PHYSICAL ACTIVITY AS A MEDIATOR OF THE RELATIONSHIP BETWEEN SELF-EFFICACY AND BODY MASS INDEX IN A NON-CLINICAL SAMPLE OF CHILDREN

BY

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ABSTRACT

The present study examined the associations among key pediatric overweight prevention and intervention variables: body mass index (BMI), physical activity self-efficacy (PASE), physical activity, and sedentary behavior. The first tested hypothesis purported an association between PASE and BMI that is mediated by physical activity. The second hypothesis stated that this mediation is moderated by sedentary behavior. A community sample of 382 fifth and sixth grade students were measured for height and weight and completed questionnaires. Findings suggest that, for girls only, PASE is negatively associated with BMI via physical activity for children who take part in longer amounts of sedentary behavior. These findings highlight the role of PASE in maintaining beneficial physical activity levels among children who are more sedentary, and the importance of accounting for sex and sedentary behavior within the physical activity literature. These findings are then discussed within the context of informing intervention efforts targeting pediatric overweight.

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Dedication

To my wife,

Anne Sinclair Beauchamp,

and my parents,

Robert and Jane Benson.

Physical Activity as a Mediator in the Relationship between Self-Efficacy and Body Mass Index in a Non-Clinical Sample of Children

With cases of child obesity and children at risk for obesity (i.e., overweight) becoming more prevalent, researchers and public health agencies have placed an increased focus on developing interventions intended to cultivate weight management behaviors in children. Despite a wide distribution of information regarding the topic, the number of obese and overweight children continues to grow. Thus, it has become apparent that effective promotion of health behaviors such as physical activity must go beyond simply increasing awareness among children and parents. In response to this realization, some weight interventionists have begun to further examine the role of self-efficacy in their work. Given the positive relationship between physical activity self-efficacy (PASE) and exercise behavior, this appears a reasonable course of study: *If a person's PASE is manipulated, then their physical activity level should change accordingly*. *If a person's physical activity is adjusted, it will have consequent effects on their weight status*. The problem with this approach is that it is based on intuitive logic rather than scientific findings demonstrating a relationship between these three variables (i.e., weight status, physical activity, and PASE). The current investigation aims to fill this notable gap in the literature by examining the association of these three variables among children in the general population. It is hypothesized that children's PASE levels will be inversely related to their body-mass index (BMI), and that this relationship will be mediated by their level of physical activity. It is further hypothesized that this mediation relationship will be stronger for people who engage in the highest level of sedentary behaviors.

Childhood Overweight and Obesity

Measurement of weight status. When discussing children's weight status in this context, what is actually of concern is their body composition or, more specifically, whether or not a child has an excess of adipose tissue (i.e., body fat). There are a variety of methods that can be used in this determination. The most practical method for the current study is the calculation of body mass index (BMI), a reliable and widely accepted estimate of body composition that is not particularly complicated and requires relatively noninvasive procedures for measurement (Center for Disease Control [CDC], 2007a).

The BMI formula is a simple calculation that determines the proportion of weight relative to height (i.e., $weight\ (kg) / [height\ (m)]^2$ or $weight\ (lb) / [height\ (in)]^2 \times 703$; CDC, 2007a). The BMI measurement has been demonstrated to correlate with measures of body fatness in children and adolescents (r = 0.39 to 0.90, depending on the measure being compared; Barlow & Dietz, 1998). Once a child's BMI is obtained, it can be compared to the corresponding national health standards for that child's age and sex (CDC, 2007a). Using this growth chart for comparison, a child can be identified as likely being obese (95^{th} percentile; CDC, 2007a) or overweight (between the 85^{th} and 95^{th} percentile; CDC, 2007a). Higher BMI among children has been shown to correlate with secondary complications related to obesity such as increased blood pressure, blood lipids, blood lipoproteins, and mortality rates (Baker, Olsen, & Sorenses, 2007; Barlow & Dietz, 1998; Garnett, Baur, Srinivasan, Lee, & Cowell, 2007).

Epidemiology of childhood overweight. The background leading up to the increased focus on weight status in the pediatric literature begins with the findings of the National Health and Nutrition Examination Surveys (NHANES III; CDC, 2007b; Troiano & Flegal, 1998). These findings revealed the percentage of obese children in the United States in the age categories of 6 to 11 years old and 12 to 17 years old was approximately 11% for males and 10% for females in both age categories (CDC, 2007b; Troiano & Flegal, 1998). For both age groups and genders, this was almost double the percentages found by the NHANES II, released in 1980 (CDC, 2007b; Troiano & Flegal, 1998). Despite closer monitoring in the 1990s as well as government initiatives of that time such as Healthy People 2000 (U. S. Department of Health and Human Services [U.S. DHHS], 1991), further increases in the prevalence of overweight rates across all age groups resulted in both the medical and news communities referring to the status of the disease as an “epidemic” (e.g., Burros, 1994; Mokdad et al., 1999; U.S. DHHS, 2001).

The most recent NHANES findings, collected from 2003-2006, estimate percentages of obesity in the United States as 17.0% for children 6 to 11 years old (18.0% of boys and 15.8% of girls) and 17.6% for children 12 to 19 years old (18.2% of boys and 16.8% of girls; Ogden et al., 2008). When children designated as overweight are added to these total percentages, the prevalences increase to 33.3% and 34.1%, respectively – over a third of the children in each age group (Ogden et al., 2008). Based on the trajectory of these estimates, this percentage has been predicted to increase to 50% by 2010 (Wang & Lobstein, 2006).

Health issues associated with overweight. The seriousness of overweight status becomes more apparent when considering the number of health complications encountered by children with this condition. Over 65% of overweight children in a non-nationwide sample of 106 children were found to have comorbid conditions related to their overweight status (Schwimmer, Burwinkle, & Varni, 2003). Numerous diseases are found to be associated with overweight, and many were considered to be primarily adult illnesses until the last decade (for a full review of all illnesses demonstrating a notable increase in prevalence related to the population increase of childhood overweight, refer to Must & Strauss, 1999). These comorbid conditions include cardiovascular issues (e.g., hypertension, high cholesterol), orthopedic complications (e.g., bowing of the legs, various hip issues), pulmonary conditions (e.g., asthma, sleep apnea, obesity hypoventilation syndrome), gastroenterological problems (e.g., fatty liver, gallstones), and endocrine issues (e.g., type II diabetes, menstrual irregularities).

In addition to physical health concerns, children who are overweight are often the subject of negative peer evaluation (Puhl & Latner, 2007). This may be a contributing factor to the prevalence of social and emotional problems associated with pediatric overweight. Psychosocial scores on the Health Related Quality of Life scale (Varni, Seid, & Kurtin, 2001) revealed that children who are overweight are almost six times more likely than healthy peers to report impairment in psychosocial health (similar to levels reported by pediatric cancer patients; Schwimmer et al., 2003). Additionally, issues such as body dissatisfaction and weight-based teasing among overweight children have been found to be associated with elevated levels of emotional problems such as low self-esteem, depressive symptomatology, and suicidal thoughts (Eisenberg, Neumark-Sztainer, & Story, 2003).

Interventions for pediatric overweight. Given the aforementioned increases in the prevalence of childhood overweight and the seriousness of the health complications associated with this condition, health professionals have been working to develop appropriate intervention and prevention programs. These programs include primary prevention efforts (i.e., preventive programs targeting the general population; e.g., the CATCH program; Leupker et al., 1996), secondary intervention (i.e., targeting at-risk populations; e.g., Traffic Light Diet; Epstein et al., 2001), or tertiary interventions (i.e., targeting populations already diagnosed with the condition; e.g., HealthWorks!; Hipsky & Kirk, 2002). Generally, each category of these programs tends to focus on variables of direct influence, primarily nutrition and activity patterns (i.e., physical activity and sedentary behaviors), as well as correlated factors that may be causally related to such variables (e.g., psychosocial, environmental, and family factors). The current study aims to further inform the development of such interventions by examining the association between one of these target variables (i.e., activity patterns) and PASE in the general population.

Physical Activity

Rationale for physical activity. The primary process by which people develop excess body fat is elegantly expressed as an equation known as the “energy balance” equation (Fields, in press). When energy intake (i.e., food) exceeds daily energy expenditure (e.g., physical activity), the energy is stored as adipose tissue (i.e., body fat):

$$Energy\ Intake + Energy\ Expenditure = \pm\ Body\ Fat$$

Within this equation, energy expenditure is considered a negative value. Following this simplified relationship, changes in body composition can be enacted by shifting the balance of energy consumed and energy expended. This can be accomplished by making adjustments to the components of energy intake and energy expenditure that are most variable: dietary intake and, the focus of the current study, activity level. Given this rationale in combination with findings regarding the decline in national physical activity levels over the past few decades (Luepker, 1999), physical activity has been identified as a primary target of health-based initiatives such as Healthy People 2010 (U.S. DHHS, 2001).

Longitudinal studies regarding the relationship between physical activity and BMI. The energy balance equation and findings regarding national activity levels both point toward the conclusion that regular physical activity patterns are predictive of low BMI (e.g., Luepker, 1999), however inconsistent findings regarding this relationship may indicate that this is an oversimplified conceptualization (Ritchie et al., 2001). Longitudinal studies tracking naturally occurring changes in physical activity levels have offered the most supporting evidence for the protective and rehabilitative properties of physical activity with regard to BMI. Perhaps the most comprehensive of these studies was performed using data from the Framingham Children's Study (Moore et al., 2003). Using electronic activity monitoring collected over eight years, Moore and colleagues found significantly smaller gains in BMI and skinfold thickness for both boys and girls in the highest third of average daily activity from ages 4 - to 11-years-old. In a separate study, Klesges, Klesges, Eck, and Shelton (1995) also found body composition changes related to physical activity when tracking 3- to 5-year-olds, demonstrating that children exhibiting higher baseline activity levels were the least likely to experience increases in BMI over the three year period. A final example of the effects of physical activity over time tracked 10- to 15-year-olds over a one year period (Berkey, Rockett, Gillman, & Colditz, 2003). Increases in physical activity over this time period resulted in decreasing BMIs for normal weight and overweight girls as well as overweight boys. The effects of physical activity changes were strongest among children who were overweight at baseline (Berkey et al., 2003).

Cross-sectional studies of the relationship between physical activity and BMI. Though longitudinal data appear to support the relationship between physical activity and BMI, results from cross-sectional studies have been less consistent. Though some cross-sectional studies have found an association between physical activity and BMI (e.g., De Bourdeaudhuij et al., 2005; Parsons, Power, & Manor, 2005; Trost, Kerr, Ward, & Pate, 2001), a number of large-scale studies have failed to do so (Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998; Obarzanek et al, 1994). This may be, in part, due to an oversimplification of the relationship.

One example of the complex nature of this relationship is The Youth Risk Behavior Study, 1999 (YRBS). Analyses of these data by Levin, Lowry, Brown, and

Dietz (2003) revealed no differences in vigorous physical activity between normal weight and overweight groups. However, they did find that girls who are overweight were less likely to be enrolled in organized sports than their normal weight peers. Additionally, they found overweight boys to be less likely to engage in moderate physical activity and strength training compared to normal weight peers. Other analyses of the YRBS data examined frequency of physical activity engagement (i.e., number of bouts rather than total time) at varying intensity levels (i.e., moderate and vigorous). Findings revealed that, for the most part, boys and girls engaging in the highest number of moderate and vigorous activity bouts (6-7 times over the past week) had lower BMIs than those engaging in a smaller number of bouts (Eisenmann, Bartee, & Wang, 2002).

A large scale cross-sectional study that offers little support for the relationship between physical activity and BMI was the initial analyses of the NHANES III data (Andersen et al., 1998). In this study, Andersen and colleagues found no significant difference in body composition (BMI or skinfold) between children of varying activity levels. Follow-up analyses of this same data replicated this lack of findings, however further examination of the data found overweight participants to be less likely to be enrolled in structured physical activities (e.g., extracurricular sports; Dowda, Ainsworth, Addy, Saunders, & Riner, 2001).

The results from these studies are not provided to downplay the role of physical activity in weight management, but instead are provided to underscore the complexity of the association between physical activity and BMI. Specifically, the intensity, duration, and frequency of physical activity all play a role in determining changes in BMI. One other variable that relates to energy expenditure that has not yet been discussed is sedentary behavior. A review of the findings of the previously discussed articles as well as select others indicate that sedentary behavior may be key in further understanding the relationship between energy expenditure and BMI.

Sedentary behavior. Sometimes thought of as the “opposite” of physical activity, sedentary behavior is typically measured as time watching television, playing video games, or being on the computer (e.g., Sallis et al, 1996). Perhaps counter-intuitively, findings have shown that the amount of sedentary behavior in which an individual engages is not always inversely related to their level of physical activity (e.g., Marshall, Biddle, Gorely, Cameron, & Murdey, 2004; Sallis, Prochaska, & Taylor, 1999; te Velde et al., 2007). In fact, some studies have identified a child’s sedentary behavior as a stronger correlate of body composition measures than his or her physical activity levels (e.g., Andersen et al., 1998; Eisenmann et al., 2002; Obarzanek et al., 1994).

Various explanations of the relationship between sedentary behavior and BMI have been explored. In regards to energy expenditure, time allocated to sedentary behaviors such as television viewing potentially replaces time that a child could otherwise be engaged in physical activity (e.g., DuRant, Baranowski, Johnson, & Thompson, 1994). Also, during television viewing, children tend to have a lower metabolic rate than when resting without television (Klesges, Shelton, & Klesges, 1993) and have less spontaneous movements (i.e., fidgeting) compared to sitting quietly (Dietz, Bandini, Morellu, Peers, & Ching, 1994). The negative effects of television watching are additionally insalubrious due to its possible influence on energy intake. For example, children tend to engage in more snack behaviors when watching television (particularly snack foods of high caloric density; Crespo et al., 2001), pay less attention to cues related to satiation (Epstein, Paluch, Smith, & Sayette, 1997), and consume increased amounts of foods they see advertised (Utter, Scrag, & Schaff, 2006).

The relationship between physical activity, sedentary behavior, and BMI. Recently, a number of studies have begun to look at the combined impact of sedentary behavior and physical activity. The findings of these studies suggest that physical activity and sedentary behavior may be most predictive of body composition when taken into account together (Andersen et al., 1998; te Velde et al., 2007; Zabinski, Norman, Sallis, Calfas, & Patrick, 2007). The most consistent finding across all three of these studies is not particularly surprising: Children who were in a cluster characterized by high sedentary behavior and low physical activity were the most likely to be overweight or at risk for overweight. Additional findings in these studies suggest that those in a cluster marked by a low level of sedentary behavior and high activity were among the least likely to be overweight, with various other clusters of behavior (e.g., high sedentary/high active) falling between these two categories in terms of body composition. Interestingly, these effects appeared to be clearer among boys (Andersen et al., 1998; te Velde et al., 2007), perhaps due to less variation in activity patterns among girls. Results such as the ones demonstrated in these three studies clearly support the importance of incorporating sedentary behavior (as opposed to physical activity alone) when developing a comprehensive picture of a person's level of energy expenditure.

Physical Activity Self-Efficacy

The ultimate goal of the current investigation is to inform future prevention and intervention programs targeting pediatric obesity. As previously stated, though the methods of treating and preventing this condition (i.e., activity and nutrition) seem relatively simple, long term weight loss continues to elude the majority of individuals (Ebbling, Pawlak, & Ludwig, 2002). The current study is designed to gain insight into the cognitive traits that may underlie the adoption and maintenance of health behaviors that effect body composition. Specifically, this study examines the social cognitive construct self-efficacy (specific to physical activity; PASE) and its associations with child activity patterns and BMI percentile.

Conceptualization of self-efficacy. Self-efficacy describes a person's belief in his or her ability to perform a behavior at a level adequate to produce a desired result. In this way, self-efficacy offers an explanation for why a person's knowledge of potentially favorable outcomes, when considered on its own, is not a sufficient predictor of his or her actions (Bandura, 1977). By introducing self-efficacy into a motivational model, psychologists can better predict the amount of effort, persistence, and resourcefulness a person will exhibit when engaging in a behavioral endeavor: People are likely to avoid tasks they perceive as exceeding their capabilities and engage in tasks they feel competent to perform (Bandura, 1977).

It is easy to conceptualize the relevance of self-efficacy to health promotion. As the American population continues to be inundated with information on how to maintain a healthy lifestyle, unhealthy behaviors (or, conversely, the absence of healthy ones) continue to be prevalent. One possible explanation for neglect of public health recommendations may be individuals' beliefs about their personal capability to maintain such major lifestyle changes. In line with this reasoning, self-efficacy has been frequently examined in the health promotion literature in the study of topics such as smoking cessation, condom use, nutritional choices, and, of course, physical activity (Maibach & Murphy, 1995). Self-efficacy's influence on these behaviors is most informative when the self-efficacy measure used is tailored to the specific behavior being studied (Maiback & Murphy, 1995).

Findings regarding the relationship between PASE and physical activity. PASE has been consistently found to be a strong predictor of physical activity among adults. Sallis and colleagues (1986) were among the first to study the relationship between PASE and naturally occurring physical activity patterns in a large community sample of adults. Their findings revealed PASE as a strong predictor in the adoption and maintenance of various levels of physical activity. In their examination of university undergraduates, Rovniak, Anderson, Winett, and Stephens (2002) have identified PASE as having the greatest total effect on physical activity when compared to other social-cognitive variables.

Despite the robust findings in the adult literature (see McCauley, Pena, & Jerome, 2001, for further review), fewer investigations have examined the association between PASE and physical activity in children. The most recent review of the child literature determined the limited findings on the topic to be “indeterminate/ inconsistent” (Sallis et al., 1999). More recent empirical findings continue to add support to the relationship between PASE and physical activity in children. For example, recent studies found PASE to be associated with longer duration of physical activity (Jago, Baranowski, Baranowski, Cullen, & Thompson, 2007; Sharma, Wagner, & Wilkerson, 2005/2006) and participation in physical activity across multiple settings (Allison, Dwyer, & Makin, 1999).

Other recent studies of PASE have used accelerometers in lieu of self-report in an attempt to access an objective measure of physical activity. Using this technology, Strauss, Rodzilsky, Burack, and Colin (2001) found a correlation between PASE and vigorous (but not moderate) levels of physical activity in children. Also using accelerometers, Trost, Pate, Ward, Saunders, and Riner (1999) found that gender influenced this relationship: For girls, PASE was associated with moderate and vigorous physical activity. For boys, PASE was only associated with vigorous physical activity. This same influence of participant gender on the PASE/physical activity relationship was found using self-report activity measures with adults (Sallis et al., 1986) and children (Trost et al., 1997). These findings highlight the importance of examining differences with regard to gender and activity intensity when researching the relationship between PASE and physical activity in children.

Intervention studies of the relationship between PASE and physical activity. Findings in the intervention literature also support an association between PASE and physical activity in children. Though the intention of the following interventions may not have always been to necessarily "train" PASE, PASE was recognized as an important component of each intervention (even if the effects on PASE were secondary), and likewise each of the following examined the influence of PASE.

Initial data from the Child and Adolescent Trial for Cardiovascular Health study (CATCH) revealed higher levels of PASE and total activity in the intervention group compared to controls (Edmundson et al., 1996; Luepker et al., 1996). Though this difference in PASE was not sustained, differences in vigorous physical activity levels between the intervention group and controls continued over time (Nader et al., 1999). Two additional programs targeting physical activity that included measures of PASE were the "Pathways" and the "Go For Health" program. "Pathways" was a school-based intervention targeting the prevention of overweight among American Indians via education and environmental changes (Stevens et al., 2003). The findings revealed that participants in the intervention condition were significantly more active than controls over a three-year period. However, differences in PASE between the intervention group and controls were evident only among females (Stevens et al., 2003). This re-emphasizes the possibly differential role PASE may have in predicting the physical activity of females as opposed to males (Trost et al., 1996; Trost et al., 1999). The "Go for Health" program, implemented by Parcel, Simons-Morton, O'Hara, Baranowski, and Wilson (1989), was a school-based intervention combining environmental changes with social-cognitive treatment. Outcome measurements revealed a significantly larger increase in PASE in the intervention group; however the co-occurring increase in physical activity did not differ from the increase in physical activity documented for controls (Parcel et al., 1989; Simons-Morton, Parcel, Barnowski, Forthofer, & O'Hara, 1991).

Within the physical activity intervention literature, numerous authors have suggested the adoption of a mediator framework for evaluation (e.g., Baranowski, Anderson, & Carmack, 1998; Baranowski & Jago, 2005; Lewis, Marcus, Pate, & Dunn, 2002). To date, only one study has evaluated PASE as a mediator when examining the relationship between an intervention and its physical activity outcomes. This exemplar study, the Lifestyle Education for Activity Program (LEAP; Dishman et al., 2004), was a school-based intervention focusing on increasing physical activity among 8th grade girls over a one year period. Evaluation of outcomes demonstrated a positive effect of the intervention on child physical activity levels, and that this effect was partially mediated by PASE (Dishman et al., 2004).

Conclusions regarding PASE and physical activity. In summary, PASE appears to be an influential predictor of physical activity behavior. Burgeoning evidence suggests it may be particularly important for vigorous physical activity, may play a more important role in female as opposed to male physical activity, and may act as a mediator among interventions seeking to increase physical activity levels. As such, PASE has often been regarded as an important construct to consider when examining physical activity, and remains a suggested point of intervention among studies intending to influence body composition via physical activity (e.g., Pivarnik & Pfeiffer, 2002; U.S. DHHS, 1996). Surprisingly, however, the relationship between PASE, physical activity, and BMI has rarely been examined within a single comprehensive model. The next section discusses some of the few studies to explore the three variables together.

The Association between PASE, BMI, and Physical Activity

Much information has been provided in order to build an empirical foundation for the current study, however yet to be reviewed are prior investigations that include all three variables of interest: body composition, physical activity, and PASE. Despite the emergence of childhood overweight as a health issue of epidemic proportions, as well as the proliferation of physical activity promotion programs targeting this issue, few studies incorporating all three of these variables exist. Given their theoretical relationships to one another, studies that include all three of these variables are of value for informing intervention design and modification. Following an extensive search of the literature, the few studies identified that examine these three variables as they naturally occur among children are reviewed.

In an investigation involving a sample of 213 sixth grade children, Trost and colleagues (2001) examined the association among BMI, physical activity, and PASE. Height and weight were measured on site and used to categorize children as either overweight ($\geq 95^{th}$ percentile) or non-overweight. Physical activity data were collected using accelerometers, and all other measures were collected via self-report. After controlling for gender and race/ethnicity, non-overweight children were found to exhibit significantly higher counts (i.e., minutes) of total physical activity, daily participation in moderate physical activity, daily participation in vigorous physical activity, and a higher number of 5, 10, and 20 minute bouts of moderate-vigorous physical activity over the seven day recording period. Additionally, children in the non-overweight group had significantly higher levels of PASE. Although the three variables were never placed within the same model, this study is significant in that it was the first to examine all three variables among children enrolled in the same study.

De Bourdeaudhuij and colleagues (2005) performed a cross-sectional study on a nationwide sample of 6078 Belgian students, ages 11 to 19 years old. Self-report information was used in all the data collection procedures, including height and weight. Using BMI, the sample was categorized as either normal weight or overweight (i.e., greater than the 85^{th} percentile in this particular study). Analyses revealed that the normal weight group engaged in significantly more hours of sport participation per week, more total physical activity per week, more bouts per week of vigorous activities (≥ 20 minutes), more days per week involving 60 minutes of continuous moderate intensity activities, and more reports of walking or cycling to school. The normal weight group also reported significantly higher PASE than the overweight group. Separate regression analyses for each group were used to predict physical activity from PASE (as well as other psychosocial variables). PASE significantly predicted physical activity in the normal weight group, however not in the overweight group, suggesting that weight status may have some effect on this relationship.

One of the more recent studies to examine these three variables utilized the control participants involved in the previously mentioned LEAP intervention (Ward et al., 2006). All participants were ninth-grade females. Height and weight were measured on site, and all other variables were measured via self-report. A two-way mixed model ANOVA with two between group factors (weight status and activity group) showed PASE to be associated with level of physical activity. Weight status, which was categorized as normal (<85th percentile), at risk (≥ 85th percentile and <95th percentile) and overweight (≥ 95th percentile), did not influence either of these variables (PASE or physical activity) or the relationship between the two.

Summary of studies related to PASE, physical activity, and BMI. Taken together, the results of Trost et al. (2001), De Bourdeaudhuij et al. (2005), and Ward et al. (2006) form the conceptual model upon which the current study is built. The first of these studies (Trost et al., 2001) used accelerometers to identify significantly lower activity levels among children of overweight status, as well as significantly lower PASE among the members of this group; however, PASE and physical activity were never placed in the same model – their relationship was assumed. The second study (De Bourdeaudhuij et al., 2005) replicated these findings using a self-report measure of physical activity, but further analyses indicated that the ability of PASE to predict physical activity was limited to individuals of normal weight. The third study (Ward et al., 2006), also using a self-report measure of physical activity, supported the relationship between PASE and physical activity, but did not find differences regarding these variables across normal weight and overweight groups.

Current Study

In their discussions of the development of pediatric illness prevention programs, recent publications from U.S. health officials cite PASE as playing a crucial role in physical activity promotion among the general population (e.g., U.S. DHHS, 1996). One of the target issues that these agencies hope to address is the rapid rise in child overweight status. Although established associations between PASE and physical activity suggest that it may be a logical route for interventions targeting childhood overweight, a notable shortcoming exists among the supporting literature: No published study has demonstrated the relationships among PASE, physical activity, and BMI among children in the general population. Such information is crucial for the development of childhood weight management programs, particularly those targeting prevention. The current study aims to fill this notable gap in the literature by examining the relationship between these three variables with data collected on a non-clinical population of 5^{th} and 6^{th} grade students.

Specific hypotheses. Based on the available literature, the first hypothesis of the current investigation is that physical activity will mediate an association between PASE and BMI. Though the variables are presented in a sequential format, it is important to re-emphasize that the cross-sectional design of the present study allows for only the investigation of associations. These associations will be used to support further, longitudinal investigation.

Though the relationships between all the variables of interest may be bidirectional, the current arrangement was chosen based on the strongest associations in the reviewed literature. Additionally, the chosen order would be most useful for the development of intervention and prevention programs targeting weight management (e.g., the variables that are most easily influenced, PASE and physical activity, are placed in positions that precede the outcome of interest, body composition). The current model is depicted in Figure 1.

PASE → Physical Activity → BMI

Figure 1. Hypothesis 1: PASE indirectly affects BMI via physical activity.

Age is controlled via the use of BMI percentile. This model was tested for the full sample as well as for boys and girls separately. Additionally, this model was tested for various levels of intensity using different means of controlling for the dynamic nature of this variable.

As previously discussed, studies such as Andersen et al. (1998), te Velde et al. (2007), and Zabinski et al. (2007) indicate that measures of physical activity, when examined alone, may be not be significantly associated with BMI. At varying levels of detail, all three of these studies discuss behavioral patterns that may better characterize the energy expenditure component of the energy balance equation, namely those that incorporate both sedentary behavior and physical activity. For instance, a person who is fairly active but spends a lot of time engaged in sedentary behaviors would be more likely to be overweight than a person who is fairly active but not involved in many sedentary behaviors, and a person who is not very active and highly sedentary is the most likely to be overweight. In this way, it appears the indirect effect of PASE on BMI percentile via physical activity may be conditional on the level of sedentary behavior the child regularly engages in. This is depicted in Figure 2.

Figure 2. Hypothesis 2: PASE indirectly affects BMI via physical activity depending on the level of sedentary behavior.

Thus, a second hypothesis of the current study is that the mediating role of physical activity in the relationship between PASE and BMI is most evident for high levels of sedentary behavior. In this way, the addition of sedentary behavior into the model will better demonstrate the relationship between the three target variables.

Methods

All of the following measures and procedures were approved by the University of Kansas Institutional Review Board (IRB) and the Lawrence Public School District Director of Educational Programming prior to implementation.

Recruitment

Following project approval, the Lawrence Public School District Director of Educational Programming contacted building principals of the fifteen Lawrence elementary schools and informed them of the current study. Six of the fifteen principals expressed interest in the project. The names and schools of interested principals were then relayed to the researchers via the Lawrence Public School District Director of Educational Programming. The researchers then met with these principals and respective fifth and sixth grade teachers to give them additional information about the project. All schools that expressed initial interest agreed to participate following these informational meetings.

Researchers met with the students of each fifth and sixth grade classroom to inform them of the nature of the study. At this time, students were also informed that the classrooms with 80% of forms signed by parents returned, regardless of consent status, would be rewarded with a classroom visit from the University of Kansas mascot. Researchers then supplied all fifth and sixth grade classroom teachers with parent consent forms to distribute to their students. Consent forms gave a brief overview of the purpose of, and the procedures involved in, the proposed study, as well as detailed information regarding privacy practices and possible risks (see Appendix A). Parent consent forms were returned to the classroom teacher for collection by the researchers as well as returned to the researchers on the day of data collection. Students were typically given between one and two weeks to return the forms. Of the 602 forms distributed, 469 (77.9%) were returned. Of those 469, the number of parents that indicated that they would allow their children to participate was 398 (84.9%).

Participants

Of the 398 eligible participants, 382 (96.0%) participated in the current study. Those who did not participate were either absent on the day of the study, unable to complete forms due to intellectual impairment, or did not assent. Of the 382 participating children, 53.9% were male. As mentioned previously, only children in the fifth and sixth grade were recruited for the current study. This resulted in the following age distribution within the participant sample: .8% 9-year-olds, 30.9% 10-year-olds, 55.8% 11-year-olds, and 12.6% 12-year-olds.

Individual information regarding socioeconomic status was not available. Information provided by the school district reported 43.3% of the children attending the six schools involved in the project qualified for free and reduced lunch according to federal guidelines. By comparison, the percentage of children that qualified for free and reduced lunch across the entire school district was 32.1%.

Children were also asked to indicate the one race/ethnicity category with which they identified. The race/ethnicity characteristics of the study sample based on this self-report information is depicted in Table 1. Though the numbers are certainly comparable, it should be noted that the study sample had an overrepresentation of students from minority cultures compared to the school district percentages.

Table 1

Race/Ethnicity Demographics

Race/Ethnicity	Study (%)	School District (%)
White (non-Hispanic)	59.2	73
Black (non-Hispanic)	6.5	8
Hispanic	9.7	4
Asian	5.8	-
Native American	6.3	-
Other	10.3	15
Multiple indications	1.8	-
No indication	.5	-

Procedure

All measures were administered on Wednesdays between the months of September and December of 2007. For most schools, everyone in the same school completed the measures on the same day. One exception had some students complete the measures on a separate day (one week later than their schoolmates) due to time constraints. Students were convened in either a classroom or multipurpose room within their respective school. Though groups of participants were typically between 13 and 20 children, the size of the administration groups ranged from 9 to 57. Students were asked to sit with one seat separating one another in order to preserve each others' privacy. Packets were distributed to participants, with the assent form serving as the top page (Appendix B). Children were also informed during this period that they were permitted to stop the study at any point if they felt uncomfortable. Children who chose not to participate were allowed to go back to class or sit quietly in their seat (n = 6). To accommodate variations in participant reading levels, instructions and assessment questions were read to participants by the researcher as they responded to the various measures. Additional researchers were also on hand to circulate about the room and offer assistance to participants if needed. The entire data collection period typically took about 30 minutes.

Measures

With the exception of anthropometric data used to calculate BMI percentile, all participant information was collected via child self-report. Appendix C lists the measures included in the study packet in their administration order with brief descriptions of each measure not used in the current study.

Body Mass Index. During the first term of each school year, height and weight is measured by school nurses at each of the elementary schools as part of a district wide health assessment. This information was collected by the researchers from school nurses contingent on parental consent, as noted on the parental consent form (Appendix A). Height and weight data were collected prior to data collection for all schools (M = 34.2 days, SD = 21.8) with the exception of one school where these data were collected 22 days after measure administration.

Height and weight data were used to calculate BMI using the formula given by the CDC: $weight\ (lb) / [height\ (in)]^2 \times 703$ (CDC, 2007a). BMI could then be used to determine BMI percentile for each individual. By using BMI percentile, child developmental factors could be accommodated by comparing children to the CDC national sample of peers the same age and gender. This percentile can then be used for comparison between groups.

Physical activity and sedentary behavior. Physical activity and sedentary behavior were measured using the Self-Administered Physical Activity Checklist (SAPAC; Sallis et al., 1996). The SAPAC is a self-report measure developed with fifth grade students for use with pre-adolescents. This measure, which consists of a list of 21 physical activities, asks children to report their engagement in specific activities for more than five minutes before, during, and after school. Additional spaces are provided for activities not listed, and another section is included for reporting the duration of time spent engaging in sedentary behaviors (e.g., playing video games). During its development, test-retest reliabilities were calculated by comparison of self- and interview format reports and yielded correlations of $r = .64$ to $r = .79$ (Sallis et al., 1996). The authors reported that the self-report measure is moderately and significantly correlated with objective measures of activity (heart rate, accelerometer). Particularly high were correlations of heart rate monitors with amount (minutes) of self-reported activity ($r = .51$ for girls and $r = .61$ for boys). These values were demonstrated to change slightly with the incorporation of metabolic values ($r = .53$ and $r = .59$, respectively).

In its original development, this measure required children to report one-day recall of minutes engaged in each activity as well as subjective levels of intensity. Of concern in the current study were typical activity levels. Exact minutes of engagement as well as subjective intensity were not requested of the participant. However, in order to develop a more comprehensive profile of activity despite limited access to students, the SAPAC was expanded to three days of recall. This duration of time (three days) has been suggested as optimal under these conditions by other studies concerned with physical activity, particularly when administered on a Wednesday because two weekdays and one weekend day are then included (Dishman et al., 2004). Administration thus occurred only on Wednesdays to access a broader profile of typical behavior. Refer to Appendix E for a copy of this measure.

Physical activity self-efficacy. PASE was examined using a self-report measure designed to assess children's perceptions of their competency to be able to overcome barriers to physical activity (e.g., "I can be physically active on most days even if it is very hot or very cold outside"; Motl et al., 2000). It consists of eight items rated on a five-point scale ranging from 1 (disagree a lot) to 5 (agree a lot). Validity testing for this measure was conducted with eight and ninth grade females. Scores demonstrated good internal reliability ($\alpha = .79$) and remained relatively consistent over the course of one year (Motl et al., 2000). The measure has been used in studies involving children of both sexes ranging from 4^{th} to 12^{th} grade (e.g., Jurg, Kremers, Candel, Van Der Wal, & De Meij, 2006). In the current study, this measure demonstrated good internal reliability in the full sample ($\alpha = .82$). After dividing the sample by sex, good internal reliability was maintained for males ($\alpha = .82$) and females ($\alpha = .84$). Refer to Appendix D for a copy of this measure.

Analyses

Mediation. The first hypothesis proposed in this study was best examined as a mediation model. Mediation occurs when the influence of the independent variable (*IV*) on the dependent variable (*DV*) is explained by the indirect effect through a mediator. This is illustrated in Figure 3. In the current study, PASE is the *IV*, BMI percentile is the *DV*, and physical activity is the mediator (*M*).

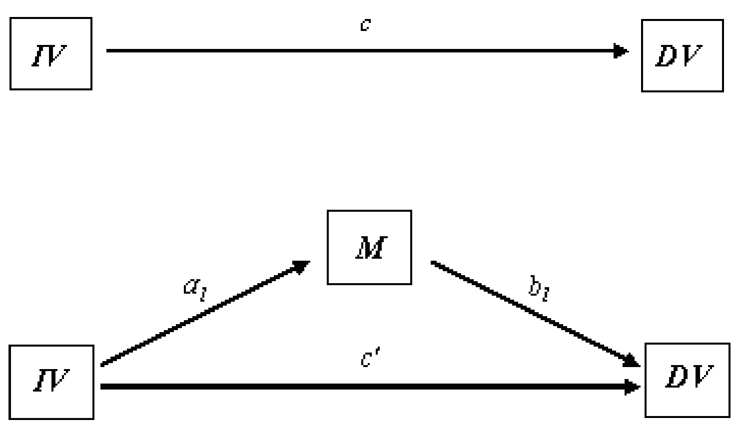

Figure 3. Example of mediation.

The symbol *c* in Figure 3 represents the coefficient of the *DV* regressed on the *IV* without taking into account the mediator (*M*). In the current study, *c* represents the association between PASE and BMI percentile when physical activity is not considered. The symbol a_1 in Figure 3 represents the coefficient of *M* regressed on the *IV*, b_1 is the coefficient of the *DV* regressed on *M*, and *c'* is the remaining association between the *IV* on the *DV* once *M* is included in the model. Again relating this to the current study, a_1b_1 is the association between PASE and BMI percentile that occurs via physical activity. The association between PASE and BMI percentile not accounted for by physical activity is represented by the symbol c'. Hence, $c - c'$ is equal to a_1b_1 (i.e., the indirect effect of the *IV* on the *DV* via *M*). The corresponding null hypothesis associated with this first hypothesis would therefore be that the relationship between PASE and BMI percentile is not explained through the indirect effect of physical activity. Generally, for mediation relationships, the null hypothesis is written H_0: $c - c' = 0$ or H_0: $a_1b_1 = 0$.

There are several methods of calculating the effects of one variable on another via a mediator. The Baron and Kenny method (Baron & Kenny, 1986), which suggests a series of regression analyses as a test of mediation, has been critiqued for not directly testing the significance of a_1b_1 (i.e., $c - c'$; Preacher & Hayes, 2004). The Sobel method (Sobel, 1982) offers a direct test of a_1b_1; however it assumes a_1b_1 to be normally distributed (a critique by Preacher & Hayes, 2004). Bootstrapping was determined to be a viable method to aid in analyses for the current study as it allows for a direct test of mediation without assuming a normal distribution of the indirect effect (Preacher & Hayes, 2004).

Bootstrapping is a nonparametric resampling procedure that can be used to test the null hypothesis for a mediation relationship (i.e., $a_1b_1 = 0$). The first step when using the bootstrapping method is the creation of a sample of size *N* from the given sample using random sampling with replacement. This means that the values for individuals are randomly chosen from the existing data set, repeatedly, without excluding already selected data, until a new sample of size *N* exists, created by the data from the original sample. For instance, when bootstrapping analyses for the full sample of the current study, participant values are chosen 381 times from the existing data set (because $N = 381$). The mean value of a_1b_1 is then determined for this new sample.

This procedure (random sampling with replacement N times followed by the determination of a sample mean value for a_1b_1) is repeated a predetermined number of times, k. For the current study, k was set to 5000 per the recommendation of K. J. Preacher (personal communication, September, 2007). Ultimately, this creates a distribution composed of 5000 sample mean values for a_1b_1.

As previously mentioned, the null hypothesis for mediation is that the indirect effect of the *IV* (PASE) on the *DV* (BMI percentile) via *M* (physical activity) is 0 ($a_1b_1 = 0$). Using bootstrapping, this is demonstrated using the confidence intervals (CI) for the aforementioned calculated a_1b_1 distribution. If 0 is included in between these confidence limits, it can be said that the null hypothesis holds true within a previously specified degree of certainty depending on the predetermined alpha value (in the current study, an alpha value of .05 is used to provide 95% certainty). See Figure 4 for an example of bootstrapping results that support the null hypothesis (i.e., no mediation).

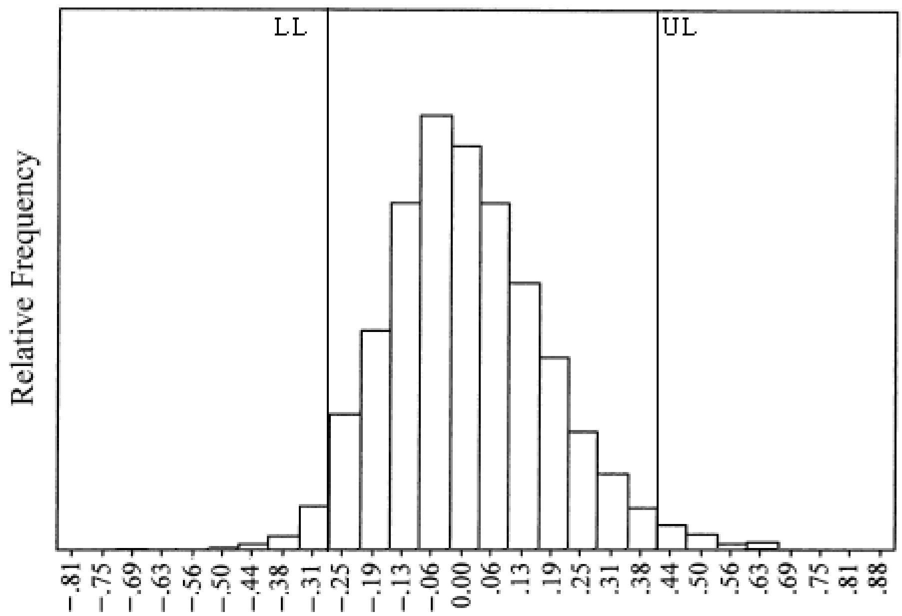

Figure 4. An example of a bootstrapped sampling distribution of the indirect effect (a_1b_1). In this example the findings do not support a mediation. LL = Lower limit of the confidence interval; UL = Upper limit of the confidence interval (Adapted from Preacher & Hayes, 2004)

Note that, in Figure 4, 0 is contained in the CI. This indicates that a_1b_1 is estimated to lie between -.38 and .40 with 95% confidence. Because 0 is contained within this interval, one cannot conclude that the indirect effect is significantly different from 0 at $p < .05$. Therefore, the null hypothesis fails to be rejected (i.e., no mediation).

If 0 does not fall between the upper and lower limits of the confidence interval, and the CI is in the expected direction (i.e., positive values for an expected positive relationship, negative values for an expected inverse relationship), then the predicted (i.e., alternative) hypothesis is most likely true. See Figure 5 for a graphic example of bootstrapping results that support the alternative hypothesis of mediation.

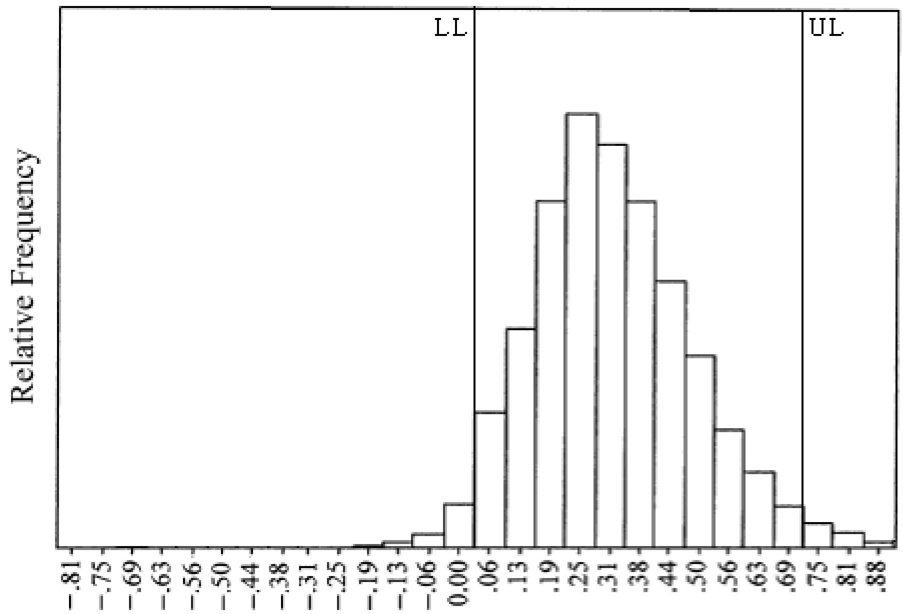

Figure 5. An example of a bootstrapped sampling distribution of the indirect effect (a_1b_1). In this example the findings support mediation. LL = Lower limit of the confidence interval; UL = Upper limit of the confidence interval (Adapted from Preacher & Hayes, 2004)

Note that, in Figure 5, 0 is *not* contained in the CI. This indicates that a_1b_1 is estimated to lie between .03 and .73 with 95% confidence. Because 0 is not contained within this interval, one can conclude that the indirect effect is indeed significantly different from 0 at $p < .05$. Therefore, the null hypothesis is rejected (i.e., there is mediation).

Moderated mediation. In the case of the second hypothesis, moderated mediation was hypothesized. This is a scenario when mediation occurs but the mediator's effects are conditional based on the value of another variable (a moderator, *W*). In other words, the *IV* (PASE) has an indirect association with the *DV* (BMI percentile) via *M* (physical activity); however the strength of this indirect association is contingent on the value of *W* (sedentary behavior). In this type of scenario, the mediation a_1b_1 is expanded to $a_1b_1 + a_1b_3W$. This is more elegantly represented in the function $f(\theta|W) = a_1(b_1 + b_3W)$.

In examining this complex relationship, the bootstrapping resampling procedure offers the most practical means of evaluation (Preacher, Rucker, & Hayes, 2007). Similar to the process described for the simple mediation, the first step in this procedure involves the creation of a sample of size *N* from the given sample using random sampling with replacement. This is then repeated *k* (e.g., 5000) times to create *k* different random samples of size *N*. These samples are then used to calculate $f(\theta|W) = a_1(b_1 + b_3W)$ for values of *W* (sedentary behavior) chosen from within the range reported by participants. For each value of *W* (sedentary behavior), a CI is included on the output to identify regions of significance.

Graphically, rather than creating a distribution similar to the mediation example above, the values determined from this procedure can be plotted at various values of the moderator, *W*. A confidence band can then be plotted around this line. Similar to simple mediation, if 0 is found within the confidence band for a given value of *W*, than it can be said with a predetermined level of confidence (e.g., 95%) that the findings support the null hypothesis. See Figure 6 for an example of a moderated mediation where the results of the bootstrapped analysis support the null hypothesis.

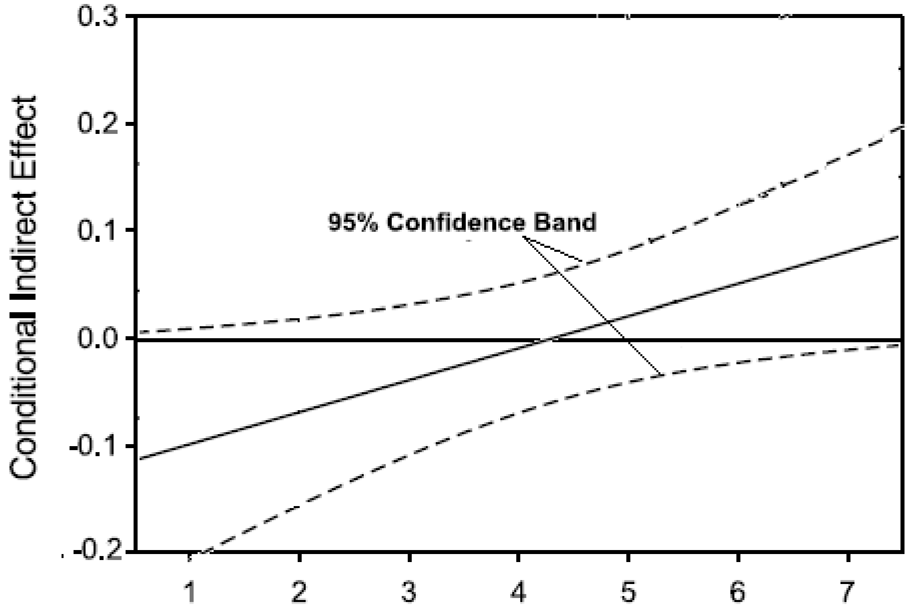

Figure 6. A plot of the indirect effect of an association for various values of the moderator listed along the x axis. In this example there are no significant findings. (Adapted from Preacher et al., 2007)

In Figure 6, it is estimated with 95% confidence that for the corresponding values of the moderator, the estimate of the indirect effect lies within the displayed confidence band. Because 0 is contained within this band for all values of the moderator, we cannot conclude that the indirect effect is significantly different from 0 at $p < .05$, and thus, the null hypothesis cannot be rejected (i.e., no moderated mediation).

Areas within the confidence band where 0 is not included mark a region of significance for the mediator at those corresponding values of W. See Figure 7 for an example of a moderated mediation where the results of the bootstrapped analysis reject the null hypothesis.

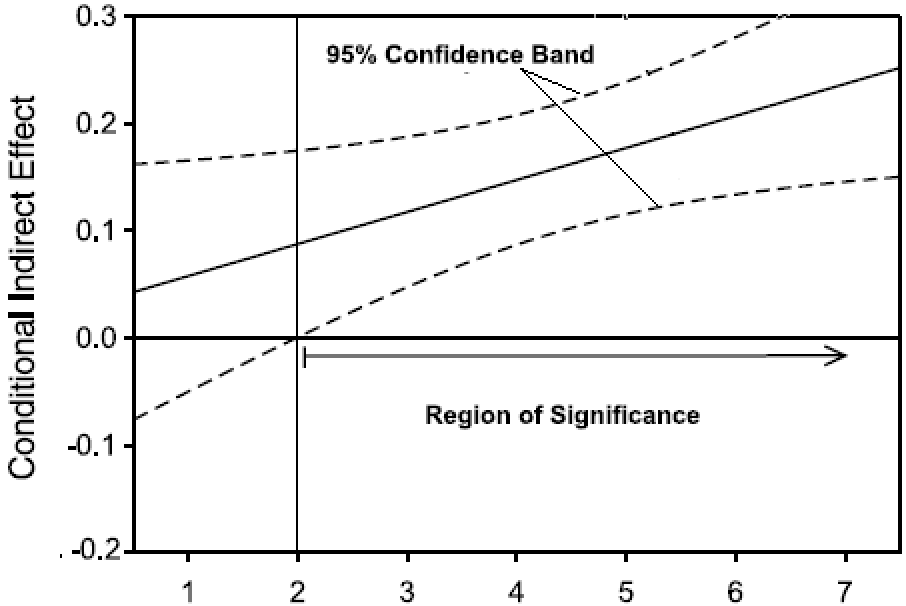

Figure 7. A plot of the indirect effect of an association for various values of the moderator listed along the x axis. In this example, the findings are significant for moderator values greater than 2. (Adapted from Preacher et al., 2007)

Note that, in Figure 7, 0 is not contained within the confidence band for all values of the moderator greater than or equal to 2. This indicates that for any value of the moderator greater than or equal to 2, the value of the conditional indirect association is estimated to be significantly different than 0 at $p < .05$. Additionally, this indirect effect has a positive increase as values of the moderator positively increase. Therefore, for values equal or greater than 2, the null hypothesis is rejected (i.e., there is moderated mediation), and the effect appears to be in the direction of the alternative hypothesis (i.e., a positive association). This area of the graph is denoted the "region of significance." For values of the moderator that are less than 2, the null hypothesis is supported as evidenced by 0 being contained within the confidence band.

Results

Missing and excluded data

Prior to analyses, procedures for missing data were established for the relevant variables. Given the large data set and the small number of missing data, the majority of missing data resulted in either participant omission (i.e., list-wise deletion) or a conservative estimate of the child's score. For BMI, one participant was excluded from analyses due to missing height and weight data (he had moved into the district after these measures were taken). In regards to physical activity, participants who had not indicated their level of engagement in an activity (i.e., left an item on the physical activity measure blank) were given a score of "0" for that activity. Similarly, if a child did not indicate the amount of time engaged in a sedentary behavior activity, this value was assumed to be "0." In the instance of PASEQ, participants were required to rate their level of PASE along a continuous scale. Because of the nature of this particular variable, children who left items on this measure blank were excluded from the analyses ($n = 9$).

Among the variables of interest, one clear outlier was identified. Among the sedentary behavior totals, the initial mean was 671.7 minutes, with a standard deviation of 1,125.4. One individual reported participating in 14,996.0 minutes of sedentary behavior over the preceding three days - an impossible feat (i.e., if the child played video games and watched television simultaneously for three days straight without sleeping, this still would only add up to 8640 minutes). The next highest total sedentary behavior score was 3,395.0 minutes. This outlier is not included in any of the following analyses, including mean scores.

Preliminary analyses

Exploratory analyses were performed to evaluate whether the weight characteristics of the current sample were representative of the general population. Table 2 summarizes weight categorizations for the entire sample, which appear to reflect the general population as estimated by Ogden and colleagues (2008). Excluded is the outlier described above, who met criteria for the obese category.

Table 2

Weight Category Percentiles for Sample

	Full Sample (%)	Boys (%)	Girls (%)	U.S. Population (%)*
Underweight (<5th percentile)	1.8	2.0	1.7	-
Normal weight (5th to <85th percentile)	65.4	62.4	68.8	-
Overweight (85th-95th percentile)	18.4	21.5	14.8	16.3
Obese (>95th percentile)	14.2	13.7	14.8	17.0

*Population estimates for 6-11 year olds (Ogden et al., 2008). Normal and underweight statistics not provided.

Means and standard deviations for each of the relevant variables are noted in Table 3. These include BMI percentile, total instances of physical activity identified, total physical activity scores incorporating metabolic (MET) weights (WPA; Sallis et al., 1996), total instances of vigorous physical activity (VPA)(i.e., activities having a

MET score at or above 6.0; Trost et al., 2001), total instances of moderate physical activities (MPA)(i.e., activities having a MET score below 6.0; Trost et al., 2001), total minutes of television, total minutes of video games, total minutes of sedentary behavior (television and videogames combined), and total PASEQ scores (i.e., the sum of the ratings for all 8 PASE items).

Table 3

Means and Standard Deviations for Measures

Measure	Full sample M(SD)	Boys M(SD)	Girls M(SD)
BMI Percentile	65.01 (27.98)	67.74 (27.21)	61.85 (28.62)
Instances PA	38.15 (25.27)	38.30 (23.67)	37.97 (27.06)
WPA	213.99 (144.19)	217.58 (136.09)	209.81 (153.37)
VPA	17.65 (12.50)	18.98 (12.82)	16.12 (11.98)*
MPA	20.49 (14.61)	19.32 (13.02)	21.86 (16.21)
Television	322.20 (263.68)	345.54 (277.40)	295.01 (244.70)
Video games	199.50 (284.75)	256.28 (339.45)	116.05 (176.35)*
Sedentary Behavior	513.70 (457.79)	601.82 (511.78)	411.06 (360.64)*
PASE	30.33 (5.31)	30.60 (5.08)	30.02 (5.57)

Note. BMI = body mass index; PA = physical activity; WPA = metabolically weighted physical activity; VPA = vigorous physical activity; MPA = moderate physical activity; PASE = physical activity self-efficacy. *Significant difference between sexes ($p < .05$)

A series of t-tests were used to compare demographic group differences. Significant differences were found based on child sex, with boys scoring significantly higher on VPA ($t = 2.25$, $p = .03$), video games ($t = 4.94$, $p < .01$), and total sedentary behavior ($t = 4.14$, $p < .01$). As such, analyses are given for each gender as well as for the full sample (see Table 3 for sex-separated means and standard deviations).

Correlational analyses were also performed prior to hypothesis testing (Tables 4 - 6). These analyses were done for the full sample (Table 4) as well as separately for boys (Table 5) and girls (Table 6). Examining relationships of interest, PASE was significantly correlated to WPA, MPA, and VPA for the full (respectively, $r = .28$, $r = .25$, $r = .28$, $p < .05$), boy (respectively, $r = .28$, $r = .23$, $r = .28$, $p < .05$), and girl (respectively, $r = .27$, $r = .28$, $r = .26$, $p < .05$) samples. PASE was not significantly correlated with BMI percentile for neither the full ($r = .06$, $p < .05$), boy ($r = .14$, $p < .05$), nor girl ($r = -.03$, $p < .05$) sample. WPA, MPA, and VPA were also not significantly correlated with BMI percentile for neither the full (respectively, $r = -.04$, $r = -.04$, $r = -.01$, $p < .05$), boy (respectively, $r = -.01$, $r = -.01$, $r = -.03$, $p < .05$), nor girl (respectively, $r = -.08$, $r = -.06$, $r = -.08$, $p < .05$) sample. For girls only, sedentary behavior had a significant positive correlation with BMI percentile ($r = .17$, $p < .05$) and PASE had a significant negative correlation with sedentary behavior ($r = -.27$, $p < .01$). These correlations were not significant for boys (respectively, $r = -.12$, $r = -.08$, $p < .05$).

Table 4

Correlations between Variables for Full Sample

Measure	1	2	3	4	5	6	7	8	9
	Full Sample (n = 380)								
1. BMI Percentile	-	-.05	-.04	-.01	-.04	.04	-.01	.02	.06
2. Instances PA		-	.99**	.92**	.94**	.17**	.23**	.24**	.28**
3. Weighted PA			-	.95**	.90**	.18**	.24**	.25**	.28**
4. VPA				-	.74**	.18**	.25**	.26**	.28**
5. MPA					-	.14**	.19**	.20**	.25**
6. Television						-	.39**	.82**	-.12*
7. Video games							-	.85**	-.11*
8. Sedentary Behavior								-	-.14*
9. PASE (n = 371)									-

* = significant at $p < .05$; ** = significant at $p < .01$

Table 5

Correlations between Variables for Boys

Measure	1	2	3	4	5	6	7	8	9
	Boys (n = 204)								
1. BMI Percentile	-	-.02	-.01	-.03	-.01	-.10	-.10	-.12	.14
2. Instances PA		-	.99**	.92**	.92**	.08	.20**	.17*	.28**
3. Weighted PA			-	.95**	.86**	.08	.20**	.17*	.28**
4. VPA				-	.68**	.10	.19**	.18*	.28**
5. MPA					-	.04	.17*	.14	.23*
6. Television						-	.37**	.79**	-.03
7. Video games							-	.86**	-.10
8. Sedentary Behavior								-	-.08
9. PASE (n = 199)									-

* = significant at $p < .05$; ** = significant at $p < .01$

Table 6

Correlations between Variables for Girls

Measure	1	2	3	4	5	6	7	8	9
	Girls (n = 176)								
1. BMI Percentile	-	-.07	-.08	-.08	-.06	.19*	.09	.17*	-.03
2. Instances PA		-	.99**	.95**	.97**	.28**	.38**	.38**	.28**
3. Weighted PA			-	.97**	.95**	.29**	.37**	.38**	.27**
4. VPA				-	.84**	.28**	.36**	.36**	.26**
5. MPA					-	.27**	.36**	.36**	.28**
6. Television						-	.45**	.90**	-.25**
7. Video games							-	.80**	-.21**
8. Sedentary Behavior								-	-.27**
9. PASE (n = 172)									-

* = significant at $p < .05$; ** = significant at $p < .01$

Hypothesis 1

The first hypothesis stated that physical activity would mediate the association between PASE and BMI percentile. Using the macro provided by Preacher and Hayes (2004) to perform the bootstrapping procedure described above, the associations among these three variables were evaluated for the full sample as well as sex-separated samples (i.e., boys only or girls only). Additionally, these analyses accounted for differences in activity intensity in two ways resulting in three analyses per sample: One using the full range of metabolically-weighted physical activity scores (i.e., WPA) as the mediator, one using only sum VPA instances as the mediator, and one using only sum MPA instances as the mediator.

The bootstrap for each analysis (i.e., all sample compositions and all types of physical activity mediators for each sample) yielded confidence intervals that contain 0 (See Table 7). This indicates that a_1b_1 is not significantly different from 0 at $p < .05$, and therefore the null hypothesis cannot be rejected. This means it is unlikely that physical activity acts as a mediator in the relationship between PASE and BMI percentile. Though not significant, it should be noted that these values indicate that the relationships favor the hypothesized direction (i.e., a negative relationship between PASE and BMI percentile).

Table 7

Results of Test for Simple Mediation: 95% Confidence Interval from LL to UL

Activity Level	Full Sample	Boys	Girls
WPA	-.28 to .07	-.34 to .14	-.39 to .10
VPA	-.27 to .07	-.40 to .12	-.39 to .09
MPA	-.26 to .05	-.28 to .11	-.37 to .15

Note. WPA = metabolically weighted physical activity; VPA = vigorous physical activity; MPA = moderate physical activity

Hypothesis 2

The second hypothesis was that the relationship between PASE and BMI percentile is mediated by physical activity contingent upon the level of sedentary behavior. This was hypothesized to be a negative relationship (i.e., the more sedentary behavior increased, the stronger the relationship between these variables would be in the negative direction).

Full sample. As noted above, the second hypothesis was evaluated using (a) the full range of metabolically weighted physical activity scores (WPA), (b) sum instances of MPA, and (c) sum instances of VPA as the mediator. First, in the full sample, no significant indirect effect of PASE on BMI percentile via WPA was found for values of sedentary behavior ranging from 0 to 3,395 minutes. That is, for all values of sedentary behavior, the 95% CI for the bootstrap analysis included 0, preventing the rejection of the null hypothesis. See Figure 8 for a graphic depiction of this relationship.

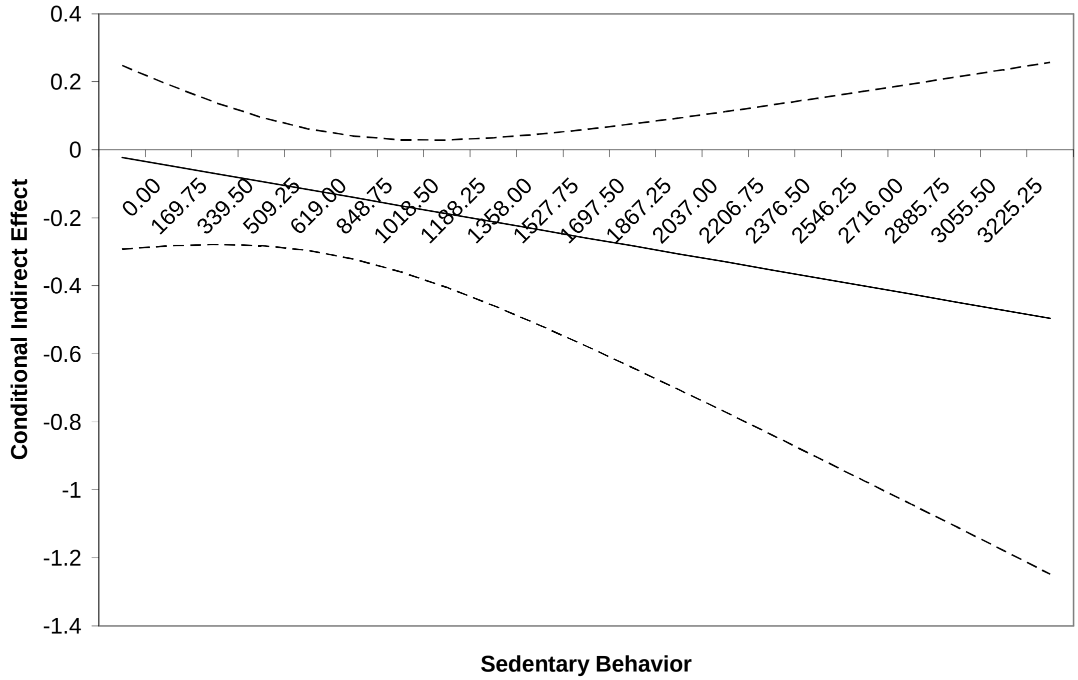

Figure 8. The plot of the mediated relationship between PASE and BMI percentile via WPA (i.e., a_1b_1) for the range of sedentary behavior values (i.e., minutes over three days) found in the full sample.

Second, as depicted in Figure 9, no significant indirect effect via MPA was found for the same range of sedentary behavior values. Just as in the instance of WPA, the 95% CI for the bootstrap analysis included 0 for all values of sedentary behavior, preventing the rejection of the null hypothesis.

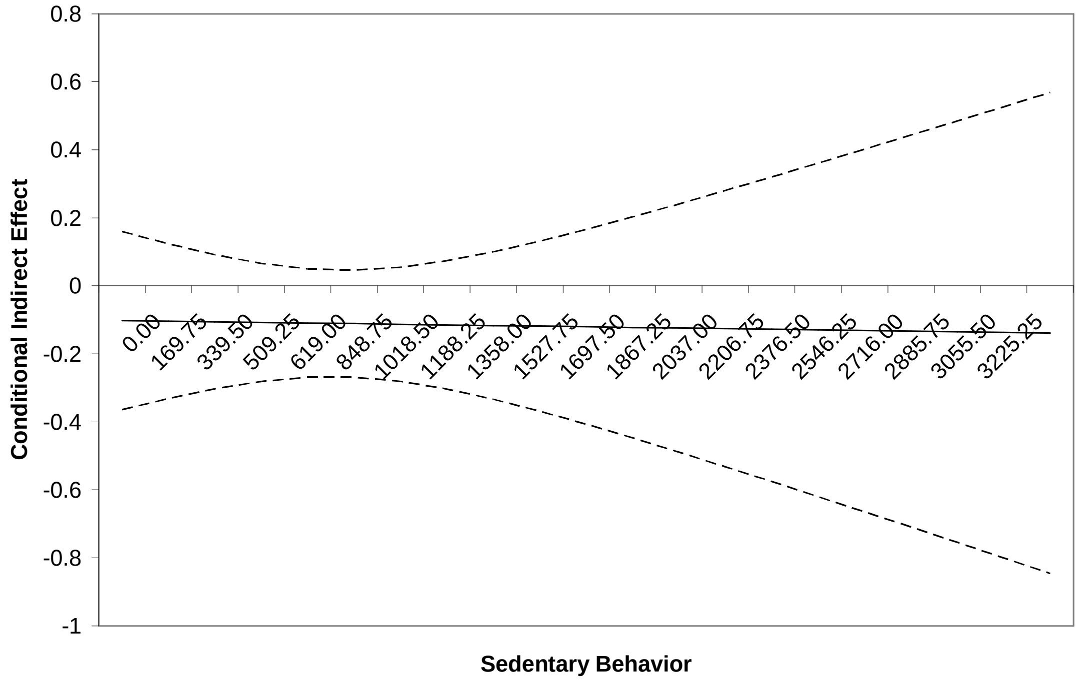

Figure 9. The plot of the mediated relationship between PASE and BMI percentile via MPA (i.e., a_1b_1) for the range of sedentary behavior values (i.e., minutes over three days) found in the full sample.

Third, and conversely, when the indirect effect of VPA was tested along the same range of sedentary behavior values, VPA did mediate the negative relationship between PASE and BMI percentile for increasing values of sedentary behavior starting at 1188.25 minutes ($p < .05$). Specifically, for the range of increasing sedentary behavior scores starting with 1188.25, the 95% CI for the bootstrapping analysis did not include 0, requiring that the null hypothesis be rejected for this range of sedentary behavior values. See Figure 10 for a graphic demonstration of this relationship.

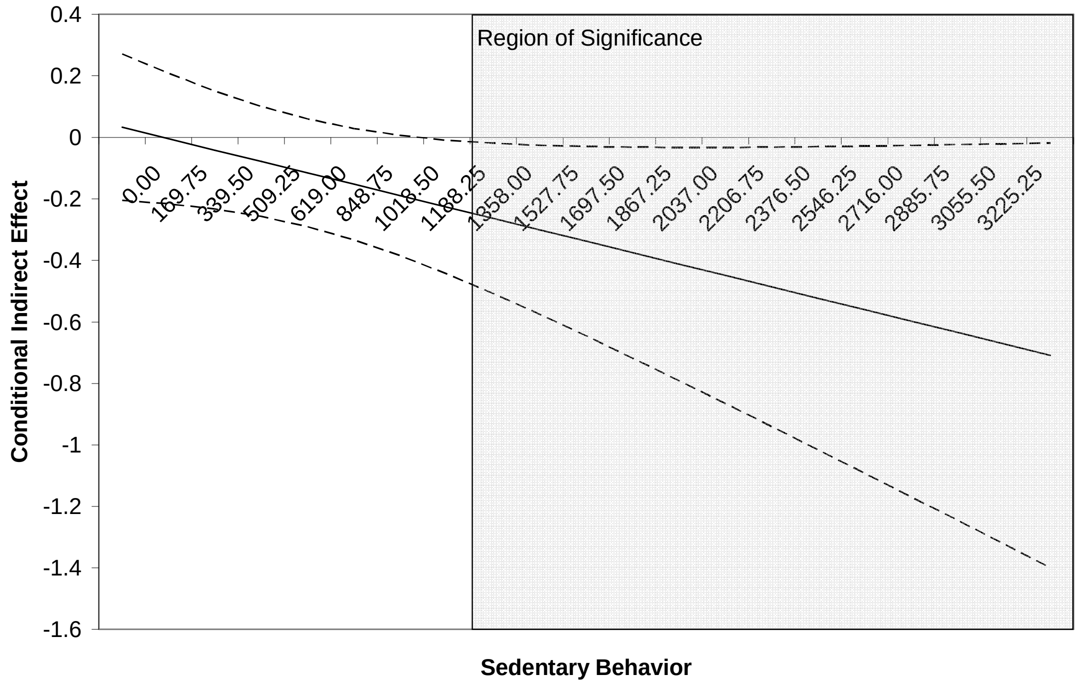

Figure 10. The plot of the mediated relationship between PASE and BMI percentile via VPA (i.e., a_1b_1) for the range of sedentary behavior values (i.e., minutes over three days) found in the full sample. In this sample, the findings are significant for sedentary behavior values greater than 1188.25.

Boys. For the sample of boys, the indirect effects of the target variables were tested for the full range of sedentary behavior values (i.e., 0 to 3,395.00 minutes). No significant indirect effects were found for WPA, VPA, or MPA along this range of sedentary behavior values. That is, for all sedentary behavior values, regardless of the mediator, the 95% CI for the bootstrap analysis included 0, preventing the rejection of the null hypothesis.

Girls. For the sample of girls, indirect effects of the target variables were tested for the full range of sedentary behavior values (i.e., 0 to 1,919.00 minutes). The indirect effect of WPA was found to be significant when minutes of sedentary behavior were within the range of 575.7 and 1055.45 ($p < .05$; see Figure 11). That is, 0 was not contained within the 95% confidence interval for this range of sedentary behavior, thereby requiring the null hypothesis to be rejected for these values.

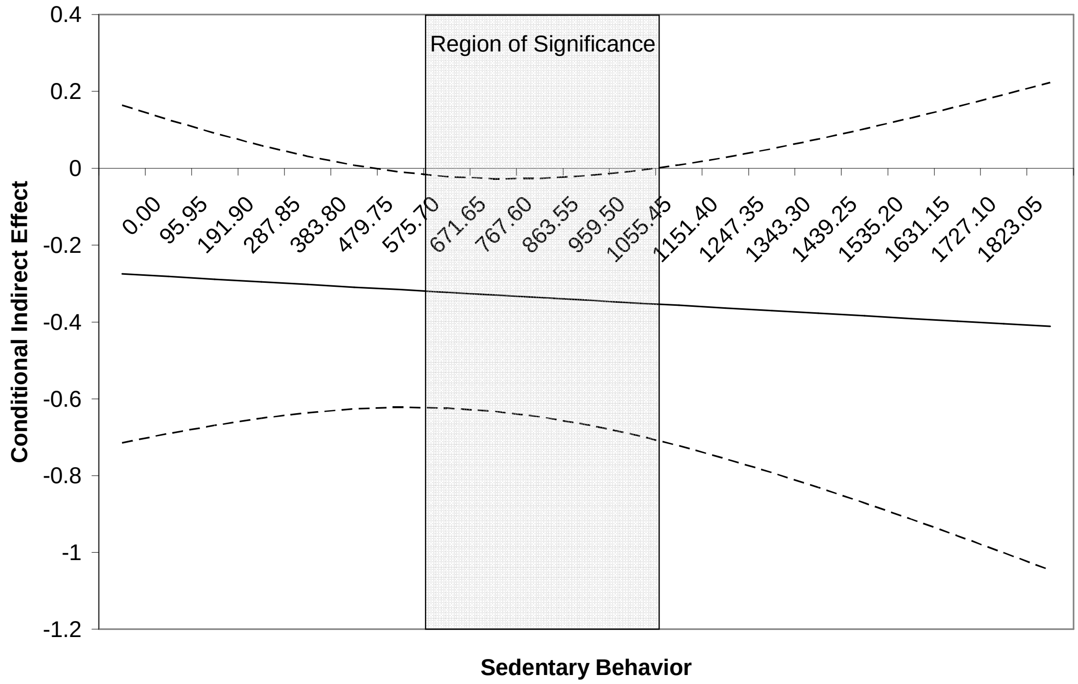

Figure 11. The plot of the mediated relationship between PASE and BMI percentile via WPA (i.e., a_1b_1) for the range of sedentary behavior values (i.e., minutes over three days) found among in the sample of just girls. In this sample, the findings are significant for sedentary behavior values between 575.70 and 1055.45.

Likewise, the indirect effect of VPA was significant when minutes of sedentary behavior were within the range of 479.75 and 959.5 ($p < .05$, see Figure 12) and the indirect effect of MPA was significant for sedentary behavior values within the range of 767.6 and 1055.45 ($p < .05$, see Figure 13). In other words, the 95% CI did not contain 0 for each respective range of sedentary behavior values, requiring the rejection of the null hypothesis in each instance.

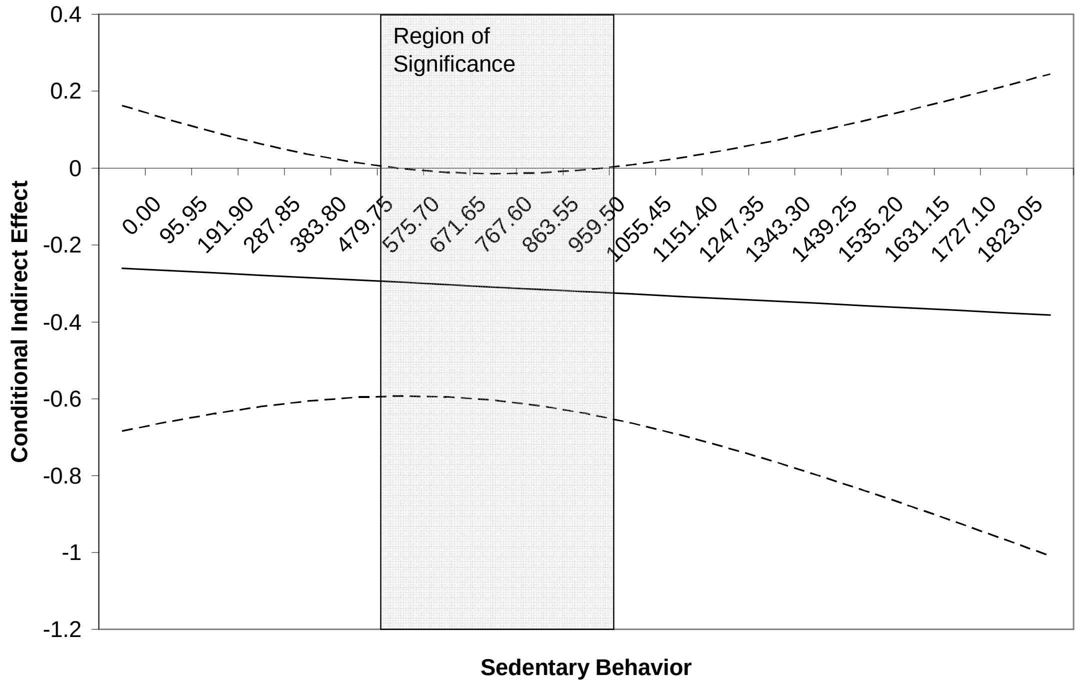

Figure 12. The plot of the mediated relationship between PASE and BMI percentile via VPA (i.e a_1b_1) for the range of sedentary behavior values (i.e., minutes over three days) found among in the sample of just girls. In this sample, the findings are significant for sedentary behavior values between 479.75 and 959.50.

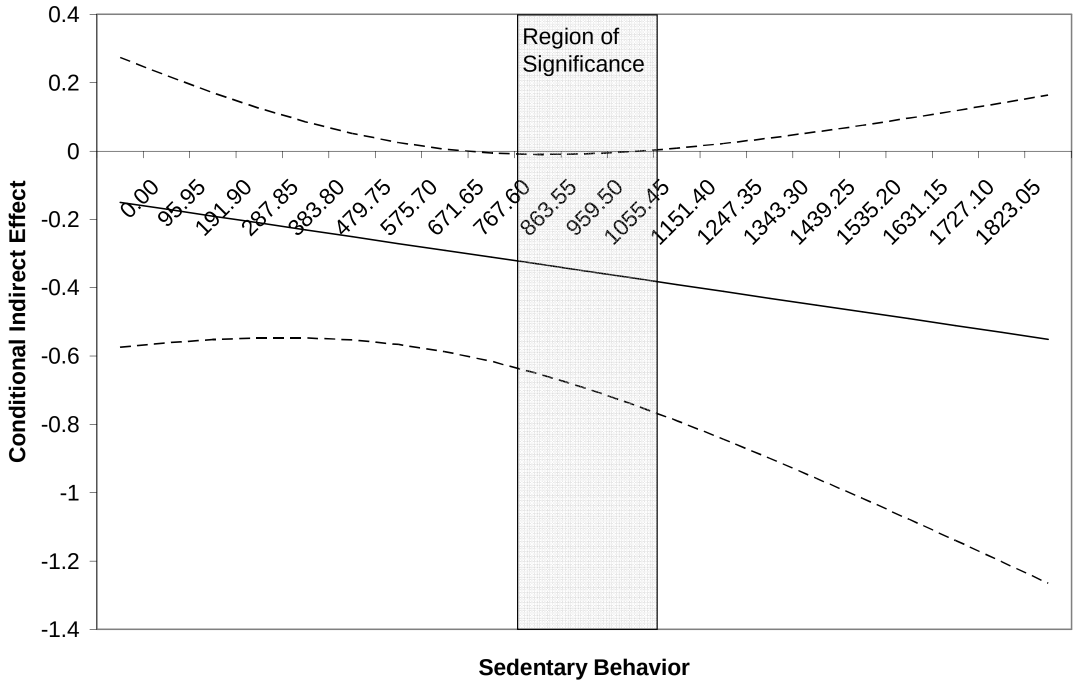

Figure 13. The plot of the mediated relationship between PASE and BMI percentile via MPA (i.e., a_1b_1) for the range of sedentary behavior values (i.e., minutes over three days) found among in the sample of just girls. In this sample, the findings are significant for sedentary behavior values between 767.60 and 1055.45.

Discussion

Despite widespread knowledge of broad factors that influence weight status, cases of obesity and overweight among children continue to increase at an alarming rate. In an effort to better inform future intervention initiatives, the current study scrutinized the relationships among PASE, physical activity, BMI percentile, and sedentary behavior. Findings indicate that the association between PASE and BMI is mediated by VPA for children, but only among those who engage in the highest levels of sedentary behavior (Figure 10). Closer inspection revealed that girls may be the primary impetus driving this association.

The first hypothesis of the current study positioned physical activity as a mediator between PASE and BMI percentile. Findings demonstrated that physical activity, regardless of intensity, did not mediate this relationship. These results resemble the findings of Ward et al. (2006), which divided an all female sample of adolescents into categories based on activity level and BMI percentile for separate analyses. This study identified significantly higher levels of PASE among individuals in the high activity group; however, differences in PASE in regards to BMI percentile category were nonsignificant. Less similar are the findings of Trost et al. (2001) and De Bourdeaudhuij et al. (2005), both of which used separate analyses to identify lower levels of physical activity and PASE among overweight groups.

Correlation analyses performed prior to hypothesis testing add some insight into this pattern of associations. PASE was significantly associated with physical activity regardless of sex (Table 5 and Table 6), a common finding in the literature (e.g., Jago et al., 2007; Sharma et al., 2006; Strauss et al., 2001). Conversely, neither of these variables was significantly associated with BMI (Table 5 and Table 6). This is not entirely surprising given the level of inconsistency in the literature regarding the association between physical activity and body composition (Andersen et al., 1998; Levin et al., 2003; Obarzanek et al., 1994; Rennie et al., 2005). Speculation has been written regarding why this is, with many suggesting that the connection between physical activity and BMI may be more complex than a simple 1:1 association. In response, some theorists are beginning to broaden their conceptualization of child activity patterns to include sedentary behavior (e.g., Andersen et al., 1998; Reilly & McDowell, 2003; Ritchie et al., 2001), further discussed below.

Perhaps the most interesting findings of the current study were found in relation to the second hypothesis. The bearing of sedentary behavior on the associations among PASE, BMI percentile, and physical activity had not yet been explored in the empirical literature. Whereas the initial analysis did not find physical activity to mediate an association between PASE and BMI percentile, evaluation of the second hypothesis revealed conditions under which the interactions between these variables becomes evident. The findings suggest that the relationship between PASE and BMI is not a simple one, but one that must take into account sex, physical activity intensity, and individual levels of sedentary behavior. For individuals who are more sedentary, the current findings suggest there is an association between PASE and BMI percentile that is explained (at least partially) by physical activity. The more time an individual regularly engages in sedentary behaviors, the stronger this relationship becomes (Figure 10). Further, it appears girls are driving this relationship in the full sample, as further explored below.

As discussed in the introduction, the benefit of including sedentary behavior in this type of study is not a particularly new revelation, though such studies are uncommon. The few studies published that examine sedentary behavior and physical activity in tandem have generally found that children who are more sedentary and less active are more likely to be overweight (Andersen et al., 1998; te Velde et al., 2007). The current study builds upon the findings of these two studies by taking a unique approach in its examination of this relationship. While the aforementioned studies have used categories identifying a variety of physical activity/sedentary behavior patterns, the current study attempted to capture the dynamic interplay between these two variables by placing sedentary behavior as a moderator in the association between physical activity and BMI percentile. By using this model, continuous values are used for all of the components, thereby increasing the ability to detect a relationship. Dichotomization of the variables would have lead to a decrease in power and less sensitivity toward individual differences (MacCallum, Zhang, Preacher, & Rucker, 2002).

The current study’s findings also emphasize the importance of differentiating between varying intensities of physical activity. In our examination of the hypotheses, intensity was accounted for using two separate techniques. The first was to weight the values according to previously determined metabolic values (Sallis et al., 1996) and use the full range of physical activity as a continuous variable (WPA). The second was to adopt previously used techniques for separating types of activities based on intensity (e.g., Trost et al., 2001) and perform separate analyses using sum instances of MPA and VPA as continuous variables. Interestingly, in our examination of the second hypothesis among the full sample, VPA was the only measurement that evidenced significant associations among the variables of interest. Conversely, the full sample model containing MPA demonstrated no association between the variables regardless of sedentary behavior level (as illustrated in Figure 9).

A review of the physical activities that fall within each category of intensity help explain these findings. VPA includes items such as swimming, running, basketball, football, and soccer; MPA includes items such as tag, bicycling, kickball, chores, and walking. Based these representative items, it appears that in addition to requiring higher levels of exertion, activities in the VPA category also call for skill techniques and/or specialized equipment. Taking these additional challenges into account, it seems logical that VPA would be associated with higher levels of PASE, particularly for more sedentary individuals. Likewise, it is fair to say that time spent in these high-intensity activities would be more "threatening" for children of higher BMI who are more sedentary. Findings such as those by Deforche, De Bourdeauhuij, and Tanghe (2006) and Zabinski, Saelens, Stein, Hauden-Wade, and Wilfley (2003) support this claim, revealing personal feelings regarding physical (i.e., body-related) barriers and lack of skill as being more common physical activity deterrents among overweight children compared to those of normal weight.

PASE has consistently been found to have a positive association with VPA across studies of children (Strauss et al., 2001; Trost et al., 1997; Trost et al., 1999; Ward et al., 2006). However, as discussed in relation to the first hypothesis, past findings regarding the relationship between VPA and BMI have been inconsistent, with higher levels of VPA being associated with lower BMI percentile in some studies (e.g., Eisenmann et al., 2002; Trost et al., 1997; Trost et al., 1999) but not others (e.g., Dowda et al., 2001; Levin et al., 2003; Obarzanek et al., 1994). One explanation for this inconsistency in the literature could be the failure to account for varying levels of sedentary behavior as done in the current study. It is a logical conclusion that higher levels of VPA could have different effects on a child's body composition depending on their level of involvement in sedentary behavior, creating a "balance within a balance" (i.e., the balance of physical activity and sedentary behavior within the energy expenditure side of the energy balance equation).

A final finding of importance relates to how the associations between these variables differ according to sex. Boys in the current study were found to engage in significantly higher levels of VPA, video games, and total sedentary behavior. Similar sex-related differences between these variables are common in the literature (e.g., Andersen et al., 1998; Berkey et al., 2003; Dowda et al., 2001; Eisenmann et al., 2002; Levin et al., 2003; Trost et al., 1997). Though significant associations were not found for either sex in the evaluation of the first hypothesis, analyses pertaining to the second hypothesis revealed some interesting differences. Analysis of the full sample identified the relationships to be significant only when VPA was included in the model; however, a division of the sample by sex revealed that, for girls, all three measures of activity (WPA, VPA, and MPA) mediated the relationship between PASE and BMI percentile for certain values of sedentary behavior. Conversely, the sample of boys yielded no significant findings using any measure of physical activity to evaluate the second hypothesis. These sex differences indicate that girls may be driving the association among PASE, physical activity, and BMI in the full sample.

One explanation for these sex differences may be cultural differences regarding behavior norms. The prevalence of high levels of VPA and sedentary behavior within the male culture may downplay the role of PASE and BMI percentile when boys decide whether or not to engage in these activities. In other words, existing social norms (or perhaps social pressure) may compel boys within this age group to engage in high levels of physical activity regardless of their size, their beliefs in their abilities, or the amount of time they are involved in sedentary pursuits. Conversely, if high levels of activity are not a part of female cultural norms, girls of various body compositions would require greater confidence in their capacity to be active in order to feel comfortable transitioning from sedentary tasks to more vigorous ones. The anticipation of social sanctions among sedentary females would necessitate higher levels of PASE for this subset of girls to overcome these beliefs and be physically active. In this way, associations between PASE and BMI percentile via physical activity would become strengthened for this population. Future research should further explore these possible effects of sex-based behavior norms.

Another explanation for these sex-related differences could be differential effects of sedentary behavior. Several studies have indicated that sedentary behaviors, as opposed to physical activity, may be particularly important to body composition among females when compared to males (Berkey et al., 2003; Crespo et al., 2001; Dowda et al., 2001; Obarzanek et al., 1994; te Velde et al., 2007). This accentuated effect of sedentary behavior for girls may help explain why sex differences were not found in the evaluation of the first hypothesis, where the null hypothesis was not rejected for either boys or girls. Related findings were revealed in preliminary analyses that demonstrated a significant correlation between BMI percentile and sedentary behavior for girls but not boys (see Table 5 and Table 6).

No empirical evidence is available that explains these possible sex-related differences regarding the effect of sedentary behavior on body composition. One viable explanation could be differences in how members of each sex commonly engage in these behaviors. For instance, boys could typically be more “fidgety” during sedentary behaviors or perhaps girls could be more prone to snacking. Co-occurring behaviors of this type would cause sedentary behavior to have different moderating qualities regarding the relationship between physical activity and BMI percentile. Another explanation could be the type of sedentary behaviors that are common to each group. Under experimental conditions, video games and action films have both been shown to increase physiologic and metabolic activity (Wang & Perry, 2006). If these types of sedentary behaviors are more common among boys than girls (e.g., video games, as demonstrated in the current study and Berkey et al., 2003), this would again cause sedentary behavior to have different moderating effects on the relationship between physical activity and BMI percentile depending on a child’s sex.

Clinical Implications

The findings of the current study build upon an expanding research base to better inform prevention and intervention efforts focused on childhood obesity and help define focal points for intervention. The results indicate that children with low PASE, who engage in low levels of VPA and high levels of sedentary behavior, also tend to be of higher BMI. Because this association appears to be driven by physical activity levels among girls within a particular range of sedentary behavior values, the discussion of clinical implications will focus on this population.

In discussing clinical significance, discussion of these findings in terms of actual minutes may provide a bit more insight. The association between PASE, physical activity (i.e., WPA, VPA, or MPA), and BMI percentile among girls is significant for values between 479.75 (i.e., the lowest significant value of sedentary behavior minutes, found in relation to VPA) and 1055.45 (i.e., the highest significant value of sedentary behavior minutes, found in relation to WPA and MPA). Dividing these values by the three day recall period, the average number of minutes per day of sedentary behavior for these girls is between 159.92 and 351.82 minutes (i.e., between 2.67 and 5.86 hours). Comparatively, the average amount of time spent engaged in sedentary behavior across the entire female sample was 411.06 minutes (i.e., 137.02 minutes or 2.28 hours per day). In other words, for girls who watch television and play video games for twenty minutes more per day than the average girl (see Figure 14), the association between PASE, physical activity, and BMI plays a more significant role. Given that most television programs are either a half or full hour, this is a difference of less than one television show. In the current study, 23.9% (n = 42) of the full sample of girls fell within this significant range of sedentary behavior.

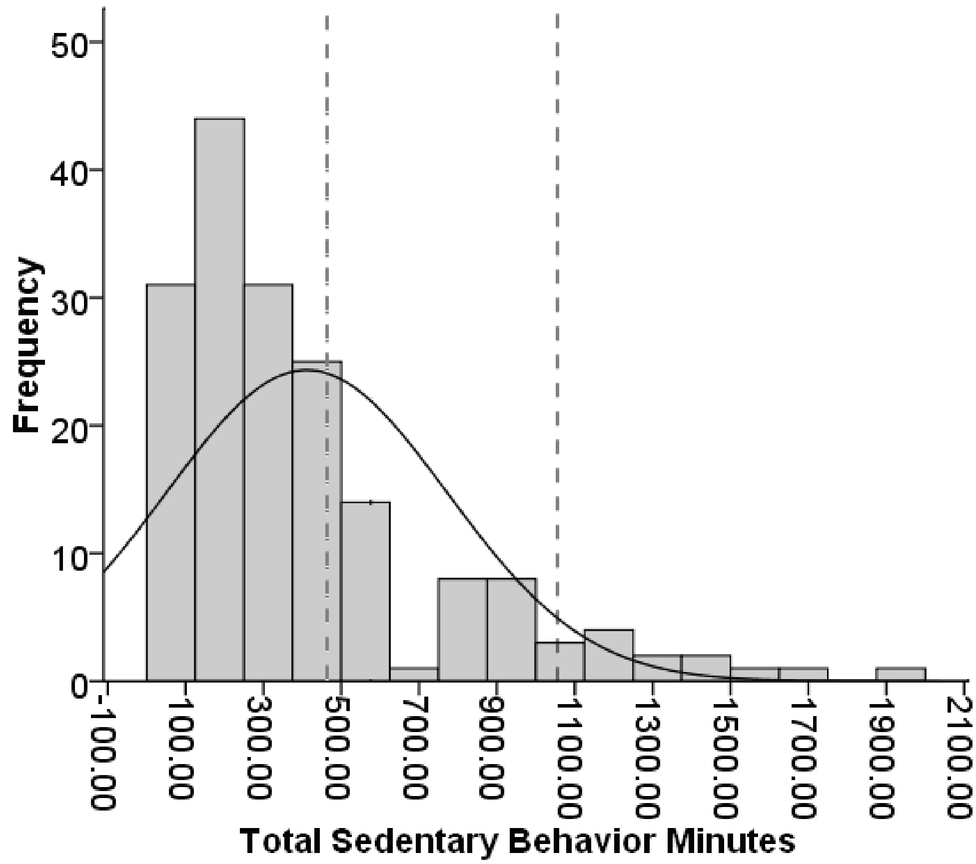

Figure 14. A histogram of the total minutes of sedentary behavior for the girls (*M* = 411.06, *SD* = 360.63, *N* = 176). The dotted lines are placed at 479.75 and 1055.45 to indicate the range where the association between PASE, physical activity, and BMI percentile is significant.

For these girls (i.e., who engage in approximately 2.5 to 6 hours of sedentary behavior per day), the focal points of interventions should be the variables most amenable to change (i.e., PASE, physical activity, and sedentary behavior). In regards to PASE and physical activity, the direction of the relationship between these two variables is inconsequential. Bandura (1997) has reported that the most effective way to affect a person's self-efficacy for a given behavior is to provide an individual with mastery experiences. This consists of setting small, attainable goals of the targeted behavior that are tailored to the individual. These behavioral demands are then increased incrementally until the desired level of behavior is attained. In this way, a child's physical activity and PASE may be increased simultaneously as the increase in one variable will continue to have effects on the other. Additional ways to affect PASE involve modeling and social feedback (Bandura, 1997). Family-based interventions may be particularly influential in regards to these methods. Parents engaging in physical activities with their children will not only positively effect children's level of physical activity but also have the potential to increase children's PASE via vicarious experience and positive feedback.

Increases in physical activity and/or PASE are only one part of an effective intervention designed in accordance with the current study's findings. Of equal importance is decreasing high levels of sedentary behavior. Some methods have been identified as successfully reducing sedentary behaviors, though interventions of this sort are far less studied than those designed to increase physical activity. Examples of sedentary behavior interventions have included electronic devices that limit television access (Epstein et al., 2008; Goldfield et al., 2006), reinforcement for decreases in sedentary behavior minutes (Epstein, Saelens, & O'Brien, 1995; Salmon et al., 2005), and combination of education and self-monitoring (Gortmaker et al., 1999; Salmon et al., 2005).

For the 7.40% (n = 13) of girls who exceeded more than an average of 5.86 hours of television per day, the associations between PASE, physical activity, and

BMI percentile were not significant. One explanation for this finding is that the small number of girls in this range of sedentary behavior made detection of significant associations among variables difficult (i.e., Type II error). Another explanation could be that there is a ceiling effect: At more than six hours of sedentary behavior per day, there would be limited time for other activities. Specifically, there would be little time to perform the high level of physical activity required to balance the effect that extreme periods of sedentary behavior could have on body composition. Intervention strategies for this group should primarily focus on the previously discussed methods of reducing time spent in sedentary behavior. Once the amount of sedentary time for these girls is decreased to less than 6 hours, interventions can begin to incorporate techniques designed to increase PASE and physical activity.

Limitations

Despite its many strengths, a few limitations pertaining to the current study also exist. First, the correlational nature of this study does not allow for causal inferences regarding the relationships between variables. Though the cross-sectional design of the current study is regarded as an essential first step in well-constructed research (Rutter, 1994), a longitudinal design would reveal valuable information regarding the direction of influence between the variables of interest. Furthermore, experimental studies designed to increase PASE and/or decrease sedentary behavior for the purpose of comparing outcomes with those of controls would offer the most insight into this relationship. The current study provides justification for the investment of time, money, and other increased resources required for these methods of further investigation.

A second limitation of the current study concerns the method of physical activity assessment. As with any measure that relies upon self-report, information gathered using this type of device may contain inaccuracies based on the participants' recall and potential response biases. The use of accelerometers such as those used in studies by Trost and colleagues (2001) would offer a more reliable record of time spent in activity. Because this type of device does not allow for assessment of activity intensity, supplemental use of a self-report device concurrent with the accelerometer is recommended. Additionally, use of a behavioral log of physical activity and sedentary behavior that is completed over the three day period would help counter issues related to recall, however this would require a higher level of participant commitment and adherence to record keeping over a prolonged time period.

A third limitation of the current study is related to the use of the bootstrapping resampling procedure. The many advantages of this procedure are discussed above, including the ability to perform a fairly complex statistical procedure (i.e. moderated mediation) with relatively limited data. A limitation of this procedure, however, is its lack of established effect size measures. Without a method of determining the magnitude of the observed effect, the usefulness of this model beyond statistical significance is difficult to identify.

Conclusions

Limitations notwithstanding, the current study provides valuable information bolstered by methodological strengths related to its large sample size, empirically determined height and weight, demographic characteristics, and three-day recall of behavior. Results emphasize the significance of examining physical activity in tandem with sedentary behavior when studying childhood weight issues and the importance of accounting for child sex and the intensity of their physical activities.

The results of this study offer some empirical support for child interventions that target unhealthy BMI by increasing PASE and physical activity and decreasing sedentary behavior. These findings indicate that this would be a particularly effective way to target unhealthy BMI among preadolescent girls. PASE and physical activity levels can be positively affected by individually tailored regimens that provide mastery experiences for program participants and include the child's parents. Interventions should simultaneously address participants' sedentary behavior levels, as higher levels would negatively impact health-related outcomes. For those who engage in the most extreme number of sedentary behavior minutes (e.g., more than 6 hours), it may be more effective to focus primarily on the reduction of this time before incorporating techniques designed to increase PASE and physical activity levels.

References

Allison, K. R., Dwyer, J. J. M., & Makin, S. (1999). Self-efficacy and participation in vigorous physical activity by high school students. *Health Education and Behavior, 26*, 12-24.

Andersen, R. E., Crespo, C. J., Bartlett, S. J., Cheskin, L. J., & Pratt, M. (1998). Relationship of physical activity and television watching with body weight and level of fatness among children: Results from the Third National Health and Nutrition Examination Survey. *Journal of the American Medical Association, 279,* 938-942.

Baker, J. L., Olsen, L. W., & Sorenses, T. I. A. (2007). Childhood Body Mass Index and the risk of coronary heart disease in adulthood. *The New England Journal of Medicine, 357*, 2329-2337.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191-215.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman & Co.

Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions: How are we doing? How might we do better? *American Journal of Preventive Medicine, 15,* 266-297.

Baranowski, T., & Jago, R. (2005). Understanding the mechanisms of change in children's physical activity programs. *Exercise and Sport Science Reviews, 33,* 163-168.

Barlow, S. E., & Dietz, W. H. (1998). Obesity evaluation and treatment: Expert committee recommendations. *Pediatrics, 102,* e29.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173-1182.

Berkey, C. S., Rockett, H. R., Gillman, M. W., & Colditz, G. A. (2003). One-year changes in activity and in inactivity among 10- and 15-year-old boys and girls: Relationship to change in body mass index. *Pediatrics, 111,* 836-843.

Burros, M. (1994, July 17). Despite awareness of risks, more in U. S. are getting fat. *New York Times*, pp. 1, 18.

Center for Disease Control. (2007a, May 22). *About BMI for children and teens.* Retrieved August 7, 2007, from http://www.cdc.gov/nccdphp/dnpa/bmi/childrens_BMI/about_childrens_BMI.htm

Center for Disease Control. (2007b, January 30). *Prevalence of overweight among children and adolescents: United States, 2003-2004.* Retrieved August 7, 2007, from http://www.cdc.gov/nchs/products/pubs/pubd/hestats/overweight/overwght_child_03.htm

Crespo, C. J., Smit, E., Troiano, R. P, Bartlett, S. J., Macera, C. A., & Andersen, R. E. (2001). Television watching, energy intake, and obesity in U.S. children: Results from the Third National Health and Nutrition Examination Survey, 1988-1994. *Archives of Pediatrics and Adolescent Medicine, 155,* 360-365.

De Bourdeaudhuij, I., Lefevre, J., Deforche, B., Wijndaele, K., Matton, L., & Philippaerts, R. (2005). Physical activity and psychosocial correlates in normal weight and overweight 11 to 19 year olds. *Obesity Research, 13,* 1097-1105.

Deforche, B. I., De Bourdeaudhuij, I. M., & Tanghe, A. P. (2006). Attitude toward physical activity in normal-weight, overweight, and obese adolescents. *Adolescent Medicine, 38,* 560-568.

Dietz, W. H., Bandini, L. G., Morelli, J. A., Peers, K. F., & Ching, P. L. Y. H. (1994). Effect of sedentary activities on resting metabolic rate. *American Journal of Clinical Nutrition, 59*, 556-559.

Dishman, R. K., Motl, R. W., Saunders, R., Felton, G., Ward, D. S., Dowda, M., et al. (2004). Self-efficacy partially mediates the effect of a school-based physical-activity intervention among adolescent girls. *Preventive Medicine, 38,* 628-636.

Dowda, M., Ainsworth, B. E., Addy, C. L., Saunders, R., & Riner, W. (2001). Environmental influences, physical activity, and weight status in 8- to 16-year-olds. *Archives of Pediatric and Adolescent Medicine, 155,* 711-717.

Durant, R. H., Baranowski, T., Johnson, M., & Thompson, W. O. (1994). The relationship between television watching, physical activity, and body composition of young children. *Pediatrics, 94,* 449-455.

Ebbing, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: Public health crisis, common sense cure. *Lancet, 360,* 473-482.

Edmundson, E., Parcel, G. S., Feldman, H. A., Elder, J., Perry, C. L., Johnson, C. C., et al. (1996). The effects of the Child and Adolescent Trial for Cardiovascular Health upon psychosocial determinants of diet and physical activity behavior. *Preventive Medicine, 25,* 442-454.

Eisenberg, M. E., Neumark-Sztainer, D., & Story, M. (2003). Associations between weight-based teasing and emotional well-being among adolescents. *Archives of Pediatrics and Adolescent Medicine, 157,* 733-738.

Eisenmann, J. C., Bartee, R. T., & Wang, M. Q. (2002). Physical activity, TV viewing, and weight in U. S. Youth: 1999 Youth Risk Behavior Survey. *Obesity Research, 10,* 379-385.

Epstein, L. H., Gordy, C. C., Raynor, H. A., Beddome, M., Kilanowski, C. K., & Paluch, R. (2001). Increasing fruit and vegetable intake and decreasing fat and sugar intake in families at risk for childhood obesity. *Obesity Research, 9,* 171-178.

Epstein, L. H., Paluch, R., Smith, J. D., & Sayette, M. (1997). Allocation of attentional resources during habituation to food cues. *Psychophysiology, 34,* 59-60.

Epstein, L. H., Roemmich, J. N., Robinson, J. L., Paluch, R. A., Winiewicz, D. D., Fuerch, J. H., et al., (2008) A randomized trial of the effects of reducing television viewing and computer use on body mass index in young children. *Archives of Pediatrics and Adolescent Medicine, 162,* 239-245.

Epstein, L. H., Saelens, B. E., & O'Brien, J. G. (1995). Effects of reinforcing increases in active behavior versus decreases in sedentary behavior for obese children. *International Journal of Behavioral Medicine, 2*, 41-50.

Fields, D. & Higgins, P. (2008). Physiological mechanisms impacting weight regulation. In E. Jelalian & R. G. Steele (Eds.), *Handbook of child and adolescent obesity* (pp. 109-126). New York: Springer.

Garnett, S. P., Baur, L. A., Srinivasan, S., Lee, J. W., & Cowell, C. T. (2007). Body mass index and waist circumference in midchildhood and adverse cardiovascular disease risk clustering in adolescence. *American Journal of Clinical Nutrition, 86*, 549-555.

Goldfield, G. S., Mallory, R., Parker, T., Cunningham, T., Legg, C., Lumb, A., et al., (2006). Effects of open-loop feedback on physical activity and television viewing in overweight and obese children: A randomized, controlled trial. *Pediatrics, 118*, e157-e166.

Gortmaker, S. L., Peterson, K., Wiecha, J., Sobol, A. M., Dixit, S., Fox, M. K., et al. (1999). Reducing obesity via a school-based interdisciplinary intervention among youth: Plant Health. *Archives of Pediatrics and Adolescent Medicine, 153*, 409-418.

Hipsky, J., & Kirk, S. (2002). HealthWorks! Weight management program for children and adolescents. *Journal of the American Dietetic Association, 102*(Suppl. 3), 64-67.

Jago, R., Baranowski, T., Baranowski, J. C., Cullen, K. W., & Thompson, D. I. (2006). Social desirability is associated with some physical activity, psychosocial variables and sedentary behavior but not self-reported physical activity among adolescent males. *Health Education Research, 22,* 438-449.

Jurg, M. E., Kremers, S. P. J., Candel, M. J. J. M., Van Der Wal, M. F., & De Meij, J. S. B. (2006). A controlled trial of a school-based environmental intervention to improve physical activity in Dutch children: JUMP-in, kids in motion. *Health Promotion International, 21,* 320-330.

Klesges, R. C., Klesges, L. M., Eck, L. H., & Shelton, M. L. (1995). A longitudinal analysis of accelerated weight gain in preschool children. *Pediatrics, 95,* 126-130.

Klesges, R. C., Shelton, M. L., & Klesges, L. M. (1993). Effects of television on metabolic rate: Potential implications for childhood obesity. *Pediatrics, 91,* 281-286.

Levin, S., Lowry, R., Brown, D. R., & Dietz, W. H. (2003). Physical activity and body mass index among U. S. adolescents. *Archives of Pediatric and Adolescent Medicine, 157,* 816-820.

Lewis, B. A., Marcus, B. H., Pate, R. R., & Dunn, A. L. (2002). Psychosocial mediators of physical activity behavior among adults and children. *American Journal of Preventive Medicine, 23,* 26-35.

Luepker, R. V. (1999). How physically active are American children and what can we do about it? *International Journal of Obesity, 23*(Suppl. 2), S12-S17.

Luepker, R. V., Perry, C. L., McKinlay, S. M., Nader, P. R., Parcel, G. S., Stone, E. J., et al. (1996). Outcomes of a field trial to improve children's dietary patterns and physical activity: The Child and Adolescent Trial for Cardiovascular Health (CATCH) collaborative group. *Journal of the American Medical Association, 275,* 768-776.

MacCallum, R. C., Zhang, S., Preacher, K. J., & Rucker, D. D. (2002). On the practice of dichotomization of quantitative variables. *Psychological Methods, 7,* 19-40.

Maibach, E., & Murphy, D. A. (1995). Self-efficacy in health promotion research and practice: Conceptualization and measurement. *Health Education Research, 10,* 37-50.

Marshall, S. J., Biddle, S. J. H., Gorely, T., Cameron, N., & Murdey, I. (2004). Relationships between media use, body fatness and physical activity in children and youth: A meta-analysis. *International Journal of Obesity, 28,* 1238-1246.

McCauley, E., Pena, M. M., & Jerome, G. J. (2001). Self-efficacy as a determinant and an outcome of exercise. In G. C. Roberts (Ed.), *Advances in motivation in sport and exercise* (pp. 235-261). Champaign, IL: Human Kinetics Publishers, Inc.

Mokdad, A. H., Serdula, M. K., Dietz, W. H., Bowman, B. A., Marks, J. S., & Koplan, J. P. (1999). The spread of the obesity epidemic in the United States, 1991-1998. *Journal of the American Medical Association, 282,* 1519-1522.

Moore, L. L., Gao, D., Bradlee, M. L., Cupples, L. A., Sundarajan-Ramamurti, A., Proctor, M. H., et al. (2003). Does early physical activity predict body fat change throughout childhood? *Preventive Medicine, 37,* 10-17.

Motl, R. W., Dishman, R. K., Trost, S. G., Saunders, R. P., Dowda, M., Felton, G., et al. (2000). Factorial validity and invariance of questionnaires measuring social-cognitive determinants of physical activity among adolescent girls. *Preventive Medicine, 31,* 584-594.

Must, A. & Strauss, R. S. (1999). Risks and consequences of childhood and adolescent obesity. *International Journal of Obesity, 23*(Suppl. 2), S2-S11.

Nader, P. R., Stone, E. J., Lytle, L. A., Perry, C. L., Osganian, S. K., & Kelder, S. (1999). Three-year maintenance of improved diet and physical activity: The CATCH cohort. *Archives of Pediatric and Adolescent Medicine, 153,* 695-704.

Obarzanek, E., Schreiber, G. B., Crawford, P. B., Goldman, S. R., Barrier, P. M., Frederick, M. M., et al. (1994). Energy intake and physical activity in relation to indexes of body fat: The National Heart, Lung, and Blood Institute Growth and Health Study. *The American Journal of Clinical Nutrition, 60,* 15-22.

Ogden, C. L., Carroll, M. D., & Flegal, K. M. (2008). High body mass index for age among U.S. children and adolescents, 2003-2006. *Journal of the American Medical Association, 299,* 2401-2405.

Parcel, G. S., Simons-Morton, B., O'Hara, N. M., Baranowski, T., & Wilson, B. (1989). School promotion of healthy diet and physical activity: Impact on learning outcomes and self-reported behavior. *Health Education and Behavior, 16,* 181-199.

Parsons, T. J., Power, C., & Manor, O. (2005). Physical activity, television viewing, and body mass index: A cross-sectional analysis from childhood to adulthood in the 1958 British cohort. *International Journal of Obesity, 29*, 1212-1221.

Pivarnik, J. M. & Pfeiffer, K. A. (2002). *Position paper: The importance of physical activity for children and youth* (Michigan governor's council on physical fitness, health and sports). Retrieved July 1, 2008, from http://www.michiganfitness.org/Publications/documents/Adolescents.pdf

Preacher, K. J. & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, and Computers, 36,* 717-731.

Preacher, K. J. & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods, 40,* 879-891.

Preacher, K. J., Rucker, D. D., & Hayes, A. F. (2007). Addressing moderated mediation hypotheses: Theory, methods, and prescriptions. *Multivariate Behavioral Research, 42,* 185-227.

Puhl, R. M., & Latner, J. D. (2007). Stigma, obesity, and the health of the nation's children. *Psychological Bulletin, 133,* 557-580.

Reilly, J. J., & McDowell, Z. C. (2003). Physical activity interventions in the prevention and treatment of paediatric obesity: Systematic review and critical appraisal. *Proceedings of the Nutrition Society, 62*, 611-619.

Rennie, K. L., Livingstone, B. E., Wells, J. C. K., McGloin, A., Coward, W. A., Prentice, A. M., et al. (2005). Association of physical activity with body-composition indexes in children aged 6-8 at varied risk for obesity. *American Journal of Clinical Nutrition, 82,* 13-20.

Ritchie, L. Crawford, P., Woodward-Lopez, G., Ivey, S., Masch, M., & Ikeda, J. (2001). *Prevention of childhood overweight – What should be done?* Position Paper, Center for Weight and Health, U.C. Berkley.

Rovniak, L. S., Anderson, E. S., Winett, R. A., & Stephens, R. S. (2002). Social cognitive determinants of physical activity in young adults: A prospective structural equation analysis. *Annals of Behavioral Medicine, 24,* 149-156.

Rutter, M. (1994). Beyond longitudinal data: Causes, consequences, changes, and continuity. *Journal of Consulting and Clinical Psychology, 62,* 928-940.

Sallis, J. F., Haskell, W. L., Fortmann, S. P., Vranizan, K. M., Taylor, C. B., & Solomon, D. S. (1986). Predictors of adoption and maintenance of physical activity in a community sample. *Preventive Medicine, 15,* 331-341.

Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (1999). A review of correlates of physical activity of children and adolescents. *Medicine and Science in Sports and Exercise, 32,* 963-975.

Sallis, J. F., Strikmiller, P. K., Harsha, D. W., Feldman, H. A., Ehlinger, S., Stone, E. J., et al. (1996). Validation of interviewer- and self-administered physical activity checklists for fifth grade students. *Medicine and Science in Sports and Exercise, 28,* 840-851.

Salmon, J., Ball, K., Crawford, D., Booth, M., Telford, A., Hume, C., et al. (2005). Reducing sedentary behaviour and increasing physical activity among 10-year-pld children: Overview and process evaluation of the "Switch-Play" intervention. *Health Promotion International, 20*, 7-17.

Schwimmer, J. B., Burwinkle, T. M., & Varni, J. W. (2003). Health-related quality of life of severely obese children and adolescents. *Journal of the American Medical Association*, *289,* 1813-1819.

Sharma, M., Wagner, D. I., & Wilkerson, J. (2005/2006). Predicting childhood obesity prevention behaviors using social cognitive theory. *International Quarterly of Community Health Education*, *24,* 191-203.

Simons-Morton, B. G., Parcel, G. S., Baranowski, T., Forthofer, R., & O'Hara, N. M. (1991). Promoting physical activity and a healthful diet among children: Results of a school-based intervention study. *American Journal of Public Health*, *81,* 986-991.

Sobel, M. E. (1982). Asymptomatic confidence intervals for indirect effects in structural equation models. In S. Leinhart (Ed.), *Sociological methodology 1982* (pp. 290-312). San Francisco: Jossey-Bass.

Stevens, J., Story, M., Ring, K., Murray, D. M., Cornell, C. E., Juhaeri Gittelsohn, J., et al. (2003). The impact of the Pathways intervention on psychosocial variables related to diet and physical activity in American Indian schoolchildren. *Preventive Medicine, 37,* S70-S79.

Strauss, R. S., Rodzilsky, D., Burack, G., & Colin, M. (2001). Psychosocial correlates of physical activity in healthy children. *Archives of Pediatric and Adolescent Medicine, 155,* 897-902.

te Velde, S. J., De Bourdeaudhuij, I., Thorsdottir, I., Rasmussen, M., Hagstromer, M. Klepp, K., et al. (2007). Patterns in sedentary and exercise behaviors and associations with overweight in 9-14-year-old boys and girls: A cross-sectional study. *BMC Public Health, 7*. Retrieved August 8, 2007, from http://www.biomedcentral.com/1471-2458/7/16

Troiano, R. P., & Flegal, K. M. (1998). Overweight children and adolescents: Description, epidemiology, and demographics. *Pediatrics, 101,* 497-504.

Trost, S. G., Kerr, L. M., Ward, D. S., & Pate, R. R. (2001). Physical activity and determinates of physical activity in obese and non-obese children. *International Journal of Obesity, 25,* 822-829.

Trost, S. G., Pate, R. R., Dowda, M., Saunders, R. Ward, D. S., & Felton, G. (1996). Gender differences in physical activity and determinants of physical activity in rural fifth grade children. *Journal of School Health, 66,* 145-150.

Trost, S. G., Pate, R. R., Saunders, R., Ward, D. S., Dowda, M., & Felton, G. (1997). A prospective study of the determinants of physical activity in rural fifth-grade children. *Preventive Medicine, 26,* 257-263.

Trost, S. G., Pate, R. R., Ward, D. S., Saunders, R. & Riner, W. (1999). Correlates of objectively measured physical activity in preadolescent youth. *American Journal of Preventive Medicine, 17*, 120-126.

U.S. Department of Health and Human Services (1991). *Healthy people 2000: National health promotion and disease prevention objectives.* Washington, DC: U.S. Government Printing Office.

U.S. Department of Health and Human Services (1996). *Physical activity and health: A report of the Surgeon General.* Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

U.S. Department of Health and Human Services (2001). *Healthy people 2010: National health promotion and disease prevention objectives.* Washington, DC: U.S. Government Printing Office.

Utter, J., Scragg, R., & Schaaf, D. (2006). Associations between advertising and consumption of commonly advertised foods among New Zealand children and young adolescents. *Public Health Nutrition, 9*, 606-612.

Varni, J. W., Seid, M., & Kurtin, P. S. (2001). The PedsQL 4.0: Reliability and validity of the Pediatric Quality of Life Inventory Version 4.0 Generic Core Scales in healthy and patient populations. *Medical Care, 39,* 800-812.

Wang, Y. & Lobstein, T. (2006). Worldwide trends in childhood overweight and obesity. *International Journal of Pediatric Obesity, 1,* 11-25.

Wang, X., & Perry, A. C. (2006). Metabolic and physiologic responses to vide game play in 7- to 10-year-old boys. *Archives of Pediatrics and Adolescent Medicine, 160*, 411-415.

Ward, D. S., Dowda, M., Trost, S. G., Felton, G. M., Dishman, R. K., & Pate, R. R. (2006). Physical activity correlates in adolescent girls who differ by weight status. *Obesity, 14,* 97-105.

Zabinski, M. F., Norman, G. J., Sallis, J. F., Calfas, K. J., & Patrick, K. (2007). Patterns of sedentary behavior among adolescents. *Health Psychology, 26,* 113-120.

Zabinski, M. F., Saelens, B. E., Stein, R. I., Hayden-Wayde, H. A., & Wilfley, D. E. (2002). Overweight children's barriers to and support for physical activity. *Obesity Research, 11,* 238-246.

Appendix A

Parent Consent Form

The University of Kansas

Clinical Child Psychology Program

PARENTAL CONSENT FORM

Social and Psychological Factors Related to Physical Activity Level in Children

INTRODUCTION

The Departments of Psychology and Applied Behavioral Sciences at the University of Kansas support the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish for your child to participate in the present study. You may decline participation in this study by marking the appropriate box on this form or by simply not returning it. You should be aware that even if you agree to participate, your child is free to withdraw, and you are free to withdraw your child at any time. If you do withdraw from this study, it will not affect your or your child's relationship with this unit, the services it may provide to you, the University of Kansas, or the Lawrence Public Schools (USD 497).

PURPOSE OF THE STUDY

The purpose of this study is to better understand the social and psychological factors that influence a child's level of physical activity.

PROCEDURES

Your child will be asked to complete questionnaires that will be read out loud by one of the researchers in your child's school classroom. This study will take no more than 20-30 minutes of your child's class time. Your child's principal has agreed to allow all students at your child's school to answer these questions in class because s/he believes the study is consistent with the school's goal to promote health related behaviors that have a lasting impact on your child's life.

RISKS

Although unlikely, it is possible that some questions may cause unpleasant thoughts or feelings in some children. If a question causes your child to have unpleasant feelings or thoughts, he or she may skip that question, or he or she may decide to stop answering questions altogether. Additionally, school personnel will be given a list of resources in the event that a child has lasting concerns following measure administration.

BENEFITS

Though your child may not directly benefit from this study, the information he or she provides will help inform the development and implementation of health promotion programs targeting other children his or her age.

INFORMATION TO BE COLLECTED

To perform this study, researchers will ask your child to answer questions about his or her physical activity, feelings or beliefs about body appearance, experiences with teasing, self-esteem, and attitudes about exercising. Additionally, each participating child's grades, height, and weight will be obtained from school district records.

We will not reveal any identifying information about your child to school personnel or other outside agencies. After completion of the forms, your child's information will be assigned an identification number allowing no information regarding your name or the name of your child to be associated with the research findings. Additionally, information linking identification numbers with child names will be kept in a separate, locked file accessible only by individuals involved with this project.

The State of Kansas requires that we notify appropriate social services if your child indicates that he or she is in immediate danger of harm. The information collected about you will only be used by Ric G. Steele, Ph.D. and members of his research team. The researchers will not share information about you with anyone not specified above unless required by law or unless you give written permission.

Permission granted on this date to use your information remains in effect indefinitely. By signing this form you give permission for the use of your information for purposes of this study at any time in the future.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you or your child are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, your child cannot participate in this study.

CANCELLING THIS CONSENT AND AUTHORIZATION

You may withdraw your consent for your child to participate in this study at any time. You also have the right to cancel your permission to use and disclose information collected about you, in writing, at any time, by sending your written request to: Ric Steele, Ph.D., 2011 Dole Human Development Building, University of Kansas, 1000 Sunnyside Avenue, Lawrence, KS 66045. If you cancel permission to use your information, the researchers will stop collecting additional information about you. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above.

PARTICIPANT CERTIFICATION**:**

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study and the use and disclosure of information about my child for the study. I understand that if I have any additional questions about my rights as a research participant, I may call (785) 864-7429 or write the Human Subjects Committee Lawrence Campus (HSCL), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7563, email dhann@ku.edu.

YES, I give permission for my child,______________________, **to take part in this study as a research participant. I further agree to the uses and disclosures of my child's information as described above. By my signature I affirm that I am at least 18 years old, that I am the legal guardian of the child whose name is listed above, and that I have received a copy of this Consent and Authorization form.**
.

____

Signature Date Phone Number

NO, I do not wish for my child to participate in this investigation.

____

Signature Date

Researcher Contact Information:
Ric G. Steele, Ph.D., ABPP
Principal Investigator
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2015 Dole Human Development Center
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Lawrence, KS 66045
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Appendix B
Child Assent Form

The University of Kansas

Clinical Child Psychology Program

CHILD ASSENT FORM

Attitudes and Activities Project

To be read to the children in each participating classroom:

I am interested in finding out more about what children think about themselves and others. I am also interested in what kinds of activities children your age like to do and why you like to do them. I have prepared a bunch of questions. Some are about the physical activity you have done during the last few days, but others are more personal and ask about your body shape, feelings, and experiences. I will be happy to answer any questions you may have now or while you are completing the forms. You are free to skip any questions that make you feel uncomfortable or to stop and go back to class at any time. Do you want to take part in this project?

Child's response:

Do you want to take part in this project? (circle one) **Yes** **No**

Date: ___________________

Researcher Signature:_______________________________________

Researcher Name (Printed): __________________________________

Appendix C

Measure order and descriptions

1. Demographic Information Questionnaire
This measure was used in the current study. Please refer to document body for description.

2. Physical and Sedentary Activity
This measure was used in the current study. Please refer to document body for description.

3. Criticism during Physical Activity
This construct will be measured using a six item measure that describes various examples of teasing that children may encounter during physical activity (e.g., “People make fun of you when you play sports or exercise;” Faith et al., 2002). Children rate the frequency that they have encountered this teasing on a five point scale from 1 (never) to 5 (very often). If the child has experienced the particular type of teasing, they are asked to rate to what degree it bothered them on another five point scale from 1 (not upset) to 5 (very upset).

4. General Self-Esteem
Self-esteem will be assessed using a five item measure composed of items drawn from various, well-established scales (Nesdale, 2007). Children are presented with positive statements related to personal and social self-esteem (e.g., “I think that I am easy to like”) and are asked to rate to what degree they agree which each statement on a scale from 1 (not at all) to 5 (a lot).

5. Attitudes toward Physical Activity
Attitudes will be assessed using a self-report measure designed to examine children’s beliefs about the consequents of being physically active (Motl et al., 2000). All items follow the stem “If I were to be physically active on most days…” Children rate various positive (e.g., “…it would help me cope with stress”) and negative (e.g., “…it would be boring”) completions of this stem on a five item scale ranging from 1 (disagree a lot) to 5 (agree a lot).

6. Physical Activity Self-Efficacy
This measure was used in the current study. Please refer to document body for description.

7. Physical Experience of Exercise
This eight item measure evaluates a child’s physical experience of exercise. Due to lack of an existing measure, one has been constructed for the current study. All items follow the stem “During exercise my body feels…” Children then rate various positive (e.g., “…strong”) and negative (e.g., “…pain.”) completions of this stem on a five item scale ranging from 1 (disagree a lot) to 5 (agree a lot).

8. General Weight Criticism

The Perceptions of Teasing Scale (Thompson, 1995) will be used to assess general weight criticism. This measure consists of 11 items describing common ways children may be teased, most of which focus on body size (e.g., "People made jokes about you being too heavy"). Children rate the frequency that they have encountered this teasing on a five point scale from 1 (never) to 5 (very often). If the child has experienced the particular type of teasing, they are asked to rate to what degree it bothered them on another five point scale from 1 (not upset) to 5 (very upset).

9. Stereotypes Related to Body Type

This construct will be assessed using the Fat Stereotypes Questionnaire (Davison & Birch, 2004). This measure consists of eighteen items describing positive and negative personal attributes linked to either thin or overweight descriptors (e.g., "Thin people are smart"; "Fat people are smart"). Children then rate each item on a four item scale from 1 (really disagree) to 4 (really agree).

10. Body Dissatisfaction

Body dissatisfaction will be measured using a picture scale displaying seven figure drawings of children (both male and female) along a continuum from 1 (extremely thin) to 7 (obese; Collins, 1991). Children are asked to use the scale appropriate to their respective sex to identify their current body size and their ideal body size.

Appendix D
Demographic Information

Attitudes and Activities Project

We are interested in knowing more about what children your age think about themselves and others as well as what kinds of activities you like to do. If we ask you to answer a question that you are not comfortable answering, you may skip it and go to the next question. You are free to stop answering questions and go back to class at any time.

Please answer all questions as honestly as possible. We will keep the answers that you provide to us confidential. That means we won't tell anyone anything you have written, unless we think you are in danger. If you are in danger, then we would want to talk to someone who makes you safer. Also, please respect your friends' privacy by not asking their answers to the different questions.

Please let us know if you have any questions about the project, or why we want this information. If you have any questions about this project after we are finished you may contact us through you teacher or principal.

PLEASE TELL US A BIT ABOUT YOURSELF:

Grade:	____________	
School:	____________	
Birthday: (month/day/year)	____________ *Example: 02/15/1997*	*Or February 15, 1997*
Age:	____________	
Sex (circle one):	Male	Female
Race (circle one):	White (non-Hispanic)	Black (non-Hispanic)
	Hispanic	Asian
	Native American	Other

Appendix E

Physical Activity and Sedentary Behavior Self-Report

<u>PAS</u> (Page 1 of 2)
Please let us know how many of the **<u>past three days</u>** you did each activity **<u>for more than five minutes</u>**.

Activity	**Before School**				**During School**				**After School**			
Bicycling	1 day	2 days	3 days	No Days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days
Swimming Laps	1 day	2 days	3 days	No Days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days
Gymnastics: Bars, beams, tumbling, trampoline	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days
Exercises: Push-ups, sit-ups, jumping jacks	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days
Basketball	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days
Baseball/Softball	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Football	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Soccer	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Volleyball	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Racquet sports: Badminton, tennis	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Ball Playing: Four square, dodgeball, kickball	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Games: Chase, tag, hopscotch	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days

PAS (Page 2 of 2)

Activity	**Before School**				**During School**				**After School**			
Outdoor Play: Climbing trees, hide and seek	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Water play (in swimming pool, ocean, or lake)	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Jump Rope	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Dance	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Outdoor chores: Mowing, raking, gardening	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Indoor chores: Mopping, vacuuming, sweeping	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Mixed walking/running	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Walking	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days
Running	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No Days

Are there any physical activities you did in the last 3 days that we forgot?

Other Activities	**Before School**				**During School**				**After School**			
	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days
	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days
	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days	1 day	2 days	3 days	No days

SBS (Page 1 of 1)

Please let us know about how long you did each activity before and after school over the last three days. If you did not do the activity, write "_0_ Hours _0_ Minutes."

Yesterday:

Activity	Before school	After school
Watched T.V./Movies	____ Hours ____ Minutes	____ Hours ____ Minutes
Played video/computer games (NOT *Wii* or *Dance Dance Revolution*)	____ Hours ____ Minutes	____ Hours ____ Minutes

Two Days Ago:

Activity	Before school	After school
Watched T.V./Movies	____ Hours ____ Minutes	____ Hours ____ Minutes
Played video/computer games (NOT *Wii* or *Dance Dance Revolution*)	____ Hours ____ Minutes	____ Hours ____ Minutes

Three Days Ago:

Activity	Before school	After school
Watched T.V./Movies	____ Hours ____ Minutes	____ Hours ____ Minutes
Played video/computer games (NOT *Wii* or *Dance Dance Revolution*)	____ Hours ____ Minutes	____ Hours ____ Minutes

Appendix F

Physical Activity Self-Efficacy Questionnaire

<u>PASEQ</u> (Page 1 of 1)

Below are statements about what some boys and girls your age feel like they can and can not do. Please read each item and rate how much you agree or disagree with the statement.

1. I can be physically active during my free time on most days.	1 Disagree a lot	2 Disagree	3 Neutral	4 Agree	5 Agree a lot
2. I can ask my parent or other adult to do physically active things with me.	1 Disagree a lot	2 Disagree	3 Neutral	4 Agree	5 Agree a lot
3. I can be physically active during my free time on most days even if I could watch TV or play video games instead.	1 Disagree a lot	2 Disagree	3 Neutral	4 Agree	5 Agree a lot
4. I can physically active on most days even if it is very hot or very cold outside.	1 Disagree a lot	2 Disagree	3 Neutral	4 Agree	5 Agree a lot
5. I can ask my best friend to be physically active with me during my free time on most days.	1 Disagree a lot	2 Disagree	3 Neutral	4 Agree	5 Agree a lot
6. I can be physically active during my free time on most days even if I stay at home.	1 Disagree a lot	2 Disagree	3 Neutral	4 Agree	5 Agree a lot
7. I have the coordination I need to be physically active during my free time on most days.	1 Disagree a lot	2 Disagree	3 Neutral	4 Agree	5 Agree a lot
8. I can be physically active during my free time on most days no matter how busy my day is.	1 Disagree a lot	2 Disagree	3 Neutral	4 Agree	5 Agree a lot