____.

    a. jump rope for 10 minutes straight.
    b. do 20 push-ups.
    c. swim 10 laps.
    d. ride your bike for 20 minutes.

13. Proteins are important building blocks for your body. Pick the protein that is HIGHEST in FAT.

    a. 1 hard boiled egg
    b. half cup of black beans
    c. 2 tablespoons of peanut butter
    d. 1 ounce of American cheese

14. Pick the choice that is LOWEST in fat.

    a. fried chicken
    b. baked chicken legs
    c. grilled chicken breast with no skin
    d. chicken nuggets

15. How do you know when you are not working hard enough during physical activity?
    a. You get bored.
    b. You can sing.
    c. Your heart rate increases.
    d. You breathe hard.

16. Which sentence is WRONG?
    a. Dancing improves your range of motion and endurance.
    b. Dancing makes you more aware of where your body is in space.
    c. The best way to dance is with a partner because it makes you feel confident.
    d. Fast dancing is an activity that can make your bones, heart, and lungs stronger.

17. The Basal Metabolic Rate (BMR) is _____
    a. how fast you walk.
    b. how often your heart beats.
    c. the amount of blood your heart pumps out when you exercise.
    d. the energy you need for basic life processes like breathing and resting.

18. Girls who are 11 to 14 years old should eat at least _____ cups of vegetables each day.
    a. 2.0
    b. 2.5
    c. 3.0
    d. 3.5

19. Experts recommend that children be physically active for at least _____ minutes each day.
    a. 15
    b. 30
    c. 60
    d. 90

20. The information on a food package's nutrition facts label applies to _____
    a. one serving.
    b. half of the package.
    c. the amount generally eaten at one time.
    d. the entire package.

21. If you want to eat a healthier diet, you could _____
    a. eat lettuce instead of dark leafy greens (like spinach and collard greens).
    b. have a fruit drink (like Hawaiian Punch) at lunch and dinner.
    c. eat less canned soup.
    d. all of the above
    e.

EBS

Instructions: Think of everything you ate yesterday. Think of breakfast, lunch, dinner and any snacks you had. This survey is going to ask you about the "number of times" you ate certain foods yesterday. For example, if you ate a sandwich and you had 2 pieces of bread, those count as "2 times" for eating bread. **Select the number of times you ate each food listed below by MARKING an "X" in the column that applies to you. Yesterday, how many times did you…**

	None	1 time	2 times	3 or more times
1. **Eat fruit? (*Do not count* juice.)**				
2. **Eat vegetables? (Include all cooked and uncooked vegetables, salads, and boiled, baked, or mashed potatoes. *Do not include* French fries or chips.)**				
3. **Eat starchy vegetables like potatoes corn or peas? (*Do not count* French fries or chips.)**				
4. **Eat any orange vegetables like carrots squash, or sweet potatoes?**				
5. **Eat a salad made with lettuce, or any green vegetables like spinach, green beans, broccoli, or other greens?**				
6. **Eat any other vegetables like peppers tomatoes, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes?**				
7. **Eat beans such as pinto beans, black beans, kidney beans, refried beans, or pork and beans? (*Do not count* green beans).**				
8. **Eat peanuts or peanut butter?**				

Yesterday, how many times did you…

	None	1 time	2 times	3 or more times
9. Drink fruit juice? (100% juice like orange juice, apple juice, or grape juice. *Do not count* punch, Kool-aid, sports drinks or other fruit-flavored drinks.)				
10. Drink any punch, Kool-Aid, sports drinks, or other fruit-flavored drinks? (*Do not count* fruit juice.)				
11. Drink any regular (NOT diet) sodas or soft drinks?				
12. Drink any diet sodas or soft drinks?				
13. Drink a bottle or glass of water? (Include sparking or any other water drink that has 0 calories).				
14. Drink any kind of milk? (Include chocolate or other flavored milk, milk on cereal, and drinks made with milk.)				

Yesterday, how many times did you…

	None	1 time	2 times	3 or more times
15. Eat <u>brown</u> rice, macaroni, and spaghetti or pasta noodles?				
16. Eat <u>white</u> rice, macaroni, and spaghetti or pasta noodles?				
17. Eat any <u>whole-grain or wheat</u> bread, buns, bagels, tortillas, or rolls?				
18. Eat any <u>white</u> bread, buns, bagels, tortillas, or rolls?				
19. Eat hot or cold cereal?				

Yesterday, how many times did you…

	None	1 time	2 times	3 or more times
20. Eat hamburger meat, hot dogs, sausage (chorizo), steak, bacon, or ribs?				
21. Eat battered or fried chicken, chicken nuggets, chicken fried steak, fried pork chops, or fried fish?				
22. Eat food from any type of restaurant? (Restaurants include fast-food, sit-down restaurants, pizza places, and coffee shops).				
23. Eat French fries or chips? (Include potato chips, tortilla chips, Cheetos, corn chips, or other snack chips.)				
24. Eat sweet rolls, doughnuts, cookies, brownies, pies, or cake?				

Yesterday, how many times did you…

	None	1 time	2 times	3 or more times
25. **Eat any kind of cheese, cheese spread, or a cheese sauce? (Include cheese on pizza or in dishes such as tacos, enchiladas, lasagna, sandwiches, cheeseburgers, or macaroni & cheese.)**				
26. **Eat yogurt or cottage cheese or drink a yogurt drink? (*Do not count* frozen yogurt.)**				
27. **Eat some type of frozen dessert? (A *frozen dessert* is a cold, sweet food like ice cream, frozen yogurt, an ice cream bar, or a Popsicle.)**				
28. **Eat any candy? (*Do not count* brownies or chocolate cookies.)**				