PHYSICAL ACTIVITY SELF-EFFICACY IN RURAL AND URBAN CHILDREN: ASSOCIATIONS WITH PHYSICAL ACTIVITY

By

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ABSTRACT

PHYSICAL ACTIVITY SELF-EFFICACY IN RURAL AND URBAN CHILDREN: ASSOCIATIONS WITH PHYSICAL ACTIVITY

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INTRODUCTION: High prevalence of obesity and insufficient amounts of physical activity (PA) among school-age children have intensified the need to identify the most influential psychosocial factors that influence PA behavior so they can be addressed in intervention research. Physical activity self-efficacy (PASE) and environmental factors (e.g., rural vs. urban) have been identified as significant correlates of PA in youth, but most of the available literature focuses on adolescents. (S)Partners for Heart Health was a multilevel intervention program among 5th grade students in Michigan designed to increase the number of students who meet national PA recommendations and improve students' PASE. **PURPOSE:** To examine: 1) the association of PASE with PA, 2) the effects of (S)Partners for Heart Health intervention on PA and PASE, 3) the mediation effect of PASE on PA, and 4) differences in PA and PASE between rural and urban children. **METHODS:** Fifth grade students (n=920) from Michigan schools who participated in (S)Partners for Heart Health from 2008 to 2013 were participants. The intervention protocol included monthly lesson plans that were taught by the school physical education or classroom teacher in addition to small group breakout meetings conducted by undergraduate kinesiology and dietetic students. Undergraduate students were also assigned with case managing ((S)Partnering) the 5th grade students through goal setting and evaluation via a web-based goal tracking and education program. The active comparison condition involved following an existing nutrition and PA curriculum. Baseline and follow-up measurements were conducted at the beginning and end of each school year. PA was assessed in two ways: 1) a single, self-report question, and 2) pedometer. PASE was assessed using four questions with a 5-point scale. Each question assessed confidence to be physically active on 1-2 days, 3-4 days, 5-6 days, and all 7 days of the week. Multiple regression analysis was used to examine the association between PASE and PA, while structural equation modeling (SEM) was used for mediation analysis. Intervention effects and rural/urban differences were examined using mixed model ANCOVA controlling for year, sex, race, school, and separately for baseline percent body fat. **RESULTS:** Physical activity self-efficacy was significantly associated with self-reported PA ($\beta = .508$, $F(3,689) = 82.223$, $p < .001$, $R^2 = .264$), but not with pedometer recorded PA. There were no significant differences in self-reported PA between the Active Comparison and (S)Partners groups at follow-up. With regard to pedometer recorded PA, there was a statistically significant difference between the Active Comparison and (S)Partners groups at follow-up, Welch's $F(1,189.6) = 4.571$, $p < .05$ (12173 ± 5457 vs 10737 ± 4040 steps/day, respectively). PASE was significantly different ($F(1,553) = 3.917$, $p < .048$) between the Active Comparison and (S)Partners groups when adjusting for year of the study, sex, race, and school (2.7 ± 1.1 vs 2.9 ± 1.0, respectively). SEM showed that follow-up PASE had a significant relationship with follow-up PA (Estimate = 0.606, S.E. = 0.031, $p < .001$. There were no significant differences in PA and PASE between rural and urban children, but rural vs. urban was borderline significant (Estimate = -0.117, S.E. = 0.061, $p = .054$) in the SEM model. **CONCLUSION:** PASE was identified as a predictor of PA, which is consistent with the existing literature. The (S)Partners for Heart Health intervention was effective in increasing children's PASE, but not PA. Follow-up PASE was identified as a mediator of follow-up PA in children; however the intervention did not play a role, which is not consistent with previous literature. Differences between rural and urban children in PA and PASE were non-existent in this sample.

To my parents: Miroslav and Živana, for their sacrifice and never-ending love and support.

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CHAPTER 1: INTRODUCTION

It is well-known that physical activity is an important factor when it comes to physical and mental health of school-aged children (Strong et al. 2005; Williams et al., 2002; CDC, 2011). Current recommendations for physical activity in youth indicate that school-age children should participate in at least 60 minutes of mostly moderate to vigorous physical activity per day (DHHS, 2008). However, approximately 60% of U.S. children 6 to 11 years of age do not meet current physical activity recommendations (Troiano et al., 2008).

In addition to the low physical activity levels, overweight and obesity rates among U.S. children dramatically increased in the last three decades (Ogden & Carroll, 2010) leading to preventive public health efforts by the U.S. Department of Health and Human Services toward promoting physical activity among children and adolescents as one of the major national health objectives (CDC – Healthy People 2020). Although most recent data from the nationally representative National Health and Nutrition Examination Survey (NHANES) have indicated that obesity prevalence remained stable among children from 2003-04 to 2009-10 (Ogden et al., 2014), some studies indicate increase in severely obese children (Skelton et al., 2009). Michigan is among the states with the highest overweight and obesity rates in children and adolescents (16.5% overweight; 12.4% obese), especially in minorities and those from low-income backgrounds (18.5%) (Anderson et al., 2009; HDRMHS Annual Health Equity Reports, 2010). Recent studies indicate that obesity rates have increased the most among the low socio-economic status children (Ogden et al., 2006; 2014).

Physical activity is beneficial in preventing obesity while also having positive effects in a variety of physiological and psychological health conditions (Blair, Kohl, et al., 1989; Dustman et al., 1994). For example, habitual physical activity during childhood and adolescence has been positively correlated with bone mineral density (Boot et al., 1997). However, despite these beneficial findings, it has been well known that physical activity declines during adolescence (Hallal et al., 2012). Although there is low to moderate tracking of physical activity from childhood to adulthood (Malina, 1996), it is important to establish early patterns of physical activity participation in school-aged children so physical activity behavior is more likely to be retained in adulthood. The national physical activity guidelines (U.S. Department of Health and Human Services, 2008), and guidelines for schools and community programs (Centers for Disease Control and Prevention's 1997) that promote life-long physical activity among youth, both further emphasize the need for promotion and maintenance of sufficient physical activity levels. Even though these efforts remain very challenging, they are among the most important objectives for the researchers, practitioners, and other educational professionals.

In order to effectively design physical activity interventions, it is crucial to identify psychosocial correlates and determinants of physical activity behavior. Correlates refer to factors identified in cross-sectional studies; no causal relationship between these variables and physical activity can be inferred (Trost et al., 1997). Determinants are potential causal factors that require a prospective study design in order to establish temporal relationship between the predictor variables and physical activity behavior (Trost et al., 1997). Evidence-based findings have been used to identify correlates of children's physical activity behavior which are then specifically targeted for improvement during intervention programs. Social norms regarding physical activity, beliefs regarding activity outcomes, physical activity enjoyment, perceived barriers to physical activity, sport team participation, and perceived parent and peer support have all been identified as correlates of physical activity among youth (Hearst et al., 2012; Sallis et al., 2000; Trost et al., 2000). However, physical activity self-efficacy has been one of the most frequently identified psychosocial correlates/determinants of physical activity (Sallis et al., 2000), and one of the variables with the strongest associations with physical activity among children and adolescents (Kohl, 1998).

Self-efficacy, in general, has been defined as one's belief in capabilities to perform in a specific domain in order to obtain certain outcomes (Bandura, 1997; 1986). Simply stated, self-efficacy consists of an individual's confidence in ability to perform certain goal-oriented tasks (Bandura, 1986). More specifically, Bandura (1995) has adopted the definition of self-efficacy to include those beliefs regarding individuals' capabilities to produce performances that will lead to anticipated outcomes. Research on self-efficacy in the physical activity domain has shown that self-efficacy is a potent determinant of physical activity in those circumstances during which the greatest challenges are presented, such as in the initial stages of adoption and maintenance stages of physical activity (McAuley, 1992). It is, therefore, important to examine self-efficacy in any physical activity intervention study in children.

Until recently, little was known regarding psychosocial correlates/determinants of physical activity in preadolescent children because of the lack of cognitive development, difficulty and inability to measure many of the psychosocial variables in children (such as physical activity self-efficacy), and the lack of measurement precision. Most research studies in the domain of self-efficacy theory applied to behaviors such as physical activity have been conducted in adolescents (Bandura, 2004), and these findings have been applied to children. Because of the limited data and inconsistent findings on social-cognitive correlates of physical activity in preadolescents, there is a need to specifically investigate physical activity and its correlates in children.

Although self-efficacy is the strongest predictor of physical activity behavior, there is no single specific correlate/determinant variable that accounts for most of the variance in physical activity among children. Previous studies using predictive models have only explained 5-15% of the variance in physical activity among children (Brodersen et al., 2005). A few recent studies, however, that employed prospective designs with complex multilevel predictors in children explained 15-33% of the variance in physical activity in children (Craggs, et al., 2011; Hearst et al., 2012; Plotnikoff et al., 2013). By itself, however, physical activity self-efficacy has been found to account for 5-13% of the variance in physical activity (Craggs, et al., 2011; Martin et al., 2008; Sallis et al., 2000; Trost et al., 1997). A large portion of the variance in children's physical activity still remains unexplained.

Other important factors that influence physical activity are sex and environment of children and youth. There are significant sex differences in physical activity and psychosocial correlates of physical activity (Caspersen, Pereira, Curran, 2000; Sallis, Prochaska, & Taylor, 2000; Strauss, Rodzilsky, Burack, & Colin, 2001) with boys being more physically active compared to girls, and with correlates of physical activity differing by sex (Strauss, Rodzilsky, Burack, & Colin, 2001; Van der Horst et al., 2007). The majority of previous studies that examined factors that influence physical activity in children have been cross-sectional (Baranowski & Jago, 2005); therefore identifying correlates of physical activity, rather than causally associated determinants (Trost et al., 1997; Dishman et al., 2009). Longitudinal data on physical activity self-efficacy as a determinant of physical activity in children is limited, implying the need for future studies to employ more prospective design (Sallis et al., 2000) while examining potential sex differences.

Another important correlate is the built environment, which influences physical activity behavior by providing or limiting opportunities. Studies examining the influence of environment (urban, rural, suburban) on physical activity in children, and its impact on physical activity correlates are sparse. Recent studies investigating the role of -neighborhood environment in children's physical activity behavior have shown that the characteristics of the built environment (access to parks, walkability of neighborhood, proximity of playgrounds, and recreational facilities, etc.) are significantly linked to physical activity behavior (Humpel, Owen, & Leslie, 2002; Carroll-Scott et al., 2013; Sallis & Glanz, 2009). Complex psychosocial and environmental factors that influence physical activity behavior vary greatly between urban and rural environments, so understanding physical activity patterns in children that live in different geographical settings – urban versus rural - may be relevant for increasing physical activity levels, and more targeted approaches in future interventions (Martin & McCaughtry, 2008). Residing in walkable neighborhoods, and living in close proximity to parks and recreational facilities have been associated with higher physical activity levels in youth (Sallis & Glanz, 2009) which may also reflect higher socio-economic status (SES). However, to date, studies comparing physical activity in rural and urban (inner-city) children have been limited. McMurray and colleagues (1999) found an association between a rural setting and obesity, but no differences in physical activity levels between urban and rural children. In general, studies comparing physical activity between rural and urban youth have reported inconsistent findings (Joens-Matre et al., 2008; McMurray et al., 1999; Felton et al., 2002) suggesting the need to better understand the urbanization influence on physical activity in children. Psychosocial and environmental determinants of physical activity behavior also seem to be influenced by the type of neighborhood environment (Pate et al., 2003) which is most likely reflected by social and cultural contexts between urban and rural settings. Further research is needed to examine differences in urban-rural physical activity and its correlates to better tailor physical activity interventions to specific populations of children.

Given high prevalence of obesity and physical inactivity among children in the US, there has been a need to develop and implement physical activity interventions targeted at previously identified correlates/determinants of physical activity behavior. As the most feasible sites to emphasize the need for promotion and maintenance of sufficient physical activity levels, schools have been frequently targeted in children's physical activity interventions. School-based, multicomponent physical activity interventions have been shown to be one of the most effective strategies for increasing physical activity in children (Kriemler et al., 2011, Stone et al., 1998;). A recent systematic review of physical activity interventions indicated that an increase in school-based physical activity was associated with an overall increase in total daily physical activity (Kriemler et al., 2011). However, even though previous studies have shown potential for future interventions to prevent long-term overweight/obesity in children, the most effective intervention components remain difficult to single out due to the heterogeneity of studies (Brown & Summerbell, 2008), and the lack of high quality, randomized trials in children (van Sluijs et al., 2007). The ability to increase and sustain physical activity while enhancing physical activity self-efficacy as an important determinant of physical activity remains a crucial objective for future school-based physical activity intervention studies.

Social Cognitive Theory has been widely used as the theoretical foundation in interventions aimed at changing behaviors such as physical activity (Dobbins et al., 2009). Research studies that have been developed and implemented in children thus far with the goal of increasing physical activity behavior based on self-efficacy theory have usually focused on manipulating one or more of the sources of efficacy in order to develop improved or sufficient physical activity self-efficacy (Bandura, 2004). Self-efficacy has been targeted as one of the key manipulation variables in multiple interventions designed to increase physical activity in children (Cataldo et al., 2012; Dishman et al., 2004; Motl et al., 2005). A recent review by Cataldo and colleagues (2012) examined the impact of physical activity intervention programs on self-efficacy in healthy children and adolescents and found moderately strong evidence that physical activity programs improve self-efficacy in youth. Of the 10 studies that matched the inclusion criteria (participants 5-18 years old), 6 studies showed improvement in the follow-up self-efficacy assessment compared to baseline with 4 showing no effect (Cataldo et al., 2012). In addition, self-efficacy has also been shown as the most commonly assessed mediator between theory based interventions and physical activity behavior in youth (Lubans, Foster, & Biddle, 2008) which encourages the use of self-efficacy as a deliberate, mediator variable in the upcoming interventions.

(S)Partners for Heart Health is a school-based, multi-level intervention aimed at promoting physical activity and dietary behavior among low socio-economic status fifth grade Michigan children (Carlson et al., 2008). The study incorporates Social Cognitive Theory as the theoretical basis for promoting children's physical activity self-efficacy, along with encouraging parent and community support, with the goal of influencing the school and the surrounding environment. Schools participating in the study were selected from a variety of urban and rural environments throughout Michigan, and had a moderate-to-high percentage (at least 30%) of students qualifying for free and reduced lunch.

Purpose of dissertation and aims and hypotheses

The **overall purpose of this dissertation** was to examine the association of physical activity self-efficacy with physical activity among fifth grade children. Specific aims were:

Aim 1: To describe physical activity self-efficacy levels among 5^{th} grade school children in Michigan, and examine differences by sex and urban/rural classification.

Aim 1 Hypothesis 1: There will be no sex differences in physical activity self-efficacy levels.

Aim 1 Hypothesis 2: Rural children will have higher levels of physical activity self-efficacy than urban children.

Aim 2: To examine the association between physical activity self-efficacy and physical activity by sex and urban/rural classification in a baseline, cross-sectional sample.

Aim 2 Hypothesis: Physical activity self-efficacy will be a significant factor associated with self-reported and pedometer recorded physical activity, accounting for 10% of the variance.

Aim 3: To examine the effects of a physical activity intervention on physical activity self-efficacy and self-reported and pedometer recorded physical activity from baseline to follow-up, versus the active comparison group.

Aim 3 Hypothesis 1: Physical activity self-efficacy will be significantly higher in the (S)Partners intervention group compared to the Active Comparison group.

Aim 3 Hypothesis 2: Physical activity will be higher, but not statistically different in the (S)Partners group compared to the Active Comparison group.

Aim 4: To examine the potential mediation effect of physical activity self-efficacy on follow-up physical activity taking (S)Partners group versus the Active Comparison group into account.

Aim 4 Hypothesis: Physical activity self-efficacy will be a significant mediator of physical activity in the (S)Partners group compared to the Active Comparison group.

Aim 5: To examine differences in Aims 3 and 4 between urban and rural children.

Aim 5 Hypotheses: Aim 3 – Physical activity self-efficacy and physical activity will be significantly higher in urban children compared to rural children. Aim 4 – Rural/urban setting will be a significant variable in the physical activity self-efficacy mediation of follow-up physical activity model.

CHAPTER 2: LITERATURE REVIEW

Introduction

According to the U.S. Department of Health and Human Services, children and adolescents should engage in 60 minutes or more of physical activity daily (USDHHS, 2008). This recommendation also states that most of that time should be spent in moderate- to vigorous-intensity with the possibility of accumulating 60 minutes through multiple shorter activity sessions in a day (USDHHS, 2008). Despite the recommended levels, children's physical activity levels have been shown to be low (Troiano, 2008) and declining as children continue developing through childhood to adolescence (Nader et al., 2008). A study by Troiano and colleagues (2008) reported that only about 40% of U.S. children 6 to 11 years of age meet current recommended levels of physical activity while in a longitudinal study by Nader and colleagues (2008) children's activity levels significantly decreased from ages 9 to 15 years. Physical activity promotion efforts have, therefore, targeted both children and adolescents, but physical activity interventions have had limited effectiveness thus far (van Sluijs, McMinn, Griffin, 2007).

Social cognitive theory has been one of the most frequently implemented and successful theories commonly used to understand the development of physical activity behavior in youth. According to Bandura (1986), in order to understand or influence an individual's physical activity behavior, one must consider that person's previous experiences, current behavioral skills, and the setting in which the person is expected to be active. Self-efficacy is considered one of the most important psychological constructs that has been developed in the history of psychology (Pajares & Urdan, 2006), and is one of the key variables in Bandura's social cognitive theory. The social cognitive theory uses cognitions in the context of social interactions and behavior to explain human action, motivation, and emotion (Pajares & Urdan, 2006). According to this theory, "behavior change operates through mutually interactive effects among aspects of the person, the environment, and the behavior itself" (Buckworth & Dishman, 2002, p. 218). In terms of physical activity behavior, this means that each of these influences among the person, environment, and behavior are the dynamic interactions representing potential physical activity behavior determinants (Buckworth & Dishman, 2002).

With elevated rates of childhood obesity (Ogden & Carroll, 2010; Ogden et al., 2014) and high rates in physical inactivity among youth (Nader et al., 2008), there has been a need to identify the most influential psychosocial factors of children's physical activity behavior that can be targeted in interventions. Widespread research effort among pediatric researchers has resulted in multiple studies on correlates and determinants of physical activity in children that have identified physical activity self-efficacy as a significant correlate or determinant of physical activity behavior (Sallis et al., 2000; Craggs et al., 2011). As such, numerous interventions have attempted to influence self-efficacy sources in order to increase physical activity (Stone et al., 1998). In addition to psychosocial factors, recent studies have examined the influence of built environment on physical activity among children, and have shown that differences in environmental setting (built environment; urban vs. rural) play role in children's physical activity (Davis, Bennett, Befort, & Nollen, 2011). Given the role of the environment in self-efficacy theory, links between self-efficacy and environmental factors should be more closely examined.

The focus of this literature review will be: 1) to outline what is currently known about physical activity self-efficacy among children, 2) to describe the role of physical activity self-efficacy as a correlate/determinant of physical activity (and a potential mediator/moderator), and 3) to provide an overview of interventions that targeted self-efficacy while attempting to change physical activity behavior. In addition, the review will also include current knowledge on the influence of environmental settings (i.e. built environment) on physical activity in children, and how this influence may differ between rural and urban children.

Self-efficacy

Self-efficacy, based on Bandura's (1977, 1997) conceptualization, has been defined as "the degree to which an individual believes he or she can successfully engage in a specific behavior in a particular situation with known outcomes". It consists of three specific domains: strength (perceived ability to overcome common barriers to engaging in a goal-striving behavior behavior), generality (ability to generalize behavior to other similar behaviors), and level (the degree or intensity to which a goal-striving behavior can be engaged in successfully) (Buckworth & Dishman, 2002). Although multiple physical, social, environmental, and psychological variables have been linked to beliefs in personal physical activity capabilities, it is now widely accepted among researchers, that children's physical activity self-efficacy is largely influenced by multiple sources: family, peers, and school environment (Feltz & Magyar, 2006). Access to physical activity settings (i.e. park and school locations, opportunities to participate in games and sports), parental influence, personal characteristics, and child beliefs have also been shown to affect physical activity self-efficacy in children (Sallis et al., 2000).

Bandura's self-efficacy theory is a competency-based theory with an assumption that self-efficacy is the primary mediator of all behavior change as a specific cognitive mechanism (Buckworth & Dishman, 2002). In addition to self-efficacy expectancy, outcome expectancy and outcome value are two other basic cognitive mediating processes that determine behavior (Buckworth & Dishman, 2002). Self-efficacy expectations are developed from four sources: performance accomplishments, vicarious experiences (observing others), verbal persuasion, and interpretation of physiological and psychological arousal (Buckworth & Dishman, 2002). Outcome expectations are judgments of the likely consequence any given action will produce; the outcomes that flow from those actions can take the form of positive or negative physical, social, and self-evaluative effects (Bandura, 1997). Outcome value refers to the importance of the behavior performed or the reinforcement value of the outcome expectancy. Because of its successful guiding in the development of physical activity behavior, the social-cognitive theory has been widely applied in numerous research studies that have targeted change in physical activity behavior (Buckworth & Dishman, 2002).

Physical activity self-efficacy as a correlate of physical activity

Social cognitive variables are formed by beliefs that come from social experiences and learning, so constructs such as self-efficacy have obvious influences on change in health behaviors such as physical activity (Bandura, 2004). These variables may be the most important during childhood, when the behavioral elements of physical activity are in the forming process, and during early adolescence, when physical activity behavior increasingly becomes part of leisure behaviors (Bandura, 2004). According to Bandura's social cognitive theory (the self-efficacy theory), the biggest impact on the adoption of a particular behavior, in this case physical activity, is a personal belief in one's own capabilities to implement the steps required to achieve a certain behavioral goal. One's perceived ability to be physically active, or physical activity self-efficacy, has been frequently documented as a correlate of physical activity in children (Baranowski et al., 1998; Trost et al., 2002; Sallis et al., 2000).

Identifying physical activity correlates and determinants has become an important focus in research targeting adoption of physical activity behavior because these variables underlie the mechanisms associated with adherence and compliance to physical activity. To date, a variety of factors (age, gender, SES, parental and peer influences) have been investigated with environmental and psychological factors receiving much attention. Previously identified correlates most likely relate to cross-sectional differences in physical activity levels which limits the hypothesis generation regarding potential causal factors or determinants (Craggs et al., 2011). All of the previously identified correlates of physical activity in children should be examined in longitudinal studies in order to identify the potential causal factors – the determinants – which would greatly improve understanding of factors associated with physical activity and enhance the development of effective interventions.

Physical activity behavior that is learned in childhood has a strong potential to carry through to adulthood and positively impact health behavior. Given the age-related declines in physical activity from childhood to adolescence, especially in girls, understanding the determinants of such behavior is high priority. Multiple studies have shown that physical activity self-efficacy is the most frequently identified correlate and determinant of physical activity behavior in children and adolescents (McAuley & Blissmer, 2000; Sallis et al., 1992; Saunders et al. 1997; Sallis, Prochaska, & Taylor, 2000; Trost et al., 1999; Trost, Kerr, Ward & Pate, 2001; Motl et al., 2007; Van Der Horst et al., 2007). Given higher cognitive development in adolescents compared to children, which warrants easier assessment of psychosocial variables, more studies have been conducted in adolescents providing sufficient evidence on the most common correlates and determinants in this population (physical activity self-efficacy, perceived activity competence, previous physical activity, access to equipment, facilities, and sport programs, peer support, parent support) (Sallis, Prochaska, & Taylor, 2000) than in children. An investigation by Reynolds and colleagues (1990) found self-efficacy to predict weekly physical activity participation among a sample of adolescents four months after the baseline assessment.

In preadolescents, however, studies on correlates and determinants have been limited, leaving those factors less clearly understood with an inconclusive evidence base. As a result, many physical activity interventions that targeted potential children's determinants of physical activity had limited effectiveness in changing behavior (Baranowski, Anderson, & Carmack, 1998). Aside from self-efficacy, physical activity preferences, intention to be active, parental overweight status, perceived barriers, previous physical activity, access to facilities and programs, and time spent outdoors are some of the variables that were found to be associated with children's physical activity (Sallis, Prochaska, & Taylor, 2000). Factors associated with children's physical activity still need to be further investigated in order to develop more appropriate interventions.

Most of the studies examining correlates of physical activity in children implemented social-cognitive theory with a goal of understanding physical activity mechanisms and how they promote or limit activity in children. In general, children with higher levels of physical activity self-efficacy were more likely to be physically active compared to children with low physical activity self-efficacy (Suton et al., 2013; Strauss et al., 2001; Trost et al., 2001). Of the studies that have been conducted on physical activity in schools or other organized settings, self-efficacy has been shown as significantly associated with almost all exercise--related activities (Dishman, Dunn, Sallis, Vandenberg, & Pratt, 2010). Bungum, Dowda, Weston, Trost, and Pate (2000) examined the relationship between self-efficacy and physical education, club sport involvement, and community based recreation among children, and found that self-efficacy based on overcoming external barriers (e.g., confidence to participate in vigorous physical activity if there was lack of support from family) was more highly related to vigorous physical activity in sports and recreation settings compared to a number of other competing demands on time, such as homework, TV watching, and video game playing. Furthermore, time spent in vigorous physical activity was positively correlated with self-efficacy and was also associated with improved self-esteem (Strauss, Rodzilsky, Burack, & Colin, 2001). Most other studies confirm these findings, and report self-efficacy as the most correlated and predictive variable of physical activity behavior (Dishman et al., 2004; Motl et al., 2005).

Previous studies have shown that variables such as socio-economic status, and other variables related to it, such as parental support and access to recreational facilities, play an important role as correlates and determinants of physical activity in this age group (Sallis et al., 1999; Craggs et al., 2011). Variables such as socio-economic status have been shown to play an important confounding role when it comes to physical activity levels among children; however, studies investigating differences in physical activity self-efficacy among children from varying socio-economic groups are currently lacking. Overall, higher socio-economic status was associated with higher levels of physical activity and smaller declines than lower socio-economic status as children approach adolescence (Strauss et al., 2001; Tandon et al., 2012). Ethnicity has been another commonly identified confounder, but only a few studies have shown that minority children and adolescents, who are often associated with low socio-economic status, are less active in non-school moderate to vigorous physical activity and physical education physical activity compared to white children (Gordon-Larsen et al., 1999; Lindquist et al., 1999). This could potentially indicate lower levels of self-efficacy in minority, non-white children than in white children. Various gaps in current literature regarding socio-economic and ethnic differences in children's physical activity self-efficacy and physical activity make research in this area priority for future studies.

Few studies have investigated differences in physical activity self-efficacy according to fatness level in children (Trost, Kerr, Ward, & Pate, 2001; De Bourdeaudhuij, Lefevre, Deforche, Wijndaele, Matton, & Philippaerts, 2005). Some studies have indicated that the level of fatness is an important factor in children's physical activity self-efficacy (De Bourdeaudhuij et al., 2005) whereas other studies found no significant association with fatness (Suton et al., 2013). For example, in a large sample of Belgian children and adolescents 11 to 19 years old, De Bourdeaudhhuij and colleagues (2005) found that physical activity self-efficacy was associated with higher total levels of physical activity and was significantly higher in a normal-weight group compared to an overweight group who had significantly lower physical activity self-efficacy and significantly lower amounts of total physical activity. In the same study, separate regression analyses for each group were performed to predict physical activity from physical activity self-efficacy (De Bourdeaudhuij et al., 2005). Self-efficacy significantly predicted physical activity in the normal-weight group, but not in the overweight (De Bourdeaudhuij et al., 2005). Increased levels of habitual physical activity seem to be an important component in the development of self-efficacy in children (Strauss et al., 2001) in addition to weight status and fatness which may have some effect on this relationship.

With regard to the amounts of moderate and vigorous physical activity among children, self-efficacy findings were very consistent across the limited number of studies. Compared to participants who doubt their ability to be physically active, those who feel efficacious about performing physical activity are more likely to attempt new forms of activity (Heitzler, Martin, Duke, & Huhman, 2006), report more time spent in moderate and vigorous physical activity (Kohl III, & Hobbs, 1998), persist longer in physical activity when faced with barriers (Trost et al., 1997), and are more likely to be physically active as adolescents (Dishman et al., 2005).

Multiple studies have found low socio-economic status children including obese and overweight children, inner-city children, and Hispanic children to be less confident in their ability to overcome barriers to be physically active (Trost et al., 2001; Martin, & McCaughtry, 2008; Gesell et al., 2008). Self-efficacy, therefore, plays important role and must be targeted as one of the key variables in interventions aiming to increase physical activity in adolescents and children, although more conclusive body of evidence is still needed in pediatric population. Future interventions targeting physical activity behavior change in preadolescents should target self-efficacy (among the rest of psychosocial determinants) while including more structural environmental and policy changes in their interventional design.

Physical activity self-efficacy as a mediator

Social cognitive theory describes the bidirectional effects of environmental, personal, and behavioral attributes on one another. As mentioned earlier in the review, physical activity self-efficacy has been shown as the most consistently identified correlate of physical activity in children and adolescents (Sallis et al., 2000; Motl et al., 2002; Lubans, Foster, & Biddle, 2008). The influence of perceived physical environment on physical activity behavior can be direct or through mediated influence of personal variables such as self-efficacy (Dishman et al., 2009). Environmental variables such as equipment accessibility and perceived neighborhood safety have also been identified as variables that influence physical activity behavior in adolescents (Motl et al., 2005). These environmental variables, accordingly, are powerful influences on behaviors such as physical activity, so they need to be examined as potential mediators of physical activity in children. Very few studies thus far have examined mediators of physical activity in children using statistically appropriate methods as part of environmental interventions (Lewis et al., 2002).

Mediators have been defined as variables that are in the causal sequence between two variables that transmit the relation or effect of an independent variable on a dependent variable (MacKinnon, Fairchild, & Fritz, 2007). Similarly, mediators can also be defined as "intervening causal variables that are necessary to complete a cause–effect pathway between an intervention and physical activity" (Bauman et al., 2002). By examining potential mediators, researchers have been attempted to identify the most common factors associated with physical activity behavior which could then be targeted in designing more effective interventions. To date, little is known about the mediators of physical activity in children, since most correlates are examined through cross-sectional studies. More evidence on the mediators of physical activity exists in adolescent literature, but those findings cannot be implied to preadolescents due to developmental, cognitive and environmental differences. Despite the importance of mediation studies in behavior change, very few interventions have assessed mediators of physical activity in children that can successfully guide interventions in increasing physical activity behavior.

More studies on mediators of physical activity behavior have been conducted in adolescents compared to children's literature, but the evidence base for mediators of behavior change remains limited due to small number of studies. In these studies, self-efficacy was the most commonly assessed mediator with strong evidence for its mediating role between interventions and physical activity (Lubans, Foster, & Biddle, 2008; van Stralen et al., 2011). Investigations by Dishman and colleagues (2004) and Motl and colleagues (2002) have focused on investigating the role of self-efficacy as a mediator of physical activity behavior in adolescents. A study by Motl and colleagues (2005) found that self-efficacy for overcoming barriers mediated the cross-sectional effect of equipment accessibility on physical activity, and weakly (although significantly) mediated the longitudinal effect of self-efficacy on physical activity in adolescent girls. Furthermore, in a randomized controlled trial and a comprehensive school-based intervention named LEAP (Lifestyle Education for Activity Program) (Dishman et al., 2004), self-efficacy partially mediated the effect of the LEAP intervention on physical activity in a large sample of adolescent girls. The rest of the interventions in the literature generally support those findings of self-efficacy mediation of physical activity behavior (Lewis et al., 2002; Salmon, Brown, & Hume, 2009; Motl et al., 2002; Dishman et al., 2005; van Stralen et al., 2011). Overall, limited studies have commonly identified self-efficacy as a mediator of physical activity behavior in adolescents, but even fewer have identified it in children. This must be considered when designing physical activity interventions in preadolescents.

Self-efficacy research limitations

One of the most obvious weaknesses of the research conducted on self-efficacy related to physical activity in children is, first of all, the lack of research studies that investigate this aspect, and second, the lack of consistency in assessment of physical activity and self-efficacy across studies. This lack of consistency in methodology could be related to differences in samples, but is also in part due to absence of the validated theory-based questionnaires and scales that measure self-efficacy in preadolescent children.

Many studies in children developed their own questionnaires and used self-reported or parent reported self-efficacy measures, most of which were not reported to be validated, which in turn made it extremely difficult to compare findings to other investigations that did use content validated instruments (Saunders et al., 1997). Some studies failed to adequately adjust for previously identified confounding and/or moderating variables, such as physical activity self-efficacy, age, gender, socio-economic status, BMI/fatness, and ethnicity. These factors must be accounted for (controlled for) in the analysis in order to avoid misestimated relationships between independent and dependent variables. Analytic strategies that did not adjust adequately for potential confounders and mediators may have led to spurious relationships and misestimated results (Shields et al., 2008). In addition to these limitations, other weaknesses in methodology include limitations in sample characteristics especially with sample sizes, socio-economic status – low socio-economic status less examined, ethnicity - especially minorities, and sex - absence of sex-specific analysis (Annesi, 2007). Overall, there are multiple limitations in research on physical activity self-efficacy in children most of which relate to inadequate methodological quality.

Another limitation relates to study designs and distinguishing between correlates and determinants of physical activity behavior (previously discussed in the correlates section). As stated previously, when identifying self-efficacy as a determinant of physical activity, many studies relied on data from cross-sectional studies (Baranowski & Jago, 2005). Cross sectional study design does not provide appropriate treatment of temporality between a potential determinant and a desired outcome, so these determinants may in fact only be correlates (Trost et al., 1997; Dishman et al., 2009). Prospective study designs must be used in order to identify behavioral determinants of the outcome. Up to date, only a few studies implemented prospective study design and identified self-efficacy as a potent determinant of physical activity (Trost et al., 1997; Sallis et al., 2000; Trost, Kerr, Ward, Pate, 2001; Craggs et al., 2011).

Physical activity self-efficacy in school-based interventions

Many previous school-based research studies aimed at developing or increasing physical activity behavior in children showed limited effectiveness and inconsistent findings

(Edmundson, et al., 1996; Pate et al., 2003; Dobbins, DeCorby, Robeson, Huson, & Tirilis, 2009). However, a recent review of reviews on the effects of school-based interventions on physical activity in children and adolescents, that focused on the new literature (published from 2007 to 2010) of school-based interventions not included in the earlier reviews, showed that 47-65% of trials were found to be effective with the most effect in school-related physical activity (Kriemler et al., 2011). Studies that showed promising results and succeeded in increasing physical activity behavior were most likely unable to sustain their effects over longer period of time (Heath et al., 2012). The inability of many physical activity promotion interventions in children to sustain physical activity behavior may be due to the lack of identification of psychosocial determinants, often resulting in inappropriate program content and strategies (Saunders et al., 1997).

According to the literature on psychosocial factors that influence physical activity in youth, self-efficacy beliefs are an important element in children's physical activity behavior because these beliefs have influence on the amount and type of physical activity performed (Foley et al., 2008). Given the recent findings that show alarming levels of inactivity among children (only 40% of children in this age group meet current physical activity recommendations) (Troiano, 2008), and high prevalence of childhood obesity (Ogden & Carroll, 2010), the ability to gain and sustain physical activity self-efficacy is of very high importance in order to keep children engaged in behavior likely to lead to active future lifestyle. Research studies with the goal of influencing physical activity behavior based on self-efficacy theory that have been developed and implemented in youth thus far have usually focused on manipulating one or more of the sources of efficacy in order to develop increased and/or sufficient physical activity self-efficacy (Bandura, 2004). However, because of the lack of cognitive development and difficulty and inability to measure many of the psychosocial variables in children (such as self-efficacy), most research in this domain of self-efficacy theory has been conducted with adolescents while studies in children are currently lacking.

Schools are settings where children spend most of their time, so many interventions have been school-based due to wide accessibility to students. Family- and community-based interventions in children have shown limited effectiveness (van Sluijs, McMinn, Griffin, 2007); researchers have, therefore, focused on schools as the most accessible settings to intervene. A recent review of reviews of school-based interventions in children and adolescents by Kriemler and colleagues (2011) (included systemic reviews and controlled trials from 2007 to 2010) reported that interventions seemed more effective in adolescents than in children. In adolescents, strong evidence exist that school-based or multicomponent interventions (community or family component in addition to school component) have been the most effective in increasing school-based physical activity and are associated with an increase in out-of-school and overall physical activity although implementation strategies have varied across the studies (van Sluijs, McMinn, Griffin, 2007; Kriemler et al., 2011). A study by Dishman and colleagues (2004) was the first one to report direct effects of an intervention (the LEAP intervention) on self-efficacy, and a subsequent direct effect of self-efficacy on physical activity in White and Black adolescent girls. Another study by Felton and colleagues (2002) found higher physical activity and self-efficacy levels in White compared to African-American adolescent girls in South Carolina. In children, however, there are no conclusive findings on the effectiveness of school-based interventions, so the evidence is still inconclusive. The CATCH (Child and Adolescent Trial for Cardiovascular Health) intervention reported significant improvements in physical activity self-efficacy after the third and fourth grade interventions, but not after fifth grade (Edmundson et al., 1996). The most effective strategies for increasing physical activity in children remain unclear with school-based environmental interventions showing the most potential (van Sluijs, McMinn, Griffin, 2007).

In order to improve physical activity self-efficacy, according to social cognitive theory, as previously mentioned, any intervention study should: 1) provide enjoyable and developmentally appropriate activities that will enable children to experience success; 2) create opportunities for children to observe influential others perform physical activity; 3) verbally encourage children to participate in PA; and 4) reduce any anxiety associated with participation in physical activity by reducing or eliminating competition or grading from intervention activities (Trost, Pate, Ward, Saunders, & Riner, 1999).

Intervention research limitations

With large proportion of youth not meeting recommended levels of physical activity, demand for interventions has increased in recent years. Most common methodological limitations in intervention research include the lack of the following: validated measures/instruments, theoretical basis, precision of the outcome measures, data on study compliance, studies with long-term follow up, and clear implementation strategies (van Sluijs, McMinn, Griffin, 2007; Kriemler et al., 2011). With regard to intervention implementation, variables that may have influenced intervention effectiveness are the levels of exposure to the intervention, and adherence to the intervention protocol (van Sluijs, McMinn, Griffin, 2007). These variables, however, were rarely reported. Most studies also did not include information on attendance, intervention implementation, and process evaluation (quality assurance) of the intervention which makes it difficult to evaluate the impact of these factors on study findings (van Sluijs, McMinn, Griffin, 2007).

Built environment and physical activity

Research on the influence of the built environment on physical activity has been receiving increasingly more attention in recent years (Transportation Research Board & IOM, 2005). The literature in this area is still in its early development, but it is progressing rapidly. The built environment has been defined "to include land use patterns (how land is used for commercial, residential, and other activities), the transportation system, and design features that together provide opportunities for travel and physical activity" (Transportation Research Board & IOM, 2005). It also includes the physical form of cities, towns or communities – how they are designed, and their physical appearance and arrangement. The built environment, in the context of physical activity behavior, has been studied at the neighborhood and regional level geographic scale (compared to the building and site level) (Transportation Research Board & IOM, 2005). A recent report by the Transportation Research Board and the Institute of Medicine (2005) on the influence of built environment on physical activity indicates the importance of understanding environmental correlates of physical activity in designing appropriate environmental interventions, and examining the role of physical environment as a determinant of physical activity behavior.

The influence of environment on physical activity has been increasingly examined in recent years, establishing a clear link between the built environment and physical activity in the adult population, although the evidence has been largely based on cross-sectional research (Handy et al., 2002). Due to lack of longitudinal investigations, no causal connections between the built environment and physical activity behavior have been established. Studies focusing on the built environment and its influence on children's physical activity have been limited thus far, but the topic has gained popularity in recent years. Children are more prone to be under the influence of the environment than adults because they don’t have as much autonomy in their behavior like adults do, and they have no ability to change or manipulate the environment to avoid its effects (Davison & Lawson, 2006; Panter, Jones, & Sluijs, 2008); therefore, separate studies of environmental influence on physical activity are needed specifically in children while the adult findings are not applicable.

In the Physical Activity Guidelines for Americans Midcourse Report (2012) by the subcommittee of the President's Council on Fitness, Sports and Nutrition, the authors concluded, after conducting a review of literature reviews, that suggestive evidence exists that modifying certain aspects of the built environment can increase physical activity among children and adolescents. These modifications pertain to increasing the number of walkable and bikeable destinations in neighborhoods, increasing residential density, and implementing traffic-calming measures (Physical Activity Guidelines for Americans Midcourse Report, 2012). More specifically to children, environmental changes in the following may increase physical activity: increasing availability of parks and recreational activities, improving walking and biking infrastructure, improving the proximity of walkable destinations, improving pedestrian safety structures, and lowering traffic speed and volume (Physical Activity Guidelines for Americans Midcourse Report, 2012). Changing the built environment of schools has not been extensively investigated because most studies focused on portable equipment and availability of resources, and not on the school built environment itself. Only a few studies have been conducted to date, and evidence remains insufficient that modifying school environment alone can increase physical activity in youth (Physical Activity Guidelines for Americans Midcourse Report, 2012). Modifying certain components of the built environment has great potential for increasing physical activity in children.

Studies over the past 20 to 30 years have shown that the built environment can influence physical activity behavior and contribute to sedentary lifestyle (Transportation Research Board & IOM, 2005). Neighborhood environment is thought to play role in the increased inactivity and high obesity prevalence in children, but a definitive mechanism by which the built environment might be linked to physical activity behavior remains unclear. Studies to date show that there are differences in physical activity of children who reside in different residential environments depending on age, sex, socio-economic status, and race (de Vet et al., 2011; Sandercock, Angus, & Barton, 2010). However, these studies have had many variations in the study variables which has made it difficult to compare the findings across the studies (Ding et al., 2011). This has further led to inconsistent associations across the studies and resulted in the large heterogeneity among the studies limiting clear conclusions (Ding et al., 2011; Feng et al., 2010). Understanding the environmental factors that influence physical activity behavior and how they vary by environmental setting, sex, and race can help future intervention programs match participants' needs.

A recent review of reviews on environmental correlates of children's physical activity (de Vet et al., 2011) showed a wide selection of correlates with only small proportion of correlates attributed to the built environment. This was largely due to variation in specific types of physical activity (e.g., commuting to school, walking to recreational activities), and specific activity settings (e.g., school location, park proximity, recreational facilities, school facilities, neighborhood infrastructure). A more thorough review (Davison & Lawson, 2006) of the built environment and children's physical activity, which included thirty three quantitative studies, showed a positive association between physical activity participation in children and access to public recreational facilities, and access to transport infrastructure (availability of sidewalks, controlled intersections, access to public transportation and destinations). Overall, studies show that multiple attributes from the built environment are associated with children's physical activity. Among the most consistent correlates are access/proximity to sport facilities and recreational programs, time spent outdoors, transport infrastructure, walkability, residential density, school physical activity related policies, and father's physical activity (Sallis et al., 2000; Sandercock, Angus, and Barton, 2010; Ding et al., 2011; Ferreira et al., 2006). Policies that target these environmental conditions should be supported and implemented in environments lacking physical activity opportunities.

In addition to those review papers, a few studies used NHANES (National Health and Nutrition Examination Survey) data in their analysis of physical activity in children residing in varying built environments (Liu et al., 2012; Davis, Bennett, Befort, & Nollen, 2010). A large scale study by Liu and colleagues (2012) examined the differences in physical activity between 14,332 rural and urban children, and found that slightly more 2- to 11-year-old rural children reported participating in exercise five or more times per week than urban children (79.7% vs. 73.8%). However, the same investigation also reported that the rural children had higher odds of being overweight or obese after controlling for sociodemographics, health, diet, and exercise behaviors (Liu et al., 2012) which implies that rural environments may contribute more to obesity related lifestyles than urban. Another study by Davis, Bennett, Befort, & Nollen (2010) also used NHANES data (2003-2006) in examining physical activity differences between rural and urban children, and found no significant differences in meeting physical activity recommendations using a single survey question. A study by Felton and colleagues (2002) reported physical activity differences between White and African-American eight grade girls in South Carolina associated with race rather than urban/rural setting. White girls, who were found to be more active than African-American girls, had more access to sports equipment and higher perceived safety of neighborhood (Felton et al., 2002).

Overall, studies show that there are no significant differences in physical activity between urban and rural children. This is in agreement with the findings of Sallis and colleagues (2000) who found no significant influence of urban or rural environment on physical activity in children. A review by Sandercock, Angus, and Barton (2010), which included the most recent studies in the US and internationally, concluded that examination between urban vs. rural differences may be overly simplistic because studies that examined physical activity in suburban children reported significantly higher physical activity compared to their urban and rural counterparts (Nelson, Gordon-Larsen, Song and Popkin, 2006; Springer et al., 2006; Joens-Matre et al., 2008). The effect of crime on physical activity opportunities, especially in urban environments, must also be considered given it has potential to outweigh positive environmental health impacts (Jilcott Pitts et al., 2013). Studies have also shown that children living in different environments predominantly participate in different types of physical activity (Sunnegardh et al., 1985; Joeans-Matre et al., 2008; Sallis et al., 2000). Those living in urbanized areas are predominantly more involved in organized activities while those from rural areas spend more time in unstructured activities (Sandercock, Angus, and Barton, 2010). Current evidence indicates that there are no significant differences in physical activity of children living in urban and rural environments even though the environmental factors differ. Understanding how these factors influence physical activity in urban and rural children, and how they differ by race and sex can help interventions match physical activity programs to specific needs and interests of children. It is crucial to identify specific environmental factors that impact physical activity and to determine how these factors influence physical activity behavior before developing and implementing effective environmental interventions.

Built environment research limitations

Studying the built environment requires researchers to move beyond psychosocial models that guide individual behavior change strategies to broader ecological models (President's Council on Physical Fitness & Sports, 2006). Ecological models teach that behavior has multiple levels of influence, and that behavior change results when all of those factors are altered (President's Council on Physical Fitness & Sports, 2006). Studies on built environment are difficult to perform because in order to change physical activity behavior and environment, implementation strategy needs to intervene at multiple levels. The most obvious limitation of research examining the influence of built environment on children's physical activity is current lack of studies. There are no randomized controlled trials because it is impossible to randomly assign people or environments to specific places, and only a few quasi-experimental studies (President's Council on Physical Fitness & Sports, 2006). Studies in adults are much more numerous showing enough evidence to establish a link between built environment and physical activity (Ding & Gebel, 2012).

Another limitation has been the lack of a detailed and logical geographical classification system (Sandercock, Angus, & Barton, 2010) to classify the built environment. Definitions of urban and rural areas have varied across the studies. Some studies combined urban and suburban children together (Felton et al., 2002; McMurray et al., 1999; Liu et al., 2008) while others used suburban as a discrete group and found it to be the most active (compared to urban and rural) (Joens-Matre et al., 2008; Springer et al., 2006, 2009). Further limitations include inadequate power, and not accounting for socio-economic status, seasonal effects, and racial factors (Sandercock et al., 2010).

Physical activity self-efficacy measurement

Measurement of self efficacy has been slightly ignored in exercise and health psychology literature, especially among children and adolescents. The construction process of efficacy measures was often termed “questionable” due to theoretical rationale of the exercise self-efficacy construct (McAuley & Mihalko, 1998). The process of self-efficacy assessment in children is particularly challenging due to their developing cognitive abilities, so measurement of such a psychological construct, even though complex, must be adopted to children’s level of comprehension. This is a rather complex task which may have led to little uniformity in the measures used to assess these constructs.

There has been very little consistency or standardized measures in assessing social-cognitive constructs in children, which limits comparison of self-efficacy among different developmental levels and races, and between sexes (Dishman et al., 2013). Most studies have employed cross-sectional designs with a very few studies using prospective cohorts and standardized measures (Standage, Gillison, Ntoumanis, & Treasure, 2012); only a few longitudinal cohort studies in adolescents have used standardized measures in assessing self-efficacy (Dishman et al., 2006; Motl et al., 2005; Dowda, Dishman, Pfeiffer, & Pate, 2007). Another methodological limitation has been lack of evidence to demonstrate the measurement equivalence of the psychometric scales among boys and girls of varying ages and races (Dishman, Hales, Sallis, et al., 2010). The assessment of social-cognitive variables has been inconsistent across the studies with insufficient evidence on psychometric equivalence of the measures between sexes, races, and varying age groups.

With respect to psychometric evidence in the measurement of self-efficacy, validity and reliability of the measures have been mostly limited to the reporting of internal consistency (McAuley & Mihalko, 1998). Factor reliability is the only other type of reliability that can be done (no test-retest reliability due to self-efficacy not being a trait construct). Most instruments used to assess self-efficacy provide coefficient alpha. Construct validity in assessing self-efficacy, according to Bandura (1986), can only be inferred if the measures predict specific behaviors influenced by social-cognitive construct. Most of the self-efficacy measures did not report information on scale development other than stating that the scale was developed according to Bandura's guidelines for constructing efficacy scales as outlined by Bandura (2006).

In terms of limitations, the most common methodological limitations in current physical activity intervention research include the lack of the following: valid physical activity measures including objective measures such as accelerometers and pedometers, data on overall and habitual physical activity, and studies with long-term follow up. Future physical activity interventions should rely on objective tools for assessment, include total physical activity, and assess physical activity behavior at multiple follow-up time points.

Physical activity measurement

Measurement of physical activity behavior in children has also been problematic. With numerous health benefits, there is an obvious need to accurately assess physical activity. Physical activity assessment tools can be categorized as subjective and objective. Most popular subjective tools include interview- and self-administered recall questionnaires which are often subject to recall bias. Early studies quantified physical activity behavior using self-report methods that had limited reliability and validity among children (Pate, 1993). Imprecision and inaccuracy have been the biggest challenges that researchers have faced using subjective measures of physical activity, especially in youth who are unable to accurately recall physical activity retrospectively leading to overestimated amounts (Booth, Okely, Chey, & Bauman, 2002). Furthermore, there is no internationally accepted questionnaire for assessing physical activity in youth, which has made it difficult to conduct comparisons among research findings given differing nature of physical activity assessed by a given questionnaire. Overall, when self-report questionnaires are used for assessment of physical activity in children, it is highly recommended to include an objective measure (Janz, 2006).

In terms of objective measures of physical activity, heart rate monitors and motion sensing devices, such as pedometers and accelerometers, have been most frequently used. Pedometers measure vertical hip displacement during movement and express activity in steps taken. Accelerometers measure body acceleration in up to three planes of movement (horizontally, vertically, and transversely), and express activity in terms of "movement counts", with higher counts indicating higher intensities. More recent interventions have relied mainly on pedometer and accelerometer devices (Carlson et al., 2008; Lubans et al., 2008) to objectively measure the amount of physical activity performed. Because accelerometers are able to assess the frequency, intensity, and duration of physical activity over long duration of time, they have been the most commonly used objective tools in children and adolescents (Trost, 2001). Accelerometers are particularly suitable for measurement of physical activity in children in studies examining potential determinants which rely on precise assessment of physical activity in establishing relationship with a potential determinant variable (Corder et al., 2008). However, accelerometers are unable to estimate activity levels during incline walking, load bearing activities (e.g., weight lifting), and activities involving movement of arms and legs (e.g., rowing and cycling) which can potentially lead to underestimations of physical activity (Trost, 2001).

Summary

Social cognitive theory has been frequently implemented in studies aiming to develop physical activity behavior in children. According to this theory, behavior change is the result of mutually interactive effects among aspects of the person, the environment, and the behavior itself. In terms of physical activity behavior, each of these influences among the person, environment, and behavior are the dynamic interactions representing potential physical activity behavior determinants (Buckworth & Dishman, 2002).

With increases in obesity and significant drops in physical activity among children of school age, a need to identify the most influential psychosocial factors of children's physical activity behavior has arisen. Multiple studies have identified physical activity self-efficacy as a significant correlate and a potential determinate of physical activity in children, but more prospective studies are needed to establish the role of a determinant (Sallis et al., 2000; Craggs et al., 2011). More conclusive evidence exists in adolescent studies, which show that self-efficacy is a potent determinant of physical activity behavior (van der Horst et al., 2007).

Self-efficacy has also been shown as the most commonly assessed mediator with sufficient evidence for its mediating role between interventions and physical activity in adolescents. However, very few interventions have assessed mediators of physical activity in children using statistically appropriate methods. More mediation studies are needed in order to successfully guide interventions in increasing physical activity behavior in children.

Multiple interventions attempted to influence the sources of self-efficacy in trying to increase physical activity behavior. However, due to lack of cognitive development and difficulty in measuring psychosocial constructs such as self-efficacy in children, most studies have been performed in adolescents with studies in children currently lacking. Overall, interventions in adolescents have been effective in increasing physical activity while limited studies in children show that school-based environmental interventions have the most potential in increasing physical activity.

The influence of built environment, one of the behavioral determinants in social-cognitive theory, on physical activity has been examined more frequently in recent years. With children being more prone to environmental influence than adults, separate studies are need in this population. Suggestive evidence exists that modifying certain aspects of the built environment can increase physical activity among children (Physical Activity Guidelines for Americans Midcourse Report, 2012); however, it must be noted that findings have shown complex patterns due to high variability in study variables. Very few studies attempted to explore differences in physical activity among children from urban and rural environments, but no conclusive differences were found.

Assessment of physical activity and self-efficacy has been inconsistent across studies. These limitations mainly include the lack of theory-validated questionnaires and scales in measurement of self-efficacy in preadolescents, and the absence of objective physical activity measures, precise outcome measures, long-term follow-up, data on study compliance, and intervention exposure measures. Several studies failed to adequately adjust for previously identified confounders and moderators of physical activity behavior limiting their findings. Very few studies used standardized measures in assessing social-cognitive constructs in children with apparent lack of evidence to demonstrate the measurement equivalence of the psychometric scales among different sexes, ages, and races.

CHAPTER 3: METHODS

Data for this study came from a multi-level intervention entitled (S)Partners for Heart Health conducted by an investigative team from Michigan State University. Details on the rationale and design of this study are found elsewhere (Carlson et al., 2008). The study included both physical activity and dietary components in promoting healthful behaviors, but only physical activity data have been used for the current study. Prior to study implementation, all of the procedures and measures were approved by the Michigan State University Institutional Review Board (IRB) and the school boards of participating schools.

(S)Partners for Heart Health

(S)Partners for Heart Health, as previously introduced, was a multidisciplinary effort by Michigan State University (MSU) researchers, health clinicians, medical and health professions students, and MSU extension staff to partner with the participating schools' staff to implement a cost-effective, sustainable intervention program designed to maintain or prevent development of cardiovascular disease risk factors among 5th grade students in Michigan (Carlson et al., 2008). The study had the following aims: 1) to increase the number of students who meet national physical activity and dietary behaviors recommendations; 2) to improve students' knowledge, attitudes, and self-efficacy about physical activity and dietary behavior; and 3) to improve or sustain the number of students with a desirable cardiovascular disease risk factor status. The theoretical framework was based on Bandura's Social Cognitive Theory (1997) along with adapted components of goal setting and group education. Each year, one to two schools were designated as "Active Comparison" schools following research-based "Jump into Foods and Fitness" (JIFF) (2008-2011) or "Show me nutrition" curricula (2011-2013) designed to stimulate learning the importance of healthy nutrition and increased physical activity in 8 to 11 year olds. The remaining schools were designated as (S)partners for Heart Health schools following (S)Partners protocol and curriculum (Table 1). The overall intervention protocol consisted of eight lesson plans conducted by physical education teachers, classroom teachers, MSU Extension staff, or (S)Partners research staff, along with case management of 5th grade students by the MSU dietetic and kinesiology undergraduates via web-based goal tracking and small group breakout meetings. True control schools were not used in comparison because most schools presently had some sort of activity/nutrition program in place.

Participants

Participants included 920 5th grade students from Michigan schools who participated in (S)Partners for Heart Health from 2008 to 2013 (Table 1). The entire population of 5th grade students from each school was invited to participate in the study each school year; only students who completed child assent and informed parental consent prior to data collection were included in assessment portion of the study. The proportion of students who were eligible for free and reduced school lunch ranged from 30% to 75% across five years of the study (Table 1). Individual information regarding students' socio-economic status was not available.

Inclusion criteria & number of schools

Participating schools were identified based on their proximity to Michigan State University (less than 50 miles) with 30% or more of 5th grade students qualifying for the free or reduced lunch program according to federal guidelines. School officials were contacted and informed of the study. After choosing to participate in the study, each participating school was required to agree to adopt the changes in the school curriculum, and to fully participate in the measurement protocol. The number of schools participating in the study varied across years depending on available funding and personnel (Table 1). Schools were eligible to participate as (S)Partners intervention schools even if they participated previously as Active Comparison schools.

Table 1. Study overview across the years including Active Comparison and (S)Partners groups, components, percent free/reduced lunch, and number of students

Year/ School	Active Comparison	(S)Partner Intervention	Components	% Free/Reduced Lunch	Number of students
2008-2009					n = 178
School D	X		Jiff curriculum	39	58
School C	X		Jiff curriculum	31	35
School B		X	Modified Jiff/website/mentors	27	30
School A		X	Modified Jiff/website/mentors	44	55
2009-2010					n = 169
School D	X		Jiff curriculum	43	52
School C	X		Jiff curriculum	53	40
School B		X	Modified Jiff/website/mentors	31	46
School A		X	Modified Jiff/website/mentors	45	31
2010-2011					n = 113
School F	X		Jiff curriculum	68	21
School C		X	Spartner curricula/website/mentors, started using one-pagers	63	45
School E		X	Spartner curricula/website/mentors, started using one-pagers	63	47
2011-2012					n = 191
School H	X		Show Me nutrition curriculum	46	21
School A		X	Spartner curricula/website/mentors	54	64
School G		X	Spartner curricula/website/mentors	62	34
School C		X	Spartner curricula/website/mentors	62	51
School F		X	Spartner curricula/website/mentors	86	21
2012-2013					n = 269
School J	X		Show Me nutrition curriculum	85	19
School K	X		Show Me nutrition curriculum	75	9
School A		X	Spartner curricula/website/mentors	51	106
School G		X	Spartner curricula/website/mentors	73	43
School I		X	Spartner curricula/website/mentors	87	20
School C		X	Spartner curricula/website/mentors	67	52
School F		X	Spartner curricula/website/mentors	98	20
2008-2013			**TOTAL**		**N = 920**

Intervention protocol

The overall (S)Partner intervention protocol included monthly lesson plans that were taught by the school physical education or classroom teacher (or MSU Extension specialist or research staff member) on exercise, nutrition, and heart health benefits of active lifestyle, with assistance from junior- and senior-level undergraduate kinesiology and dietetic students from MSU who conducted small group breakout meetings with fifth graders following the completion of the lesson plan (Carlson et al., 2008). In addition, MSU kinesiology and dietetic students were also assigned with case managing ((S)Partnering) the 5th grade students through goal setting and evaluation via a web-based goal tracking and education program. This website was designed to facilitate learning about the preventive role of physical activity and healthy dietary behavior on cardiovascular disease risk factors, and to further enable MSU students to mentor/tutor the 5th grade students through internet interactions regarding achievement of suggested nutritional and physical activity behavioral goals. Interactions via (S)Partners website between 5th grade students and MSU undergraduate students were monitored by study coordinators, graduate students, and faculty. In some schools, exercise and nutrition promotion tips were announced over the school intercom weekly along with informational bulletin board posted monthly. Parents of the participating 5th grade students who consented to measurement received information sheets and copies of their child's pre- and post-intervention cardiovascular disease risk profile.

Procedures

Data used in this dissertation represent five cohorts of 5th grade students from five consecutive years of (S)Partners for Heart Health study (2008-2013). Baseline measurements were conducted by MSU staff, medical and graduate and undergraduate students at the beginning of the school year (Sept-Oct) with follow-up measurements at the end of each school year (Apr-May). The students and staff participating in measurement procedures were previously trained and tested for proficiency. All measurements, including surveys, were administered on the same day in a school setting. Surveys were introduced and explained to all participants prior to being administered in a classroom setting. To accommodate variations in participants' reading levels, specific questions and instructions were read to participants by the research team while they recorded their responses. The assessment included physical activity behavior, physical measures including body size and composition, and psycho-social variables related to physical activity behavior. The entire data collection session took between 30 and 45 minutes.

The subjects were classified as urban or rural based on the school's Rural-Urban Commuting Area (RUCA) code (Hart et al., 2005) which has been used previously in pediatric physical activity research (Liu et al., 2012). The RUCA definition was developed by the University of Washington's Rural Health Research Center and the Economic Research Service at the USDA (Hart et al., 2005). It uses the Census Bureau information on the size of developments and the functional relationships between locations as indicated by tract-level work-commuting data (Hart et al., 2005). As described by Hart and colleagues (2005), RUCA codes between 1-3 indicated urban while RUCA codes between 4-10 indicated rural areas.

Physical activity

Physical activity was assessed in two ways: 1) a single, self-report question adopted from the Youth Risk Behavior Survey which stated "During the past 7 days, how many days were you physically active for a total of at least 60 minutes per day (add up all the time you spend in any type of activity that increases your heart rate and makes you breathe hard some of the time?") (scale range: 0-7 days; kappa = 61%-100%) (CDC-YRBS, 2004) ; 2) pedometer (Digiwalker 200-SW). For the latter instrument, participants were given a brief, hands-on demonstration after which they conducted a10-step validity check test. Non-functioning pedometers were replaced. Participants were instructed to wear a pedometer every day for one week, at least 10 hours/day while recording data on a personalized pedometer index card including time put on and taken off.

Participants also recorded comments related to activities performed while not wearing the pedometer, and other comments regarding any compliance related issues. Data were expressed as the number of steps per day with a minimum wear time requirement of three weekdays and one weekend day. Only data that met these standards were included in the analysis, and data were also analyzed in steps/hour due to differences in wear time. Self-reported and pedometer assessed physical activity data were analyzed separately.

Physical activity self-efficacy

The physical activity self-efficacy measure was developed according to Bandura's guidelines for constructing efficacy scales with content validity of the items assessed by an expert (Bandura, 2006). Due to the lack of physical activity self-efficacy scales appropriate for children, the new physical activity self-efficacy scale was developed by the investigators to be easily comprehensible to fifth grade students and reflect their ability to meet physical activity recommendations at the time (see Appendix A). Each participant completed survey questions on physical activity self-efficacy, which was assessed using four questions with a 5-point scale. Each question assessed confidence to be physically active on 1-2 days (1^{st} question), 3-4 days (2^{nd} question), 5-6 days (3^{rd} question), and all 7 days of the week (4^{th} question), and stated: "How sure you are that you can be physically active for a total of at least 60 minutes per day on _-_ days? (Add up all the time you spend in any kind of physical activity that increases your heart rate and makes you breathe hard some of the time)". To make this 5-point scale appropriate for the fifth grade students, the scale was formatted with five increasing circles from small to large (the smallest -"not sure" coded 1; the largest -"very sure" coded 5)(Chase, 2001) to reflect the level of confidence to be physically active for a total of at least 60 min per day on 1-2 days, 3-4 days, 5-6 days, or all 7 days of the week (see Appendix A). Physical activity self-efficacy score was calculated as an average of the scores from the four questions (range 0-4).

Physical characteristics

Height was measured without shoes to the nearest 0.1 cm using a Shorr Board (Shorr Production, Olney, MD). Body mass and body fat percent were assessed using a foot-to-foot bioelectric impedance device (Tanita BC-534 InnerScan Body Composition Monitor, Tokyo, Japan). Participants were instructed to remove socks and correctly align their heels with the electrodes on the measuring platform foot-pad while looking straight ahead and remaining completely stationary. Age, gender, and height were programmed into the device prior to measurement. The average of two measurements was recorded as body mass. Body fat percentile curves were calculated as described in detail previously (Laurson, Eisenmann, Welk, 2011; Laurson, Eisenmann, Welk, 2011). Fitnessgram percent body fat classifications (Healthy Fitness Zone (HFZ), Needs Improvement (NI), Needs Improvement – Health Risk (NI-HR)) were based on 4th edition of Fitnessgram Reference Guide (Going, Lohman, Eisenmann, 2013). The BMI (weight in kg/height in m^2) was calculated from measured height and body mass, and classified using age- and sex-specific cut-points (CDC-NCHS, 2001). Participants were informed that they were permitted to stop the study at any point if they felt uncomfortable during physical measurements. Age, sex and race were obtained via self-report. Students were asked to indicate one race/ethnicity category with which they most closely identified.

Statistical Analysis

A power analysis was conducted for both physical activity outcome variables (self-reported & pedometer). At the power of 0.8, alpha level of 0.05, and effect size of 0.3 (medium effect size), the results of the power analysis indicated the sample size of 269 for self-reported

PA variable and 111 for pedometer PA variable - sample size was insufficient to detect small effect size (pedometer sample size needed 1073). Statistical analyses were conducted using IBM SPSS Statistics version 22.0 (Armonk, NY). Descriptive statistics were calculated for all variables.

Aim 1: To describe physical activity self-efficacy levels among 5th grade school children in Michigan, and examine differences by sex and urban/rural classification.

Aim 1 Hypothesis 1: There would be no sex differences in physical activity self-efficacy levels.

Aim 1 Hypothesis 2: Rural children would have higher levels of physical activity self-efficacy than urban children.

Statistical Analyses: Descriptive statistics were used to report levels of physical activity self-efficacy. T-tests and ANOVA were used to test for differences in physical-activity self-efficacy by sex and by urban/rural status.

Aim 2: To examine the association between physical activity self-efficacy and physical activity by sex and urban/rural classification in a baseline, cross-sectional sample.

Aim 2 Hypothesis: Physical activity self-efficacy would be a significant factor associated with self-reported and pedometer recorded physical activity, accounting for 10% of the variance.

Statistical Analysis: Multiple regression analysis was used to examine the association between physical activity self-efficacy and physical activity.

Aim 3: To examine the effects of a physical activity intervention on physical activity self-efficacy and self-reported and pedometer recorded physical activity from baseline to follow-up, versus the active comparison group.

Aim 3 Hypothesis 1: Physical activity self-efficacy would be significantly higher in the (S)Partners group compared to the Active Comparison group.

Aim 3 Hypothesis 2: Physical activity would be higher, but not statistically different in the (S)Partners group compared to the Active Comparison group.

Statistical Analysis: Mixed model ANCOVA was used to separately examine pre- and post- levels of physical activity self-efficacy and physical activity using sex, year of the study, percent body fat at baseline, school, and race as covariates.

Aim 4: To examine the potential mediation effect of physical activity self-efficacy on follow-up physical activity taking (S)Partners group versus the Active Comparison group into account.

Aim 4 Hypothesis: Physical activity self-efficacy would be a significant mediator of physical activity in the (S)Partners group compared to the Active Comparison group.

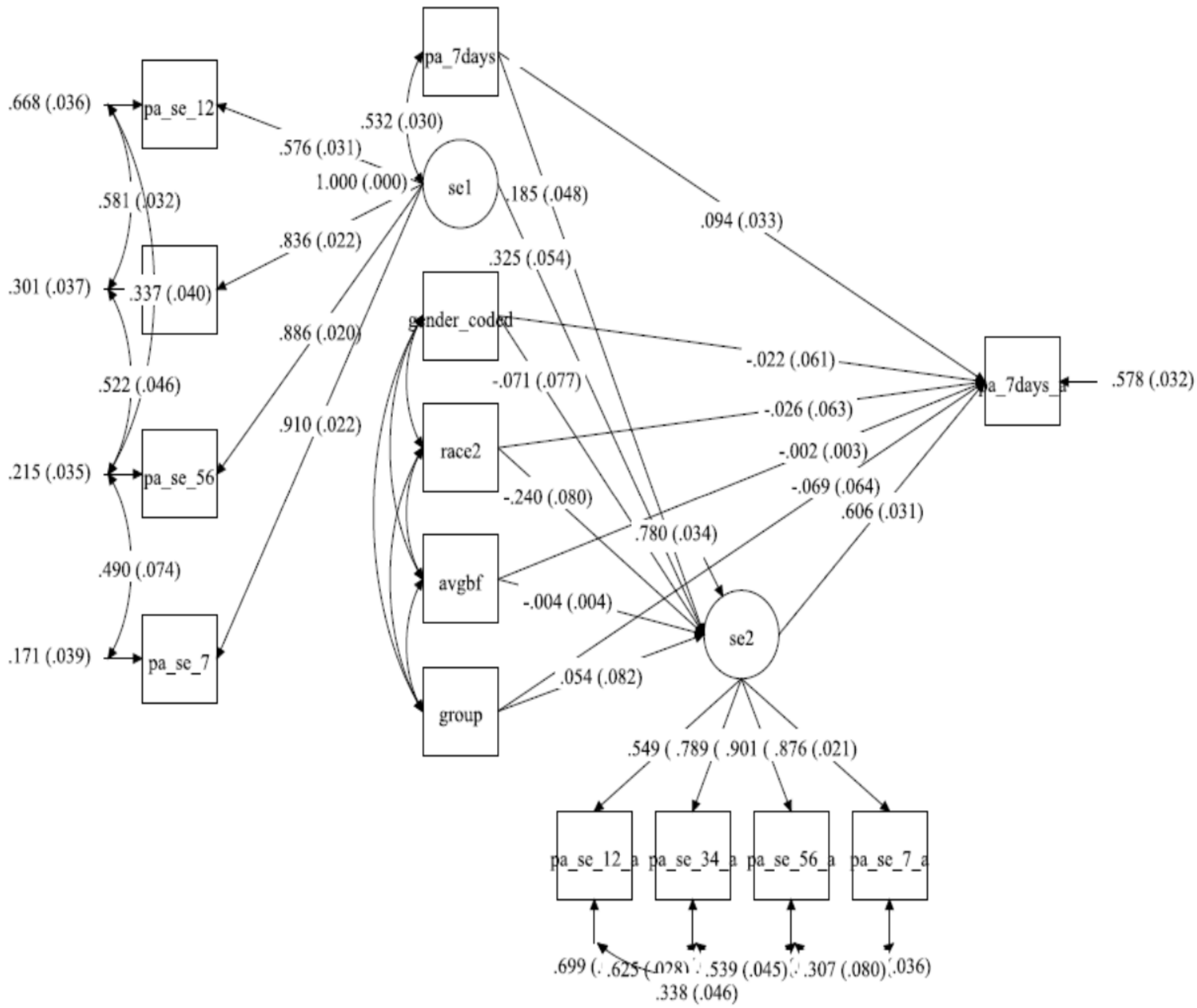
Statistical Analysis: SEM was used to test the mediator effect of physical activity self-efficacy given change in physical activity. The Barron and Kenny method (Barron & Kenny, 1986) which uses a series of regression analyses as a test of mediation, has been criticized for not testing the significance among the mediator and independent and dependent variables directly (Hayes, 2009).

Model Fit

To test Aim 4 hypothesis, structural equation modeling (SEM) was used. SEM was performed using MPlus version 7.3 statistical software (Muthén & Muthén, 2009) to test the fit of the model including latent variables. Three model fit indices were used: the Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) where values of 0.95 or greater suggest adequate fit (Hu & Bentler, 1999); and the Root Mean Square Error of Approximation (RMSEA), where values of less than 0.08 indicate adequate fit, and values under 0.05 which suggest excellent fit (Browne & Cudeck, 1992). Follow-up physical activity was regressed on baseline physical activity, baseline physical activity self-efficacy, race, year of the study, and rural/urban setting.

Model specification

Physical activity self-efficacy (PASE) variables were assessed as continuous latent constructs formulated from four survey questions on physical activity self-efficacy to be active on 1-2, 3-4, 5-6, and all 7 days of the week (baseline and follow-up PASE variables). Self-reported physical activity (baseline and follow-up), PASE variables (baseline and follow-up), and baseline body fatness were continuous, whereas sex, race, year of the study, and rural/urban were categorical variables in the model. As seen in Figure 1, the structural model included the paths between: baseline and follow up self-reported physical activity (1); baseline and follow up self-reported self-efficacy (2); baseline physical activity and follow-up self-efficacy (3); follow-up self-efficacy and follow up physical activity (4); intervention (labeled as group in Figure 1) and follow up physical activity (5); and intervention (labeled as group in Figure 1) and follow up physical activity self-efficacy (6). MLR (maximum likelihood parameter estimates with standard errors that are robust to non-normality and non-independence of observations when used with TYPE=COMPLEX in MPlus) (Muthén & Muthén, 2009), which is the default estimator in M-plus, was used. This model accounted for the possible correlations between self-efficacy questions (PASE 1-2, 3-4, 5-6, and 7 days).



<u>Figure 1. Model depicting the effects on follow-up physical activity</u>. pa_7days is baseline physical activity; se1 is baseline physical activity self-efficacy; se2 is follow-up physical activity self-efficacy; gender_coded is sex; race2 is race; avgbf is percent body fat; group is intervention (Active Comparison vs (S)Partener); pa_7days_a is follow-up physical activity; pa_se_12, 34, 56, 7 are physical activity self-efficacy questions on self-efficacy to be active on 1-2, 3-4, 5-6, 7 days.

Aim 5: To examine differences in Aims 3 and 4 between urban and rural children.

Aim 5 Hypotheses: Aim 3 – Physical activity self-efficacy and physical activity would be significantly higher in urban children compared to rural children. Aim 4 – Rural/urban setting would be a significant variable in the physical activity self-efficacy mediation of follow-up physical activity model.

Statistical Analyses: Aim 3 – Mixed model ANCOVA was used to examine pre- and post-levels of physical activity self-efficacy and physical activity between urban and rural children using sex, BMI/fatness, and race as covariates. Aim 4 - Structural Equation Modeling (SEM) was used to test the mediator effect of physical activity self-efficacy on physical activity among urban and rural children.

CHAPTER 4: RESULTS

Physical characteristics and demographics

Demographic characteristics of the total sample, boys and girls, and all of the cohorts 2008-2013 are shown in Table 2. In addition, school information and student enrollment from each school in the study over the years are shown in Table 2. All of the participants were fifth grade students, and 66.5% of the overall sample were white (n = 608), 14.2% were African-American (n = 130), and 19.3% were other (n = 176). Schools A, C and D were enrolled in the study multiple times, providing the highest enrollment of students in the study (28%, 24%, and 12% of the total sample, respectively). Out of eleven schools that participated in the study from 2008 to 2013, two schools (schools B and C) were classified as rural, and the rest were urban. School C was the only school that served as both active comparison (Years 2008-10) and (S)Partner intervention (Years 2010-13) school during subsequent years. In 2010-11, with only three schools enrolled in the study, the majority of the participants came from two schools, C and E (39.8% and 41.6% of the study enrollment, respectively). School A participated in the study for four years while school C participated all five years.

Physical characteristics of the total sample and all the cohorts from 2008 to 2013 are shown in Table 3. Approximately 57% of the sample were female (n = 523). Significant differences were found between boys and girls for height, weight, and BMI in 2010-11, 2011-12 and total sample ($t(110) = -2.503$, $p = .014$, $t(110) = -2.474$, $p = .015$, $t(110) = -2.049$, $p = .043$, $t(188) = -2.623$, $p = .009$, $t(187) = -3.468$, $p = .000$, $t(188) = -2.660$, $p = .005$, $t(914) = -2.995$, $p = .003$, $t(902) = -3.063$, $p = .002$, $t(903) = -2.370$, $p = .018$, respectively). Girls were taller (Total sample: 144.8 ± 7.0 vs 143.5 ± 6.6 cm), heavier (Total sample: 43.2 ± 12.1 vs 40.8 ± 11.0 kg), and had higher BMI (Total sample: 20.3 ± 4.6 vs 19.6 ± 4.2) compared to boys. The only year for which there was a significant difference in BMI percentiles was 2011-12 (63.2 ± 26.2 for boys versus 72.5 ± 25.9 for girls, $t(185) = -2.376$, $p < .05$). There were no significant differences between boys and girls in 2008-09 and 2009-10 except in percent body fat, for which girls had higher values than boys. In addition, percent body fat was higher in girls than in boys for all other years and the total sample ($p < .001$). Significant differences in age between boys and girls were found in 2011-12, 2012-13, and the total sample ($p < .05$), with boys slightly older than girls. According to CDC BMI percentiles, 18.0% and 19.3% of the total sample were overweight and obese, respectively, with more obese girls (20.5%) than boys (17.6%). For the total sample, 69.4% (n = 618) were classified as being in the Fitnessgram Healthy Fitness Zone (HFZ) for percent body fat, with 20.5% (n = 183) classified in the Needs Improvement (NI) category, and 10.1% (n = 90) in Needs Improvement – Health Risk (NI-HR) category. There were no significant differences between participants who had valid pedometer data and the rest of the sample, participants who had valid and non-compliant pedometer data, and participants who had valid physical activity self-efficacy data and those who did not (by BMI, sex, and race).

Table 2. Demographic characteristics of the participants from 2008-2013 and total sample

	2008-09			2009-10			2010-11			2011-12			2012-13			Total		
Race	Male (n = 73)	Female (n = 104)	Total (n = 177)	Male (n = 72)	Female (n = 97)	Total (n = 169)	Male (n = 52)	Female (n = 61)	Total (n = 113)	Male (n = 76)	Female (n = 114)	Total (n = 190)	Male (n = 117)	Female (n = 151)	Total (n = 268)	Male (n = 390)	Female (n = 524)	Total (n = 914)
White	61 (83.5%)	93 (89.4%)	154 (87.0%)	59 (81.9%)	85 (87.6%)	144 (85.2%)	27 (51.9%)	36 (59.0%)	63 (55.8%)	41 (53.9%)	74 (64.9%)	115 (60.5%)	61 (52.1%)	71 (48.0%)	132 (49.8%)	249 (63.8%)	359 (68.5%)	608 (66.5%)
Black	5 (6.8%)	2 (1.9%)	7 (4.0%)	1 (1.4%)	/	1 (0.6%)	13 (25.0%)	14 (23.0%)	27 (23.9%)	17 (22.4%)	19 (16.7%)	36 (18.9%)	23 (19.7)	36 (24.3%)	59 (22.3%)	59 (15.1%)	71 (13.5%)	130 (14.2%)
Hispanic	1 (1.4%)	2 (1.9%)	3 (1.7%)	4 (5.6%)	4 (4.1%)	8 (4.7%)	2 (3.8%)	3 (4.9%)	5 (4.4%)	3 (3.9%)	7 (6.1%)	10 (5.3%)	9 (7.7%)	8 (5.4%)	17 (6.4%)	19 (4.9%)	24 (4.6%)	43 (4.7%)
Asian	2 (2.7%)	1 (1%)	3 (1.7%)	3 (4.2%)	/	3 (1.8%)	2 (3.8%)	/	2 (1.8%)	3 (3.9%)	/	3 (1.6%)	3 (2.6%)	3 (2.0%)	6 (2.3%)	13 (3.3%)	4 (0.8%)	17 (1.9%)
Native	1 (1.4%)	3 (2.9%)	4 (2.3%)	2 (2.8%)	4 (4.1%)	6 (3.6%)	1 (1.9%)	1 (1.6%)	2 (1.8%)	3 (3.9%)	1 (0.9%)	4 (2.1%)	2 (1.7%)	1 (0.7%)	3 (1.1%)	9 (2.3%)	10 (1.9%)	19 (2.1%)
Other	3 (4.2%)	3 (2.9%)	6 (3.4%)	3 (4.2%)	4 (4.1%)	7 (4.1%)	7 (13.5%)	7 (11.5%)	14 (12.4%)	9 (11.8%)	13 (11.4%)	22 (11.6%)	19 (16.2)	29 (19.6%)	48 (18.1%)	41 (10.5%)	56 (10.7%)	97 (10.6%)
School	Male (n = 73)	Female (n = 105)	Total (n = 178)	Male (n = 72)	Female (n = 97)	Total (n = 169)	Male (n = 52)	Female (n = 61)	Total (n = 113)	Male (n = 77)	Female (n = 114)	Total (n = 191)	Male (n = 118)	Female (n = 151)	Total (n = 269)	Male (n = 392)	Female (n = 528)	Total (n = 920)
School A	25 (34.2%)	30 (28.6%)	55 (30.9%)	15 (20.8%)	16 (16.5%)	31 (18.3%)	N/A	N/A	N/A	28 (36.4)	36 (31.6%)	64 (33.7%)	46 (39.0%)	60 (39.7%)	106 (39.4%)	114 (29.1%)	142 (26.9%)	256 (27.8%)
School B	12 (16.4%)	18 (17.1%)	30 (16.8%)	18 (25.0%)	28 (28.9%)	46 (27.2%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30 (7.7%)	46 (8.7%)	76 (8.3%)
School C	14 (19.2%)	21 (20.0%)	35 (19.6%)	16 (22.2%)	24 (24.7%)	40 (23.7%)	19 (36.5%)	26 (42.6%)	45 (39.8%)	16 (20.8%)	35 (30.7%)	51 (26.8%)	23 (19.5%)	29 (19.2%)	52 (19.4%)	88 (22.4%)	135 (25.6%)	223 (24.2)
School D	22 (30.2%)	36 (34.3%)	58 (32.7%)	23 (31.9%)	29 (29.9%)	52 (30.8%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	45 (11.5%)	65 (12.3%)	110 (12.0%)
School E	N/A	N/A	N/A	N/A	N/A	N/A	22 (42.3%)	25 (41.0%)	47 (41.6%)	N/A	N/A	N/A	N/A	N/A	N/A	22 (5.6%)	25 (4.7%)	47 (5.1%)
School F	N/A	N/A	N/A	N/A	N/A	N/A	11 (21.2%)	10 (16.4%)	21 (18.6%)	10 (13%)	11 (9.6%)	21 (11.0%)	10 (8.5%)	10 (6.6%)	20 (7.4%)	31 (7.8%)	31 (5.9%)	62 (6.7%)
School G	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15 (19.5%)	19 (16.7%)	34 (17.9%)	17 (14.4%)	26 (17.2%)	43 (15.9%)	32 (8.2%)	45 (8.5%)	77 (8.4%)
School H	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8 (10.4%)	13 (11.4%)	21 (11.0%)	N/A	N/A	N/A	8 (2.0%)	13 (2.5%)	21 (2.3%)
School I	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10 (8.5%)	10 (6.6%)	20 (7.4%)	10 (2.6%)	10 (1.9%)	20 (2.2%)
School J	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9 (7.6%)	10 (6.6%)	19 (7.1%)	9 (2.3%)	10 (1.9%)	19 (2.1%)
School K	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3 (2.5%)	6 (4.1%)	9 (3.4%)	3 (0.8%)	6 (1.1%)	9 (1.0%)

Table 3. Physical characteristics of the participants 2008-2013 and total sample

Year	Total			2008-09			2009-10			2010-11			2011-12			2012-13		
	Male (n = 390)	Female (n = 523)	Total (n =913)	Male (n = 72)	Female (n = 105)	Total (n = 178)	Male (n = 70)	Female (n = 97)	Total (n = 167)	Male (n = 51)	Female (n = 61)	Total (n = 112)	Male (n = 77)	Female (n = 113)	Total (n = 190)	Male (n = 113)	Female (n = 147)	Total (n = 260)
Age	10.6 ± 0.4*	10.5 ± 0.4	10.6 ± 0.4	10.5 ± 0.4	10.5 ± 0.4	10.5 ± 0.4	10.5 ± 0.4	10.5 ± 0.4	10.5 ± 0.4	10.6 ± 0.4	10.6 ± 0.4	10.6 ± 0.4	10.6 ± 0.4*	10.5 ± 0.4	10.6 ± 0.4	10.7 ± 0.4*	10.5 ± 0.4	10.6 ± 0.4
Height (cm)	143.5 ± 6.6*	144.8 ± 7.0	144.3 ± 6.9	143.2 ± 6.0	144.3 ± 7.3	143.8 ± 6.8	143.6 ± 7.4	143.8 ± 6.5	143.7 ± 6.9	143.6 ± 6.0*	146.5 ± 6.3	145.2 ± 6.3	142.4 ± 5.6*	144.9 ± 7.0	143.9 ± 6.6	144.2 ± 7.1	145.2 ± 7.4	144.7 ± 7.3
Weight (kg)	40.8 ± 11.0*	43.2 ± 12.1	42.2 ± 11.7	40.9 ± 10.6	42.5 ± 11.8	41.8 ± 11.3	41.3 ± 11.4	41.5 ± 10.6	41.4 ± 10.9	40.9 ± 10.7*	46.4 ± 12.4	43.9 ± 11.9	38.9 ± 9.5**	44.8 ± 12.7	42.4 ± 11.9	41.9 ± 12.0	42.4 ± 12.4	42.2 ± 12.2
BMI (kg/m2)	19.6 ± 4.2*	20.3 ± 4.6	20.0 ± 4.4	19.8 ± 4.3	20.1 ± 4.3	20.0 ± 4.3	19.8 ± 4.4	19.9 ± 4.1	19.8 ± 4.2	19.7 ± 4.1*	21.4 ± 4.8	20.6 ± 4.5	19.0 ± 3.8*	20.9 ± 5.3	20.1 ± 4.8	19.9 ± 4.2	19.9 ± 4.5	19.9 ± 4.4
BMI percentile	67.3 ± 26.4	69.0 ± 26.8	68.3 ± 26.6	67.9 ± 26.1	66.8 ± 28.4	67.2 ± 27.4	68.5 ± 25.9	67.5 ± 26.4	67.9 ± 26.1	68.9 ± 27.1	74.3 ± 27.4	71.8 ± 27.3	63.2 ± 26.2*	72.5 ± 25.9	68.7 ± 26.4	68.1 ± 27.0	66.7 ± 25.9	67.3 ± 26.3
% Overweight	17.1%	18.8%	18.0%	16.4%	20.2%	18.6%	14.1%	21.6%	18.5%	21.6%	21.3%	21.4%	14.3%	20.0%	17.6%	19.3%	13.6%	16.1%
% Obese	17.6%	20.5%	19.3%	19.2%	20.2%	19.8%	21.1%	16.5%	18.5%	15.7%	31.1%	24.1%	13.0%	24.5%	19.8%	18.4%	15.7%	16.9%
	n = 381	n = 510	n = 891	n = 70	n = 103	n = 178	n = 70	n = 96	n = 166	n = 51	n = 61	n = 112	n = 77	n = 111	n = 188	n = 113	n = 139	n = 252
Body fat %	21.0 ± 8.5**	26.8 ± 10.9	24.3 ± 10.3	21.3 ± 8.4**	25.7 ± 8.5	23.9 ± 8.7	20.9 ± 8.0**	25.7 ± 7.8	23.7 ± 8.2	21.8 ± 8.3**	28.4 ± 8.5	25.4 ± 9.0	20.6 ± 9.2**	27.8 ± 8.8	24.9 ± 9.6	20.9 ± 8.5**	26.7 ± 15.5	24.2 ± 13.2
HFZ[a] (%)	267 (70.1%)	351 (68.8%)	618 (69.4%)	47 (67.2%)	74 (71.8%)	121 (69.9%)	47 (67.1%)	69 (71.9%)	116 (69.9%)	32 (62.7%)	34 (55.7%)	66 (58.9%)	61 (79.2%)	68 (61.3%)	129 (68.6%)	80 (70.8%)	106 (76.3%)	186 (73.8%)
NI[b] (%)	76 (19.9%)	107 (21.0%)	183 (20.5%)	15 (21.4%)	21 (20.4%)	36 (20.8%)	17 (24.3%)	20 (20.8%)	37 (22.3%)	16 (31.4%)	20 (32.8%)	36 (32.2%)	8 (10.4%)	27 (24.3%)	35 (18.6%)	20 (17.7%)	19 (13.6%)	39 (15.5%)
NI-HR[c] (%)	38 (10.0%)	52 (10.2%)	90 (10.1%)	8 (11.4%)	8 (7.8%)	16 (9.3%)	6 (8.6%)	7 (7.3%)	13 (7.8%)	3 (5.9%)	7 (11.5%)	10 (8.9%)	8 (10.4%)	16 (14.4%)	24 (12.8%)	13 (11.5%)	14 (10.1%)	27 (10.7%)

* Significant differences between boys and girls, $p < .05$; ** Significant differences between boys and girls, $p < .001$

[a]Healthy Fitness Zone; [b]Needs Improvement; [c]Needs Improvement - Health risk

Results for each aim and hypothesis are noted in the following text. First, the aim and hypothesis are noted, followed by the results specific to that aim and hypothesis.

Aim 1

Aim 1: To describe physical activity self-efficacy levels among 5th grade school children, and examine differences by sex and urban/rural classification.

Aim 1 Hypothesis 1: There would be no sex differences in physical activity self-efficacy levels.

Aim 1 Hypothesis 2: Rural children would have higher levels of physical activity self-efficacy than urban children.

Baseline physical activity self--efficacy levels of the total sample, boys and girls, and urban and rural children are shown in Table 4. Participants who incorrectly completed physical activity self-efficacy survey questions (Total sample: n = 222 at baseline, n = 176 at follow-up) were excluded from the analyses (e.g., physical activity self-efficacy for 5-6 or 7 days was higher compared to physical activity self-efficacy for 1-2 days). Independent t-tests, as hypothesized, indicated that there were no significant differences in physical activity self-efficacy between boys and girls in the total sample, but contrary to the hypothesis, there were also no significant differences between urban and rural children in the total sample. There were no significant differences between boys and girls, and urban and rural children across the years of the study.

Table 4. Physical Activity Self Efficacy Levels by Sex and Urban/Rural Classification

	Rural			**Urban**			**Total**		
Year	Male (n=103)	Female (n=161)	Total (n=264)	Male (n=213)	Female (n=270)	Total (n=483)	Male (n=316)	Female (n=431)	Total (n=747)
2008-09	2.3±1.4	2.6±1.4	2.5±1.4	2.6±1.4	2.1±1.4	2.3±1.4	2.5±1.4	2.3±1.4	2.3±1.4
2009-10	2.5±1.3	2.4±1.3	2.4±1.3	2.2±1.5	2.6±1.3	2.4±1.4	2.3±1.4	2.5±1.3	2.4±1.3
2010-11	2.2±1.2	2.5±1.4	2.3±1.3	2.4±1.3	2.1±1.4	2.3±1.3	2.3±1.2	2.3±1.4	2.3±1.3
2011-12	3.4±0.8	2.9±0.9	3.1±0.9	2.6±1.3	2.6±1.2	2.6±1.3	2.8±1.3	2.7±1.1	2.8±1.2
2012-13	2.9±1.1	2.6±1.2	2.7±1.1	2.7±1.3	2.5±1.3	2.6±1.3	2.7±1.2	2.5±1.2	2.6±1.2

Aim 2

Aim 2: To examine the association between physical activity self-efficacy and physical activity by sex and urban/rural classification in a baseline, cross-sectional sample.

Aim 2 Hypothesis: Physical activity self-efficacy would be a significant factor associated with self-reported and pedometer recorded physical activity, accounting for 10% of the variance.

Physical activity was assessed in two ways: via single survey question and via pedometer. Both variables were used separately in the analysis. Pedometer data were analyzed as both total steps and steps per hour in order to normalize for wear time. Table 5 shows how many participants had valid data for self-reported physical activity, pedometer recorded physical activity, and physical activity self-efficacy by year and total sample. Only pedometer data from 2008-09 to 2010-11 were included in the analysis (see Table 5) because data from 2011-12 and 2012-13 were not available. At baseline, 397 participants were measured using pedometers. Of these, 102 had incomplete data, and 41 had invalid data that were removed from the analysis, leaving 254 included in analyses (27.6% of the total sample). At follow-up, 407 participants were assessed using pedometers. Of these, 112 had incomplete data, and 92 had invalid data that were removed from the analysis, leaving 203 included in analyses (22.0% of the total sample). Based on previous literature (Trost, Kerr, Ward, & Pate, 2001; Heitzler, Martin, Duke & Huhman, 2006), percent body fat was also included in both models in addition to physical activity self-efficacy. Regression coefficients for total sample and subsample (assessed by pedometer) are presented in Table 6. The assumptions of linearity, homoscedasticity, independence of errors, and normality of residuals were met in both models.

For the overall sample, physical activity self-efficacy was the only statistically significant factor associated with physical activity ($\beta = .508$, $p < .001$) in the self-reported physical activity model, but not in the pedometer model. The pedometer model showed percent body fat as the only significant factor associated with physical activity (β = -.212, $p < .001$, $R^2 = .055$); additionally, when percent body fat was excluded from the model the rest of the factors remained non-significant ($p > .05$). Similarly, when percent body fat was removed from the self-reported physical activity model, the model remained identical. The self-report model explained 26.4% of the variance in self-reported physical activity ($F(3,689) = 82.223$, $p < .001$, $R^2 = .264$) while the pedometer model, after percent body fat was removed, was not statistically significant ($F(3,231) = 1.813$, $p > .05$). Gender and urban/rural classification had no significant association in either model.

Table 5. Number of self-reported physical activity, pedometer recorded physical activity, and physical activity self-efficacy participants by year and total sample.

Year	Physical activity-Self-report		Physical activity-Pedometer		Physical activity self-efficacy	
	Baseline n = 886	Follow-up n = 883	Baseline n = 254	Follow-up n = 203	Baseline n = 698	Follow-up n = 744
2008-09	171	174	88	65	117	142
2009-10	165	166	91	94	132	158
2010-11	108	110	75	44	90	93
2011-12	187	177	N/A	N/A	157	151
2012-13	255	256	N/A	N/A	202	200
Total	886	883	254	203	698	744

Table 6. Multiple Regression Coefficients for Total Sample and Pedometer Subsample

[b]**PA by Self-report**	Unstandardized Coefficients		Standardized Coefficients	[b]**PA by Pedometer**	Unstandardized Coefficients		Standardized Coefficients
	B	Std. Error	Beta		B	Std. Error	Beta
(Constant)	2.528	0.3		(Constant)	11712.284	1149.136	
PASE[a]	0.883	0.057	0.509*	PASE[a]	337.184	219.642	0.1
Gender	-0.09	0.139	-0.021	Gender	-977.537	569.789	-0.112
Urban/Rural	-0.251	0.142	-0.058	Urban/Rural	-336.711	562.636	-0.039

* $p < .001$; [a]Physical activity self-efficacy; [b]Physical activity

Aim 3

Aim 3: To examine the effects of a physical activity intervention on physical activity self-efficacy and physical activity from baseline to follow-up, versus the active comparison group.

Aim 3 Hypothesis 1: Physical activity self-efficacy would be significantly higher in the (S)Partners intervention group compared to the Active Comparison group.

Aim 3 Hypothesis 2: Physical activity would be higher, but not statistically different in the (S)Partners group compared to the Active Comparison group.

All of the assumptions that underlie the mixed model ANCOVA were tested, and none were violated. Time was used as the within-subject factor with two levels (baseline and follow up); whereas, Group was assigned as the between-subject factor with two levels (Active Comparison and (S)Partners group). Year of the study, sex, race, school, and baseline percent body fat were covariates in the model.

Physical characteristics of the active comparison and (S)Partners groups at baseline and follow up are shown in Table 7. Statistically significant differences were found between the Active Comparison and (S)Partners groups for the following: baseline percent overweight, follow-up percent overweight, percent in the healthy fitness zone (HFZ) group, percent in the needs improvement (NI) group, and for baseline percent obese (Table 7). The Active Comparison group was higher for all except percent in the HFZ. No other significant differences between the groups were found. There were statistically significant differences within each group between baseline and follow-up for age, height, weight, BMI, percent overweight (only in the Active Comparison group), percent obese (only in the (S)Partners group) and percent body fat (only in the Active Comparison group) (Table 7). The follow-up values were higher for all variables.

Table 8 shows the means and standard deviations of self-reported physical activity, pedometer recorded physical activity, and physical activity self-efficacy at baseline and follow-up in the Active Comparison and (S)Partners groups. Self-reported physical activity improved from baseline to follow up in both groups (also see Table 9). However, there was no significant effect of time ($p = .557$) when the model was adjusted for year of the study, sex, race, and school. No significant interactions were found with time as the within-subject factor. No changes were found when adjusting the model for baseline percent body fat. In terms of between-subjects factors, we found no significant main effects and a significant interaction effect between sex and race ($F(1,745) = 2.599$, $p < .024$) when adjusting for year of the study, sex, race, and school (Figure 3). Self-reported physical activity increased from baseline to follow-up in all races in males. However, in females, self-reported physical activity increased from baseline to follow-up in White and Native American, decreased in Hispanic, Black and other, and remained unchanged in Asian (see Figure 3). When we adjusted the model for baseline percent body fat, there was a significant effect of baseline percent body fat ($F(1,810) = 7.646$, $p < .006$) with no other significant effects or interactions. Table 9 shows the number and percentage of children achieving specific number of self-reported days of physical activity per week by sex, Active Comparison vs. (S)Partners, and total sample. The number of children exhibiting 60 min or more of physical activity on 6 and 7 days per week increased from baseline to follow-up in all groups.

Table 7. Physical characteristics of Active Comparison and (S)Partners groups at baseline and follow up

	Active Comparison		(S)Partners	
	Baseline (n = 254)	Follow-up (n = 254)	Baseline (n = 659)	Follow-up (n = 655)
Age (years)	10.5 ± 0.4	11.0 ± 0.4*	10.6 ± 0.4	11.2 ± 3.9*
Height (cm)	144.1 ± 7.0	147.4 ± 7.1*	144.3 ± 6.8	147.6 ± 7.1*
Weight (kg)	42.7 ± 12.1	45.9 ± 13.3*	42.0 ± 11.5	45.1 ± 12.6*
BMI (kg/m2)	20.3 ± 4.6	20.6 ± 4.5*	19.9 ± 4.4	20.3 ± 5.0*
BMI percentile	70.0 ± 26.0	70.5 ± 25.6	67.6 ± 26.8	67.7 ± 27.3
% Overweight	20.30%	18.4%*	17.2%***	17.2%***
% Obese	20.70%	20.40%	18.7%***	19.9%*, ***
	n = 248	n = 253	n = 643	n = 635
Body fat %	24.5 ± 9.1	24.9 ± 9.6**	24.2 ± 10.8	24.4 ± 9.1
HFZ[a] (%)	163 (65.7%)	164 (64.8%)	447 (69.5%)***	445 (70.1%)***
NI[b] (%)	60 (24.2%)	62 (24.5%)	132 (20.5%)***	128 (20.2%)***
NI-HR[c] (%)	25 (10.1%)	27 (10.7%)	64 (10.0%)	62 (9.8%)

* Significantly different within the groups, $p < .001$; ** Significantly different within the groups, $p < .05$; *** Significantly different between the groups, $p < .05$.

Table 8. Means and SDs of main outcome variables in Active Comparison and (S)Partners groups at baseline and follow up

	Active Comparison		(S)Partners	
	Baseline	Follow-up	Baseline	Follow-up
Physical activity - Self-report (days)	4.2 ± 2.1	5.0 ± 2.0	4.6 ± 2.0	5.0 ± 1.9
Physical activity - Pedometer (steps/day)	10825 ± 4242	12173 ± 5457	10469 ± 4292	10737 ± 4040*
Physical activity self-efficacy	2.6 ± 1.2	2.7 ± 1.1	2.7 ± 1.1	2.9 ± 1.0**

* Significantly different from the Active Comparison group, $F(1,189.6) = 4.571$, $p < .05$.
** Significantly different from the Active Comparison group, $F(1,553) = 3.917$, $p < .05$.

Table 9. Number and percent of children achieving specific number of self-reported days of physical activity per week by sex, Active Comparison vs. (S)Partners, and total sample

	Baseline				
Days of Physical Activity per Week	Male	Female	Active Comparison	(S)Partners	Total
0	8 (2.1%)	13 (2.5%)	10 (4.0%)	11 (1.7%)	21 (2.4%)
1	24 (6.4%)	29 (5.7%)	18 (7.2%)	35 (5.5%)	53 (6.0%)
2	39 (10.5%)	57 (11.1%)	27 (10.8%)	69 (10.8%)	96 (10.7%)
3	67 (18.0%)	81 (15.8%)	50 (20.1%)	98 (15.4%)	148 (16.7%)
4	34 (9.1%)	72 (14.0%)	29 (11.6%)	77 (12.1%)	106 (12.0%)
5	45 (12.1%)	76 (14.8%)	29 (11.6%)	92 (14.4%)	121 (13.7%)
6	31 (8.3%)	39 (7.6%)	16 (6.4%)	54 (8.5%)	70 (7.9%)
7	125 (33.5%)	146 (28.5%)	70 (28.1%)	201 (31.6%)	271 (30.6%)
Total	373	513	249	637	886
	Follow-up				
0	6 (1.6%)	4 (0.8%)	5 (2.0%)	5 (0.8%)	10 (1.1%)
1	16 (4.3%)	29 (5.7%)	12 (4.9%)	33 (5.2%)	45 (5.1%)
2	32 (8.6%)	40 (7.8%)	24 (9.7%)	48 (7.5%)	72 (8.2%)
3	36 (9.7%)	69 (13.5%)	24 (9.7%)	81 (12.7%)	105 (11.9%)
4	31 (8.4%)	47 (9.2%)	19 (7.7%)	59 (9.3%)	78 (8.8%)
5	42 (11.4%)	80 (15.6%)	32 (13.0%)	90 (14.2%)	122 (13.8%)
6	50 (13.5%)	64 (12.5%)	33 (13.4%)	81 (12.7%)	114 (12.9%)
7	157 (42.4%)	180 (35.1%)	98 (39.7%)	239 (37.6%)	337 (38.2%)
Total	370	513	247	636	883

Pedometer assessed physical activity changed from baseline to follow up in the Active Comparison and (S)Partners groups (see Table 8). Mixed model ANCOVA showed that there were no significant within-subjects effects or interactions, when adjusting for year of the study, sex, race, and school. Tests of between-subjects effects showed no significant effect of group. After we adjusted for percent body fat, there was a significant effect of baseline percent body fat ($F(1,138) = 10.874$, $p < .001$). However, Box's test of equality of covariances matrices was significant ($p < .001$), indicating that the assumption of equality of covariance was violated and those results must be interpreted with caution. Therefore, due to this violation and unequal sample sizes between and within the groups, we used the Welch's t test and Brown-Forsythe test (Kohr & Games, 1974) to examine the differences between the groups (without the ability to adjust for covariates). Both tests showed identical results. There were no statistically significant differences in steps per day ($p > .05$) between the groups at baseline. At the follow-up, however, there was a statistically significant difference between the groups, Welch's $F(1,189.6) = 4.571$, $p < .05$ (see Table 8, Figure 2). The Active Comparison group was higher than (S)Partners group, 12173 ± 5457 vs 10737 ± 4040 steps/day, respectively. In order to examine the differences within the groups while taking into account the violation of equality of covariance assumption, two repeated measures ANCOVAs were performed separately for each group adjusting for baseline percent body fat, year of the study, sex, race, and school. In the Active Comparison group, subsequent repeated measures ANCOVA showed no main effects and a significant interaction effect between time and sex, $F(1,65) = 7.325$, $p < .05$ (see Figure 4). At the baseline, boys were more active with an average of 12644 steps per day; whereas, girls had 9938 steps per day. At the follow up, however, girls improved to 11756 steps per day compared to 12840 steps per day in boys (Figure 4). In the (S)Partner group, the effect of time was non-significant with no significant interactions.

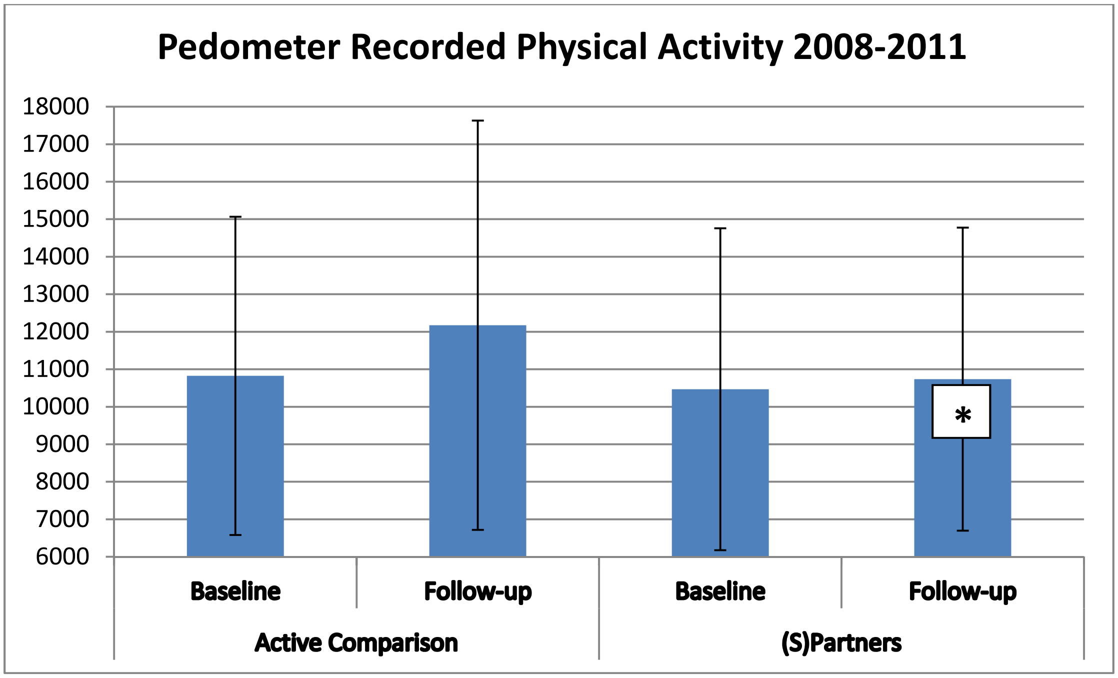


Figure 2. Means and standard deviations of pedometer recorded physical activity between Active Comparison and (S)Partner groups at baseline and follow-up. * Significantly different from the active comparison follow-up group, $p < .05$.

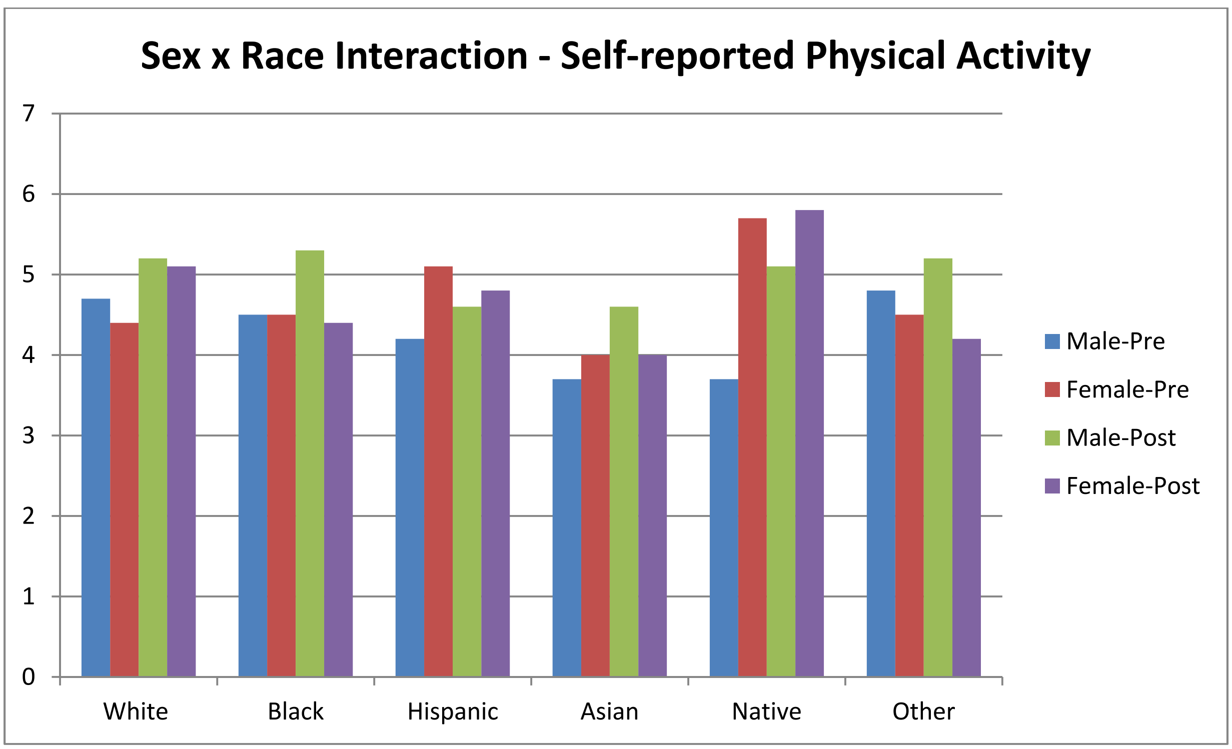


Figure 3. Significant interaction between race and sex in self-reported physical activity; $F(1,745) = 2.599$, $p < .024$.

Physical activity self-efficacy slightly changed from baseline to follow-up in both groups (Table 8). There were no significant within-subjects effects or interactions, when adjusting for year of the study, sex, race, and school. After we also adjusted for baseline percent body fat, there were no changes. Tests of between-subjects effects showed a significant effect of group ($F(1,553) = 3.917$, $p < .048$) when adjusting for year of the study, sex, race, and school. However, when we also adjusted for baseline percent body fat, the main effect of group was non-existent anymore while a significant effect of baseline percent body fat ($F(1,553) = 9.326$, $p < .005$) was found.

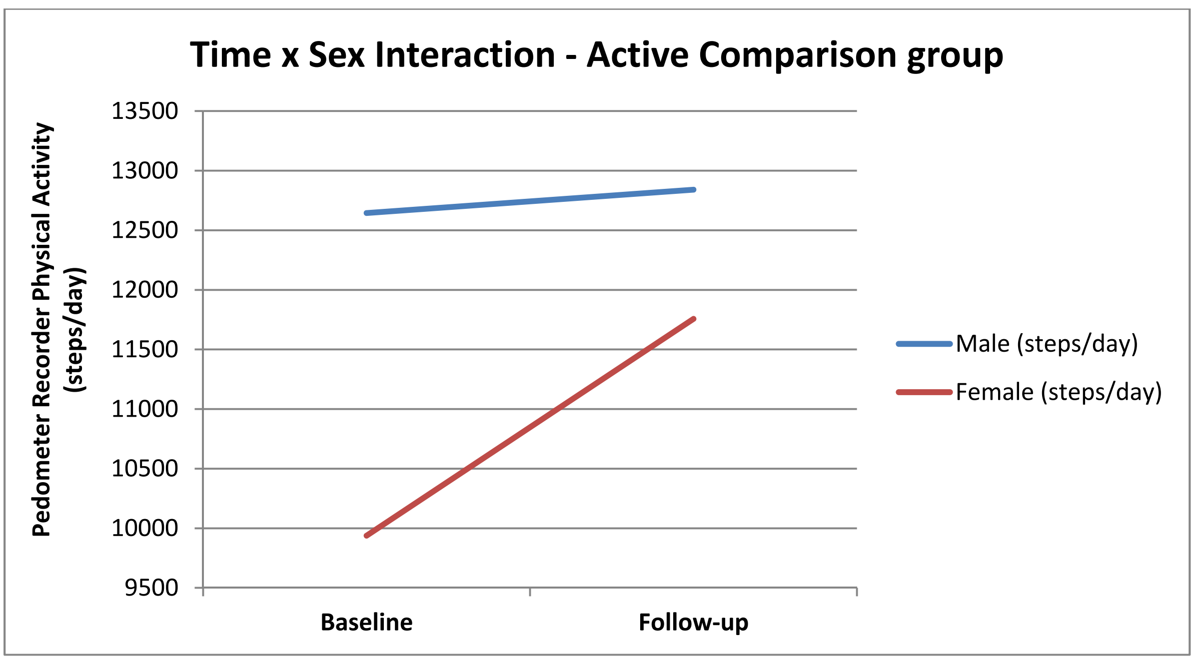


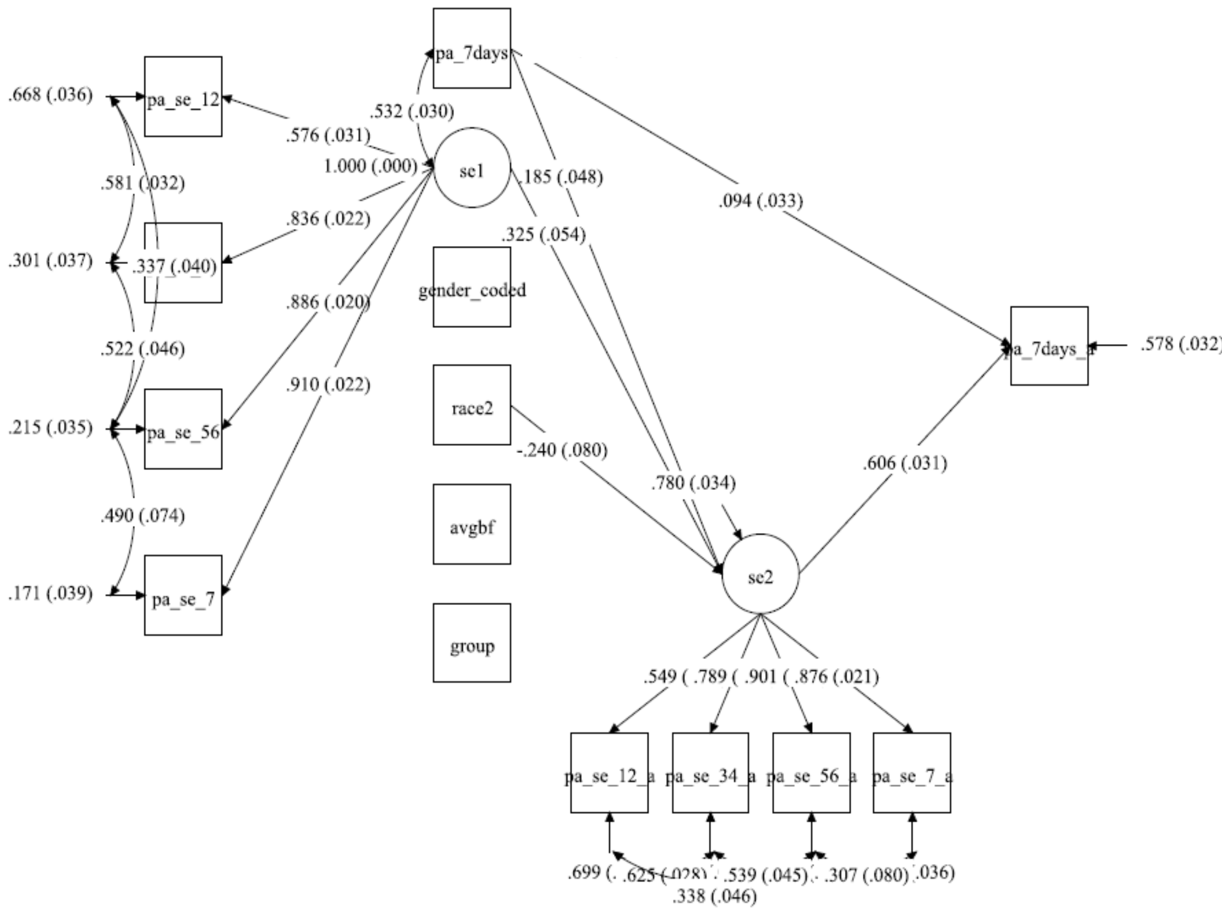
Figure 4. Significant interaction between time and sex in the Active Comparison group; $F(1,65) = 7.325$, $p < .05$

Aim 4

Aim 4: To examine the potential mediation effect of physical activity self-efficacy on follow-up physical activity taking (S)Partners group versus the Active Comparison group into account.

Aim 4 Hypothesis: Physical activity self-efficacy would be a significant mediator of physical activity in the (S)Partners group compared to the Active Comparison group.

The model shown in Figure 1 was tested using SEM. The model in Figure 5 shows only the statistically significant paths tested in Figure 1, and it represented an excellent fit (CFI = 0.992, TLI = 0.988, RMSEA = 0.031 [90% CI = 0.021-0.040]). Standardized estimates (STDY standardization) for the model controlling for sex, race, year of the study, baseline body fatness, and baseline physical activity are reported (Figure 5): baseline physical activity self-efficacy had a significant relationship with follow-up physical activity self-efficacy (Estimate = 0.325, S.E. = 0.054, $p < .001$); baseline physical activity had statistically significant direct effect on follow-up physical activity (Estimate = 0.094, S.E. = 0.033, $p < .004$); baseline physical activity had a significant relationship with follow-up physical activity self-efficacy (Estimate = 0.185, S.E. = 0.048, $p < .001$); and follow-up physical activity self-efficacy had a significant relationship with follow-up physical activity (Estimate = 0.606, S.E. = 0.031, $p < .001$). Thus, there was also an indirect effect of baseline physical activity on follow-up physical activity partially mediated by follow-up self-efficacy (Figure 5). In addition, when follow-up self-efficacy was treated as outcome in the model, there was a significant effect of race on follow-up self-efficacy (Estimate = - 0.240, S.E. = 0.080, $p < .003$) (Figure 5). The effect of intervention on follow-up physical activity and follow-up self-efficacy was non-significant ($p < .279$ and $p < .508$, respectively). There were significant relationships between self-efficacy variables (PASE 1-2, 3-4, 5-6, and 7 days), baseline and follow-up physical activity and physical activity self-efficacy (Figure 5).



<u>Figure 5. Model depicting the effects on follow-up PA with significant paths only</u>. pa_7days is baseline PA; se1 is baseline PASE; se2 is follow-up PASE; gender_coded is sex; race2 is race; avgbf is percent body fat; group is intervention (Active Comparison vs (S)Partener); pa_7days_a is follow-up PA; pa_se_12, 34, 56, 7 are PASE questions on self-efficacy to be active on 1-2, 3-4, 5-6, 7 days.

Aim 5

Aim 5: To examine differences in Aims 3 and 4 between urban and rural children.

Aim 5 Hypotheses: Aim 3 – Physical activity self-efficacy and physical activity would be significantly higher in urban children compared to rural children. Aim 4 – Rural/urban setting would be a significant variable in the physical activity self-efficacy mediation of follow-up physical activity model.

Self-reported physical activity improved from baseline to follow-up in rural and urban children (Table 10). There was no significant effect of time ($p > .05$) when the model was adjusted for year of the study, sex, and race. No significant interactions were found with time as the within-subject factor. When the model was also adjusted for baseline percent body fat, no changes were found. In terms of between-subjects factors, the effect of group was non-significant when the model was adjusted for year of the study, sex, and race. However, when we also adjusted the model for baseline percent body fat, the effect of baseline percent body fat was significant ($F(1,809) = 8.542$, $p < .005$).

Table 10. Means and SDs of main outcome variables in Rural and Urban children at baseline and follow up

	Rural		Urban	
	Baseline	Follow-up	Baseline	Follow-up
Physical activity - Self-report (days)	4.6 ± 2.0 (n = 283)	5.1 ± 1.9 (n = 283)	4.5 ± 2.1 (n = 571)	5.0 ± 2.0 (n = 571)
Physical activity - Pedometer (steps/day)	10371 ± 4042 (n = 113)	11645 ± 5047 (n = 100)	10848 ± 4436 (n = 141)	11305 ± 4690 (n = 103)
Physical activity self-efficacy	2.7 ± 1.2 (n = 255)	2.8 ± 1.0 (n = 273)	2.7 ± 1.2 (n = 443)	2.9 ± 1.0 (n =471)

Pedometer assessed physical activity increased from baseline to follow up in rural and urban children (Table 10). Mixed model ANCOVA showed that there were no significant within-subjects effects or interactions, when adjusting for year of the study, sex, and race. Tests of between-subjects effects showed no significant effect of group or interactions. There were no changes within-subjects when we also adjusted the model for baseline percent body fat, but there was a significant effect of baseline percent body fat ($F(1,130) = 9.572$, $p < .005$) when adjusting for baseline percent body fat between-subjects. However, Box's test of equality of covariances matrices was significant ($p < .001$), indicating that the assumption of equality of covariance was violated and those results must be interpreted with caution. Therefore, due to this violation, unequal error variances of follow-up pedometer data (Levene's test $F = 1.987$, $p < .005$), and unequal sample sizes between and within the groups, we used the Welch's t test and Brown-Forsythe test to examine the differences between the groups (without the ability to adjust for covariates) (Kohr & Games, 1974). Both tests showed identical results. There were no statistically significant differences in steps per day ($p > .05$) between rural and urban children at baseline and follow-up. In order to examine the differences within the groups while taking into account the violation of equality of covariance and error variance assumptions, two repeated measures ANCOVAs were performed separately for each group adjusting for year of the study, sex, and race. In both, rural and urban children, separate repeated measures ANCOVAs showed no main effect of time and no significant interactions. Adjusting also for baseline percent body fat did not show any changes.

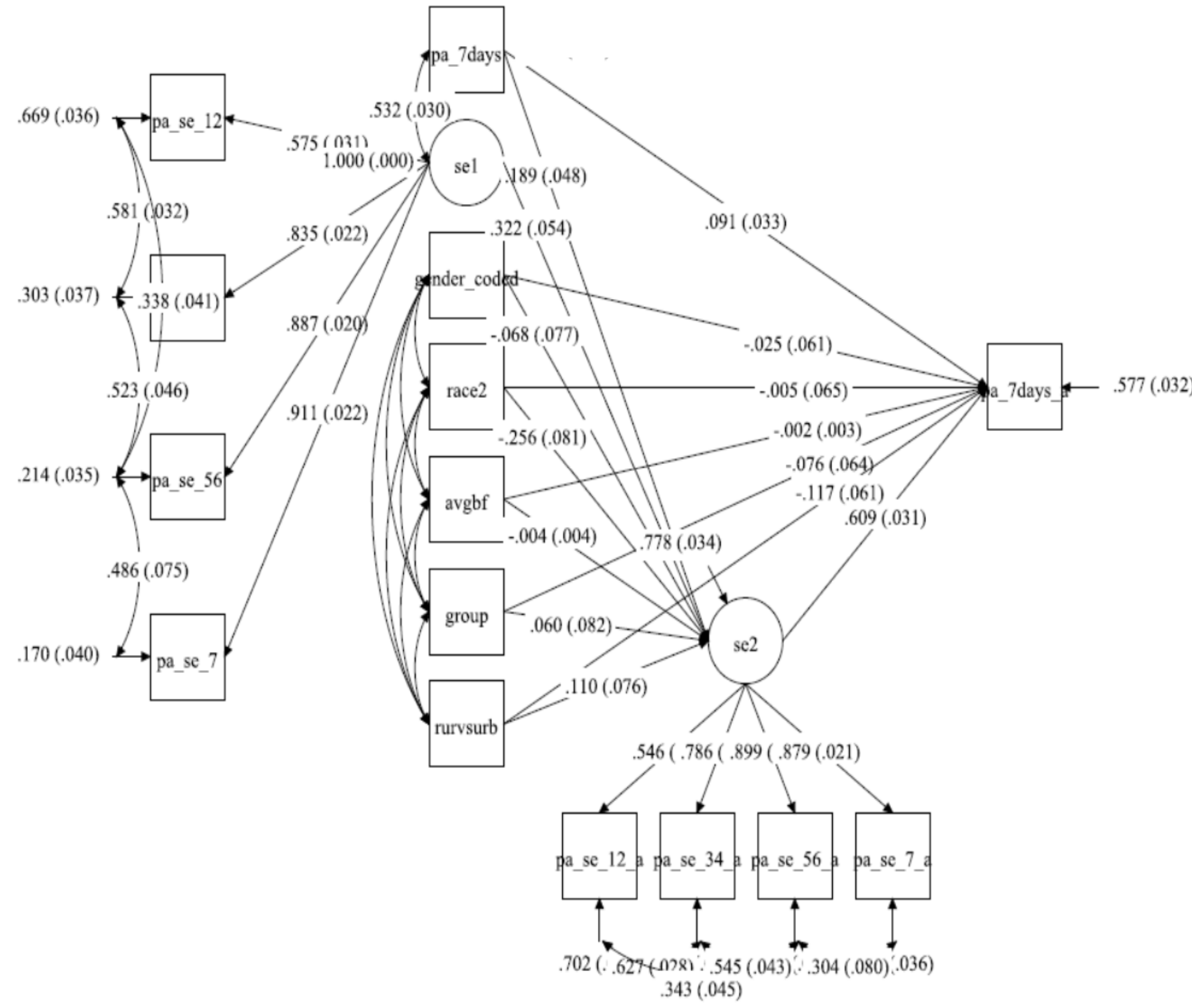


Figure 6. Model depicting the effects on follow-up physical activity including rural and urban setting. pa_7days is baseline physical activity; se1 is baseline physical activity self-efficacy; se2 is follow-up physical activity self-efficacy; gender_coded is sex; race2 is race; avgbf is percent body fat; group is intervention (Active Comparison vs (S)Partener); rurvsurb is rural/urban setting; pa_7days_a is follow-up physical activity; pa_se_12, 34, 56, 7 are physical activity self-efficacy questions on self-efficacy to be active on 1-2, 3-4, 5-6, 7 days; rurvsurb is rural/urban classification.

Physical activity self-efficacy slightly changed from baseline to follow-up in both rural and urban children (Table 10). There were no significant within-subjects effects or interactions, when adjusting for year of the study, sex, and race. Tests of between-subjects effects showed no significant effect of group and no significant interactions. When we also adjusted the model for baseline percent fat, there were no changes within-subjects; however, there was a significant effect of baseline percent body fat ($F(1,571) = 10.593$, $p < .001$) between-subjects.

In order to test Aim 5 hypothesis regarding rural/urban setting as a significant variable in the physical activity self-efficacy mediation of follow-up physical activity model (Aim 4), the model shown in Figure 5 was tested using SEM. This model included the rural/urban variable, which was added to the previous model (Figure 1). The path coefficient between rural/urban setting and follow-up physical activity was inspected. The model fit remained almost identical to the previous model and represented an excellent fit (Figure 6) (CFI = 0.992, TLI = 0.988, RMSEA = 0.029 [90% CI = 0.020-0.038]). Rural vs. urban was borderline significant in the model (Estimate = -0.117, S.E. = 0.061, $p = .054$) (Figure 5). With the estimate of -0.117, one standard deviation increase from the mean in physical activity of rural children (SD = 1.9) would mean 0.234 decrease for the mean of urban children's physical activity (SD = 2.0) while holding all other relevant regional connections constant.

CHAPTER 5: DISCUSSION

The overall purpose of this dissertation was to examine the association of physical activity self-efficacy with physical activity among fifth grade children. This chapter outlines major findings of this study, discusses main findings in terms of Aims 1, 2, 3, 4 and 5 and explanations for the results, provides strengths and limitations of the study, and offers conclusions along with suggestions for future research directions.

Overview of the main findings

No differences were found in children's physical activity self-efficacy between boys and girls or between rural and urban children. Among physical activity self-efficacy, sex, and rural/urban classification, physical activity self-efficacy was the only statistically significant factor found to be associated with self-reported physical activity, explaining 26.4% of its variance. Furthermore, no significant differences were found in self-reported physical activity between Active Comparison and (S)Partners groups (both groups improved from baseline to follow-up) and from baseline to follow-up within the groups when adjusting for covariates (including percent body fat). With regard to pedometer-recorded physical activity, no differences were found between baseline and follow-up or between Active Comparison and (S)Partners groups at baseline. At follow-up, however, the Active Comparison group was significantly higher in steps/day compared to (S)Partners group (not adjusting for covariates). In addition, the effect of percent body fat was found to be significant (have a significant negative linear association with physical activity) while controlling for all other covariates in the model. Similarly, no differences were found between baseline and follow-up Active Comparison and (S)Partners groups in physical activity self-efficacy when adjusting for covariates. Additionally, percent body fat had a significant effect on physical activity self-efficacy while controlling for all other covariates in the model. However, when percent body fat was removed from the model, we found significantly higher physical activity self-efficacy in the (S)Partners group compared to the Active Comparison group. Furthermore, physical activity self-efficacy was found to be a mediator of follow-up physical activity with borderline significant differences between rural and urban children. No differences were found between baseline and follow-up and rural and urban children in self-reported and pedometer- recorded physical activity and physical activity self-efficacy while adjusting for covariates. When adjusting for percent body fat, there was a significant linear association between percent body fat and physical activity (self-reported and pedometer recorded), and between percent body fat and physical activity self-efficacy while controlling for all other covariates in the model.

Interpretation of findings

Physical activity self-efficacy has been one of the most frequently identified psychosocial correlates/determinants of physical activity (Hearst et al., 2012; Sallis et al., 2000) among children and adolescents. In children, however, studies have been much more limited due to the lack of cognitive development and difficulty in measuring many psychosocial variables such as self-efficacy. For this reason, findings from adolescent studies have often been applied to younger children, which emphasizes the importance of specifically investigating and accurately assessing self-efficacy in any children's physical activity intervention. In the present study, we implemented a new self-efficacy instrument, specifically designed for children's self-efficacy to meet physical activity recommendations. Hypothesis 1 of Aim 1 stated that there would not be any differences between boys and girls in physical activity self-efficacy levels. The results supported the hypothesis. Although previous studies reported significant sex differences in psychosocial correlates of physical activity (Strauss, Rodzilsky, Burack, & Colin, 2001; Van der

Horst et al., 2007), participants in those studies were slightly older compared to the participants in the present study, and perhaps already entered early pubertal stages, when differences in psychosocial correlates start to initiate (Saris, Elvers, Van't Hof, & Binkhorst, 1986). Hypothesis 2 of Aim 1 stated that rural children would have higher levels of physical activity self-efficacy compared to urban children. The results do not support this hypothesis as no significant differences were found between rural and urban children's physical activity self-efficacy levels. There are a limited number of studies comparing physical activity and psychosocial correlates between rural and urban children that have reported inconsistent findings thus far (Felton et al., 2002; Joens-Matre et al., 2008; McMurray et al., 1999; Sandercock, Angus, & Barton, 2010). Psychosocial and environmental determinants of physical activity are likely influenced by the type of environmental setting (Joens-Matre et al., 2008; Pate et al., 2003); however, a classification scheme of built environment into urban and rural settings may be over-simplistic when considering that suburban children reported significantly higher physical activity compared to their urban and rural counterparts (Nelson, Gordon-Larsen, Song and Popkin, 2006; Springer et al., 2006; Joens-Matre et al., 2008). Not including the suburban setting into environmental classification systems may have led to current inconsistent findings among the studies.

Identifying physical activity correlates and determinants in children has been an important goal in intervention research targeting adoption of physical activity behavior. The Aim 2 hypothesis stated that physical activity self-efficacy would be a significant factor associated with self-reported and pedometer recorded physical activity, accounting for 10% of the variance in physical activity. The results supported the Aim 2 hypothesis that physical activity self-efficacy would be a significant factor associated with self-reported physical activity. In addition, physical activity self-efficacy was a significant correlate in the self-reported physical activity regression model accounting for 26.4% of the variance in physical activity. Most of the previous studies investigating correlates of physical activity in children used some sort of self-report instrument and identified self-efficacy as a correlate (Trost et al, 1997; Trost et al, 2002; Van Der Harst, 2007) indicating that our findings are in agreement with the literature. In terms of variance in physical activity that is explained solely by physical activity self-efficacy, this is the first study to report such high variance explained by a single social-cognitive construct (26.4%); therefore, it is one of this study's most important findings. A recent study by Suton and colleagues (2013), using a subsample from the current sample, found 25% of the variance in self-reported physical activity was accounted for by physical activity self-efficacy using the same self-efficacy scale. Furthermore, Martin and McCaughtry (2008) were able to account for 19% of the variance in physical activity using social-cognitive variables and built environment constructs in inner-city African-American children. Previous studies which also included prospective designs with complex multilevel models and meta-analyses explained 15-33% of the variance in physical activity in children (Craggs, et al., 2011; Hearst et al., 2012; Plotnikoff et al., 2013). By itself, however, physical activity self-efficacy has been found to account for only 5-13% of the variance in physical activity (Craggs, et al., 2011; Martin et al., 2008; Sallis et al., 2000; Trost et al., 1997). A recent cross-sectional study in middle school children by Martin, McCaughtry, Flory, Murphy, and Wisdom (2011) tested social-cognitive constructs in predicting self-reported physical activity. Only a small portion of the variance in physical activity was explained by the model (12%) with barrier self-efficacy as a predictor of physical activity (Martin, McCaughtry, Flory, Murphy, and Wisdom, 2011). Overall, most of the variance in children's physical activity remains unexplained.

The results did not support the Aim 2 hypothesis that physical activity self-efficacy would be a significant factor associated with pedometer recorded physical activity. Very few studies tested predictive ability of social-cognitive theory in explaining objectively measured physical activity in children (Dewar et al., 2012). Ramirez, Culinna, and Cothran (2012) tested a social-cognitive model to explain physical activity in children using pedometer step counts, but the model was poorly supported (only 2% of the variance in physical activity was explained). A study by Trost and colleagues (1999) used accelerometers in their physical activity assessment and reported physical activity self-efficacy as a significant factor associated with objectively measured physical activity. More studies on the integration of social cognitive models in explaining objectively measured physical activity in children are clearly needed, particularly since research has shown different strengths of relationships between psychosocial variables and subjectively vs. objectively assessed physical activity (Dishman, Darracott, Lambert, 1992). Often, relationships are stronger for subjectively assessed physical activity and psychosocial correlates (Dishman, Darracott, Lambert, 1992; Epstein et al., 1996). Child self-reported measures of physical activity over-report activity compared with objective measures (Epstein et al., 1996). Correlates/determinants of physical activity depend on the method of activity assessment (Dishman, Darracott, Lambert, 1992; Epstein et al., 1996).

Multicomponent, school-based physical activity interventions targeting previously identified correlates/determinants of physical activity behavior have been shown to be one of the most effective strategies for increasing physical activity in children (Kriemler et al., 2011; Physical Activity Guidelines for Americans Midcourse Report, 2012; Stone et al., 1998). In the present study, Aim 3 hypothesis 1 stated that physical activity self-efficacy would be significantly higher in the (S)Partners intervention group compared to the Active Comparison group, and Aim 3 hypothesis 2 stated that self-reported and pedometer recorded physical activity would be higher, but not statistically different, in the (S)Partner group compared to the Active Comparison group. The results of this study support Aim 3 hypothesis 1. Physical activity self-efficacy in the (S)Partners group was significantly higher compared to the Active Comparison group while adjusting for sex, year, race, and school. When percent body fat was included with the rest of the covariates, significant differences between the groups were non-existent, and the effect of percent body fat was found significant. This implies that percent body fat had a significant linear association with physical activity while controlling for all other covariates in the model. It must be noted that there were significant differences between the Active Comparison and (S)Partners groups for percent overweight, healthy fitness zone (HFZ) group, needs improvement (NI) group, and percent obese group at baseline (Table 4.6) (the Active Comparison group was higher in percent overweight, needs improvement (NI) group, and percent obese group; the (S)Partners group was higher in healthy fitness zone (HFZ) group) which may have contributed to percent body fat's linear association with physical activity while controlling for all other covariates in the model. The highest improvement in self-efficacy from baseline to follow-up was in the NI-HR category (high percent body fat) which was also the lowest category in self-efficacy at baseline (Figure 3). In a large scale, school-based randomized controlled trial among 11-year olds by Bergh and colleagues (2012) (the HEIA study), self-efficacy was significantly higher in intervention group whereas weight status moderated the effect of the intervention on self-efficacy, with a positive effect observed among normal weight children only. Previous studies have reported similar findings that overweight/over-fat children had lower levels of self-efficacy compared to normal-weight/normal-fat children (De Burdeaudhuij et al., 2005; Taylor et al., 2002; Trost, Kerr, Ward, & Pate, 2001) which corroborates the findings of the present study. Trost and colleagues (2001) found significantly lower levels of daily physical activity self-efficacy among overweight sixth grade preadolescents compared to their normal-weight counterparts. Furthermore, De Bourdeaudhuij et al. (2005) reported significantly higher physical activity self-efficacy among normal-weight middle school and high school students compared to their overweight peers. The results of our study confirm the findings from previous studies which showed weight/fatness status influenced physical activity self-efficacy levels in addition to also interfering with intervention effects.

The results of this study do not support the Aim 3 hypothesis 2 regarding self-reported physical activity, as the (S)Partners group did not show higher number of days per week compared to the Active Comparison group (5.0 ± 1.9 vs 5.0 ± 2.0, respectively). These results are partly in contrast to several reviews on physical activity interventions in youth (Brown & Summerbell, 2009; Kriemler et al., 2011; Shaya, Flores, Gbarayor, & Wang, 2008; Stone et al., 1998; van Sluijs, McMinn, & Griffin, 2007) which showed potential for school-based interventions in terms of increasing physical activity behavior. However, it should be noted that the Active Comparison schools were not typical control group schools because they followed the JIFF or "Show Me Nutrition" curricula, which were research-based curricula designed to stimulate learning the importance of healthy nutrition and increased physical activity in 8- to 11-year-old children. Therefore, some increase in pedometer-recorded physical activity in the Active Comparison group should have been expected, given these schools followed a curriculum designed to stimulate physical activity participation. Much more evidence exists for school-based interventions in adolescents compared to children. The most recent review of reviews by Kriemler and colleagues (2011) on the effects of school-based interventions on physical activity in children and adolescents, that focused on the new literature (published from 2007 to 2010) of school-based interventions not included in the earlier reviews, showed that 47-65% of trials were found to be effective with the most effect in school-related physical activity. More specifically, from the total of five studies that used self-report, total physical activity was significantly increased in intervention group in four studies with one study showing no effects (Kriemler et al., 2011). In terms of overall physical activity, nine out of ten studies showed positive intervention effects for physical activity (Kriemler et al., 2011). In contrast to previous reviews (Brown & Summerbell, 2009; Shaya, Flores, Gbarayor, & Wang, 2008; Stone et al., 1998), this review included studies published since January 2007 and had more rigorous inclusion criteria requiring adequate methodology, baseline and follow-up assessment of physical activity, and a minimal study duration of 3 months (Kriemler et al., 2011). Moreover, eligibility of 20 studies in the Kriemler et al. review (2011),given rigorous inclusion criteria, shows the progress that has been made in designing and implementing quality interventions over the last eight years, but the majority of those interventions were conducted in adolescents and were of higher quality compared to studies in children. In children, however, multiple reviews have reported inconsistent findings, limited effectiveness, and lack of high quality methodological evaluations (Brown & Summerbell, 2009; Shaya, Flores, Gbarayor, & Wang, 2008; van Sluijs, McMinn, & Griffin, 2007; van Sluijs, Kriemler, McMinn, 2011) leaving evidence as inconclusive. More specifically, a review by van Sluijs and colleagues (2007) found limited evidence for interventions targeting children from low socio-economic populations and inconclusive evidence for multicomponent interventions. Furthermore, educational interventions and studies targeting females have also showed limited effectiveness in increasing physical activity among school-aged children (van Sluijs, McMinn, & Griffin, 2007; van Sluijs, Kriemler, McMinn, 2011). Most studies in children did not describe implementation and evaluation of the intervention, which could help explain inconsistent findings.

With regard to Aim 3 self-reported physical activity, we also found a significant interaction between sex and race. Physical activity increased from baseline to follow-up in all races in males, but in females, physical activity increased from baseline to follow-up in Whites and Native Americans, decreased in Hispanics, Blacks and other, and remained unchanged in Asians. This finding is partly supported by the limited number of previous studies which have shown that physical activity levels in youth vary by sex (Caspersen, Pereira, Curran, 2000; Sallis, Prochaska, & Taylor, 2000; Strauss, Rodzilsky, Burack, & Colin, 2001) and race (Felton et al., 2002; Trost et al., 2002). Overall, sex is the correlate/determinant of physical activity with boys being more physically active compared to girls (Strauss, Rodzilsky, Burack, & Colin, 2001; Van der Horst et al., 2007). A few studies have shown that minority children and adolescents, who are often associated with low socio-economic status, are less active in non-school moderate to vigorous physical activity and physical education physical activity compared to white children (Gordon-Larsen et al., 1999; Lindquist et al., 1999). A study by Felton and colleagues (2002) found Black girls to be significantly less active than White girls, reporting less 30-minute blocks of moderate-to-vigorous and vigorous physical activity. Differences in physical activity among children can be attributed to sex and race. School-based health professionals, teachers and practitioners should design physical education and health programs sensitive to race with promotion efforts focused on Black girls.

The results of this study do not support the Aim 3 hypothesis 2 regarding pedometer recorded physical activity as significantly higher steps/day were found in the Active Comparison compared to (S)Partners group at follow-up. This result is unexpected and is only partly supported by previous studies, although it is not uncommon in adult intervention research to find improvements in comparison groups (Waters, Reeves, Fjeldsoe, & Eakin, 2012). As noted by Waters and colleagues (2012), possible explanatory factors for comparison (or control) group improvements include aspects of behavioral measurement, participant characteristics, and control group treatment. Furthermore, the Active Comparison schools were, in a way, also intervention schools because they followed the JIFF or "Show Me Nutrition" curricula designed to stimulate learning the importance of healthy nutrition and increased physical activity in 8- to 11-year-old children. Therefore, increase in pedometer-recorded physical activity in the Active Comparison group should have been expected. It should be noted that school C was an Active Comparison school during the first two years of the study and a (S)Partner school during the third year of the study due to randomization process. School C officials expressed their regrets multiple times for not being a (S)Partners school which may have triggered them to enhance their implementation of the JIFF curriculum during the first two years of the study. In fact, school C staff and officials may have been so motivated that they may have gone above and beyond with their JIFF implementation in order to receive the status of intervention school the following year, which, in turn, may have impacted physical activity.

The most unexpected finding of the present study was that pedometer-recorded physical activity improved significantly more in the Active Comparison compared to the (S)Partners group, which showed non-significant increase from baseline to follow-up. In contrast to our findings, Kriemler et al. review (2011) reported significant intervention effects in five well-designed and methodologically sound studies using objective measurements of physical activity (pedometers and accelerometers), which found increase in total and school physical activity. Furthermore, the review of studies using pedometers to promote physical activity in youth by

Lubans, Morgan and Tudor-Locke (2009) reported significant increases in physical activity in 12 out of 14 studies. More specifically, the review included six school-based studies in children and adolescents, five of which resulted in significant intervention effects for physical activity. The Fit 'n Fun Dudes (Horne et al., 2009) was a peer modelling, rewards and pedometer-feedback intervention designed to increase children's physical activity. The results showed significant improvements in steps/day in both, intervention boys and girls, during intervention and compared to baseline (Horne et al., 2009). The Learning to Enjoy Activity with Friends (LEAF) (Lubans and Morgan, 2008) and Program X (Lubans et al., 2009) were multi-component interventions that used pedometer goal setting and behavior tracking along with fitness activities to promote lifetime physical activities. In contrast to our results, both studies showed significant increases in physical activity, but only in participants categorized as low-active at baseline, and not in participants categorized as active (Lubans and Morgan, 2008; Lubans et al., 2009). However, even though the (S)partners group was lower in steps/day at baseline, the intervention group failed to increase steps/day significantly more compared to the Active Comparison group, at follow-up as was the case with the LEAF and Program X.

The lack of success in increasing physical activity in (S)Partners group compared to the Active Comparison group, as reported previously by many school-based interventions, might be partly attributed to inadequate implementation of the intervention components, particularly with regard to the (S)Partners website and breakout meetings. The (S)Partners website experienced technical difficulties in the early phase of intervention in 2008-09, which affected communication between MSU kinesiology and dietetic students and fifth graders, delayed goal setting and limited tutoring/mentoring time and learning process. Problems with the website continued in 2009-10 and 2010-11 and were related to website server issues, school network issues, and difficulties connecting, using and navigating the site which led to missing scheduled log-ins and not replying to messages sent by (S)Partners mentors. These communication challenges possibly reduced some students' motivation to participate in the intervention. Additionally, focus groups with school staff and students indicated the need to improve the website appearance, and increase user-friendliness and "fun factor". Breakout meetings between fifth graders and MSU undergraduate kinesiology and dietetic students following the completion of the lesson plan, at some instances, had a limited number of MSU students which resulted in oversized breakout groups. This could have negatively impacted the reinforcement of physical activity goals among fifth graders especially if their MSU tutor/mentor was not present during the break out meeting. Implementation issues with the (S)Partners website and poor attendance of breakout group meetings by MSU kinesiology and dietetic students negatively influenced intervention efforts, and perhaps may have contributed to lack of increase in physical activity in the (S)Partners group.

The Aim 4 hypothesis stated that physical activity self-efficacy would be a significant mediator of physical activity taking the (S)Partners versus the Active Comparison group into account. The results of this study completely support that hypothesis, as self-efficacy was found to mediate follow-up physical activity. To our knowledge, this is the first study showing self-efficacy as a mediator of change in physical activity in preadolescent children. Previous studies have established the role of self-efficacy as a mediator of physical activity behavior in adolescents (Dishman et al., 2004; Haerens et al., 2008; Motl et al., 2002; Motl et al., 2005; Taymoori et al., 2008), but mediation studies in children remain limited. In a randomized controlled trial and a comprehensive school-based intervention named LEAP (Lifestyle Education for Activity Program) Dishman et al. (2004) found that self-efficacy partially mediated the effect of the LEAP intervention on physical activity in a large sample of adolescent girls. A review of mediators in physical activity interventions by Lubans, Foster, & Biddle (2008) highlighted two interventions, one in Belgian middle school students (Haerens et al., 2008) and the other in Iranian adolescent girls (Taymoori & Lubans, 2008), both of which found self-efficacy to mediate follow-up physical activity. Furthermore, van Stralen and colleagues (2011) recently conducted a review of mediating mechanisms in children and adolescents and found more studies which showed that changes in self-efficacy triggered by interventions were associated with increased physical activity (Dishman et al., 2005; Lubans et al., 2010; Haerens et al., 2008). However, the non-significant effect of intervention on follow-up physical activity and follow-up self-efficacy in this study is in contrast to the previous literature findings mentioned above. The lack of significant intervention impact also signifies the mediator role of self-efficacy in the total sample of fifth graders including the Active Comparison group. Therefore, we have identified physical activity self-efficacy as a mediator of follow-up physical activity in the total sample with no mediation of (S)Partners intervention effect on physical activity.

It is difficult to compare the magnitude of effects of baseline physical activity and follow-up self-efficacy on follow-up physical activity from the present study to other studies due to the lack of preadolescent studies with mediation analyses. In this study, the effect of follow-up self-efficacy on follow-up physical activity (Estimate = 0.606, S.E. = 0.031) was more than three times in magnitude compared to the effect of baseline physical activity on follow-up self-efficacy (Estimate = 0.185, S.E. = 0.048). In addition, the effect of baseline physical activity on follow-up self-efficacy (Estimate = 0.185, S.E. = 0.048) was more than double in magnitude compared to the effect of baseline physical activity on follow-up physical activity (Estimate = 0.094, S.E. = 0.033). The significant effect of race on follow-up self-efficacy (Estimate = -

0.240, S.E. = 0.080, $p < .003$) implies that a one standard deviation increase from the mean in self-efficacy of White children (2.9 ± 1.0) (the reference group) would mean 0.288 decrease from the mean of all other races' children's self-efficacy (2.7 ± 1.2) while holding all other relevant regional connections constant. No previous studies in youth have explored differences in physical activity self-efficacy between different races. One study, by Felton and colleagues (2002), reported physical activity self-efficacy differences between White and Black eight grade girls in South Carolina. White girls had significantly higher physical activity self-efficacy compared to Black girls ($p < .001$) (Felton et al., 2002). Overall, a number of emerging studies, including the present study, are starting to show evidence for self-efficacy as a mediator of change in physical activity behavior in children. These results should encourage the use of self-efficacy as a specific target variable in interventions designed to increase physical activity, especially among non-White children. Higher self-efficacy for White children may originate from more access to physical activity opportunities, sports equipment and higher perceived neighborhood safety (Felton et al., 2002). In fact, race may be closely tied to rural/urban status which may have had confounding effects.

The Aim 5 hypothesis stated that physical activity self-efficacy and physical activity would be significantly higher in urban children compared to rural children, and that rural/urban setting would be a significant variable in the physical activity self-efficacy mediation of follow-up physical activity model. The results of this study do not support the hypothesis on differences in physical activity between rural and urban children, as no significant differences were found. A study by Liu and colleagues (2012) examined the differences in physical activity between 14,332 rural and urban children using NHANES data, and found only slightly more 2- to 11-year-old rural children participating in exercise five or more times per week compared to urban children

(79.7% vs. 73.8%). Similarly, a study by Davis, Bennett, Befort, & Nollen (2010) also used NHANES data (2003-2006) in examining physical activity differences between rural and urban children, and found no significant differences in meeting physical activity recommendations using a single survey question. Joens-Matre and colleagues (2008) reported non-significant, small to moderate differences in physical activity between rural, suburban, and urban children. In addition, Sallis and colleagues (2000) found no significant influence of urban or rural environment on physical activity in children. However, Liu and colleagues (2008) reported higher physical activity in rural compared to urban children and adolescents using the 2003 National Survey of Children's Health (NSCH) data (N = 47757). Another large scale rural-urban comparison using accelerometers in North Carolina fourth, fifth, sixth, seventh, and eight graders showed no significant differences in moderate-to-vigorous physical activity between rural-urban boys, but reported significantly higher moderate-to-vigorous physical activity in rural girls compared to suburban and urban counterparts (Moore et al., 2014). In contrast, an investigation by Moore and colleagues (2013) found significantly lower moderate-to-vigorous physical activity in rural compared to urban middle school children using an objective assessment of physical activity. Felton and colleagues (2002) reported physical activity differences between White and African-American eighth grade girls in South Carolina associated with race rather than urban/rural setting. Furthermore, a review by Sandercock, Angus, and Barton (2010) which included the most recent domestic and international studies, found classification between urban vs. rural settings to be overly simplistic given that studies that examined physical activity in suburban children reported significantly higher physical activity compared to their urban and rural counterparts (Nelson, Gordon-Larsen, Song and Popkin, 2006; Springer et al., 2006; Joens-Matre et al., 2008). Findings on differences in physical activity between urban and rural children appear inconsistent and more complex than originally anticipated. Further studies should investigate correlates and determinants of children's physical activity in rural and urban settings.

The rural/urban setting classification system that was used in the present study, Rural-Urban Commuting Area (RUCA) code (Hart et al., 2005; Liu et al., 2012), has been previously used in children's physical activity research (Liu et al., 2012). The previously mentioned study by Liu and colleagues (2012) used the RUCA codes in examining differences in physical activity between rural and urban children, and found that slightly more 2- to 11-year-old rural children reported participating in exercise five or more times per week than urban children (79.7% vs. 73.8%). However, the RUCA code did not have a suburban setting in its classification which may have impacted the results of the present study. Previous studies that examined physical activity in suburban children reported significantly higher physical activity compared to their urban and rural counterparts (Nelson, Gordon-Larsen, Song and Popkin, 2006; Springer et al., 2006; Joens-Matre et al., 2008). In addition, the RUCA code classified eleven schools as urban and only two schools as rural in our study which resulted in uneven samples (total sample: rural = 283, urban 571). The results of this study may have been influenced by uneven samples determined by using the RUCA classification, and by the absence of a suburban designation in the RUCA classification system. Studies examining multiple environmental classification systems are needed.

The results of this study do not support the Aim 5 hypothesis on differences in physical activity self-efficacy between rural and urban children. Studies examining differences in physical activity self-efficacy between rural and urban children are currently lacking. The present study is among the first ones to examine those differences in fifth grade, low-income students. A study by Barnett, O'Loughlin, and Paradis (2002) identified low physical activity self-efficacy as a one-year predictor of physical activity decline in fourth and fifth grade Canadian inner-city children. Martin and McCaughtry (2008) found moderate levels of physical activity self-efficacy among inner-city African American children, but self-efficacy was not identified as the main predictor of physical activity in this sample. In contrast to findings of Martin and McCaughtry (2008), Trost and colleagues (1997) examined determinants of physical activity in rural, predominantly African-American children and found physical activity self-efficacy to be a significant predictor of vigorous physical activity. More studies examining differences in physical activity self-efficacy between rural and urban children are needed in order to develop effective intervention strategies for children residing in those environmental settings.

The results of this study partially support the Aim 5 hypothesis that rural/urban setting would be a significant variable in the SEM analysis (physical activity self-efficacy mediation of follow-up physical activity model), as rural/urban setting was found to be borderline significant ($p = .054$) variable in the mediation model. With the estimate of -0.117, 1.9 days increase from the mean in physical activity of rural children would mean 0.234 days decrease from the mean of urban children's physical activity while holding all other relevant regional connections constant. Recent studies comparing rural and urban children have reported differences in physical activity (Liu et al., 2008; Moore et al., 2013; Moore et al., 2014) along with predictive capacity of physical activity self-efficacy (Trost et al., 1997). Given that the effects of varying environmental factors on children's physical activity have been under-investigated across rural and urban settings, the present study's findings warrant investigation of physical activity self-efficacy as a mediator in interventions targeting rural and urban children.

Limitations

Although the current study has several strengths, it should be considered in light of some limitations. First, the baseline sample in Aim 2 was cross-sectional which prevents inferring a causal relationship between physical activity and physical activity self-efficacy for that portion of the analyses. Second, self-reported physical activity was based on a single item which assessed the number of days in the last seven days the participants were physically active for a total of 60 minutes per day. This warrants attention because previous studies in preadolescents showed moderate correlations between self-reported physical activity and objectively measured physical activity (Trost, 2001; Welk, Corbin, & Dale, 2000) as well as a tendency for children to overestimate their self-reported physical activity levels (Chinapaw et al., 2010). However, the single questions to assess physical activity and new physical activity self-efficacy scale were designed considering children's developmental level and have been previously used in this age group (CDC, 2004; Chase, 2001). Third, the physical activity self-efficacy questions need further psychometric evaluation. The lack of consistency in assessment of self-efficacy is apparent across studies; there is an absence of universally accepted and validated theory-based questionnaires or scales that measure self-efficacy in children. In the case of the present study, with the use of a newly designed physical activity self-efficacy scale for children, the biggest limitation with physical activity self-efficacy assessment was the inability of the large portion of participants (n = 222 at baseline, n = 176 at follow-up) to fully understand the concept of confidence to be physically active on a given number of days in a week (1-2, 3-4, 5-6, all 7 days) even though thorough explanation was given prior to survey administration ("How sure you are that you can be physically active for a total of at least 60 minutes per day on _-_ days?"). Participants who erroneously filled circles denoting higher physical activity self-efficacy for 5-6 or 7 days compared to 1-2 days were therefore excluded from the analysis. In the total sample, there were 222 at baseline, and 176 at follow-up responses excluded from the analysis; while the numbers may seem high, once broken down per year (5 years of the study duration) and per school (4-5 schools enrolled in the study per year), they average between 7 and 11 students per year per school which is within reasonable range. According to Bandura's guide for creating self-efficacy scales (2006), scales of perceived self-efficacy must be tailored to the particular domain of functioning that is the object of interest. Adopting a self-efficacy scale in the physical activity domain and making it comprehensible to level of fifth grade students is difficult, so some error is to be expected. However, a previous study by Chase (2001) successfully included a one-item question to measure self-efficacy in children 8-14 years old and an 11-point scale to indicate their self-efficacy for a specific skill. Children were determined to have demonstrated an understanding of the scale, and the concept was reinforced by reading the definition to those who clearly had understanding, and explained and reiterated to those who were unsure or did not have clear understanding (similar to the present study). Children ages 10-11 years are believed to be able to, at least in part, differentiate ability and effort whereas children 11 years and older are believed to completely differentiate ability and effort while understanding that ability is a capacity to perform a task (Chase, 2001). Fourth, objective physical activity assessment using pedometers was performed in a subsample (2008-09 to 2011-12), not in the total sample of children. Due to the high variability in mean physical activity, combined with the lower number of participants, the pedometer analyses should be interpreted with caution. Pedometers measure ambulatory activity and provide data in steps in response to vertical displacement; however, they do not capture all types of physical activity (cycling, swimming, weight lifting, skating, skiing, etc.). In addition, pedometer data compliance was very poor (64% at baseline, 50% at follow-up). Fifth, the RUCA classification system used to designate rural vs urban settings in the present study did not include the suburban category which, according to previous studies, was a limitation. The RUCA definition was primarily chosen because it had the ability to identify the rural portions of metropolitan counties and the urban portions of non-metropolitan counties (Hart et al., 2005), along with the fact that it was previously used in a large scale NHANES analysis (Liu et al., 2012). Finally, inadequate intervention implementation was a limitation including the (S)Partners website functionality and communication problems and unavailability of (S)Partners mentors. Many (S)Partners mentors/tutors (college seniors in kinesiology and dietetics) were not available during designated times for lesson plans and breakout groups at schools, which likely limited the impact of the intervention. If the fifth grade student was not paired up with his actual mentor/tutor, then the breakout group lost it personal interactive touch and possibly limited the fifth grader's motivation to continue meeting physical activity goals.

Strengths

The strength of this study was in its large sample of fifth grade students coming from diverse backgrounds of low SES while representing a population with currently high obesity rates. The proportion of students who were eligible for free and reduced school lunch ranged from 30% to 75% across five years of the study. Objective assessment of physical activity using pedometers, in addition to self-report, although only in a subsample of participants, was also a strength of this study. The design of this intervention which targeted educational, environmental and behavioral components corresponded well to person, behavior, and environment interaction of Social Cognitive Theory, and can be considered as one potential strength of the study. In addition, the fact that the key personnel conducting the measurement and the intervention consisted of well-trained graduate students and undergraduate students receiving academic credit for participation in intervention. Another strength of the study was in its method of using direct assessment of body fatness (foot-to-foot bioelectric impedance) which has been used less frequently than body mass index in previous studies of school-age children. Although this method is good, it also has limitations, such as assuming adequate hydration level at time of measurement (can be questionable in children) and overestimation of percent body fat in severe abdominal obesity.

Summary

Social cognitive theory has been frequently implemented in studies aiming to develop physical activity behavior in children. According to this theory, each of the influences among the person, environment, and behavior are the dynamic interactions representing potential physical activity behavior determinants (Buckworth & Dishman, 2002). With increases in obesity and without increases in physical activity among children of school age, a need to identify the most influential psychosocial factors related to children’s physical activity behavior has arisen. The present study, along with multiple previous studies, identified physical activity self-efficacy as a significant correlate and a potential determinant of physical activity in children. More conclusive evidence exists in adolescent studies, which show that self-efficacy is a potent determinant of physical activity behavior (van der Horst et al., 2007); however, more prospective studies are needed in children. Self-efficacy has also been shown as the most commonly assessed mediator with sufficient evidence for its mediating role between interventions and physical activity in adolescents. Very few interventions have assessed mediators of physical activity in children using statistically appropriate methods. The present study is, to our knowledge, the first prospective study in lower-income preadolescent children to show physical activity self-efficacy as a mediator of physical activity using structural equation modeling.

Multiple interventions have attempted to influence the sources of self-efficacy in trying to increase physical activity behavior. However, due to lack of cognitive development and difficulty in measuring psychosocial constructs such as self-efficacy in children, most studies have been performed in adolescents with studies in children currently lacking. Overall, interventions in adolescents have been effective in increasing physical activity while limited studies in children show that school-based environmental interventions have the most potential in increasing physical activity. (S)Partners for Heart Health did not succeed in increasing physical activity significantly more in (S)Partners group compared to the Active Comparison group, but did succeed in increasing physical activity self-efficacy significantly more than the Active Comparison group.

The influence of built environment, one of the behavioral determinants in social-cognitive theory, on physical activity has been examined more frequently in recent years. More evidence exists in adolescents and adults compared to children. The present study, along with a few previous studies, investigated differences in physical activity and physical activity self-efficacy among children from urban and rural settings, but no consistent differences were found.

Conclusion

Despite all the limitations, this study showed strong relationships in a school-based setting surrounded by less than ideal circumstances. Physical activity self-efficacy was shown as an important predictor and a mediator of physical activity in fifth grade children. These findings provide an important base for future prospective studies in children attempting to explore the role of self-efficacy as a determinant of physical activity behavior. This study’s findings also help reduce a gap in the literature between adolescent and child studies by confirming findings from adolescents to the preadolescent population. Our finding that physical activity self-efficacy accounts for more than a quarter of variance in physical activity and is a mediator of change in physical activity behavior suggest that physical activity intervention programs in children should endeavor to increase efficacy beliefs related to physical activity. However, most of the variance in children's physical activity still remains unexplained. The (S)Partners for Heart Health intervention was shown as an effective way of increasing physical activity self-efficacy, but not as effective in increasing physical activity. Differences in physical activity and physical activity self-efficacy between rural and urban children appear to be non-existent, based on our sample. Despite some limitations, our findings may have important implications for health professionals devising programs to increase physical activity in children, especially those from low socio-economic areas and schools. These findings also suggest that physical activity self-efficacy should be considered as one of the key variables in future intervention studies that aim to enhance physical activity behavior in middle school children. In addition, these findings show relevance for professionals and practitioners in school, clinical, and intervention settings, and could assist future researchers in designing their intervention studies. The fact that strong relationships between physical activity and physical activity self-efficacy were found despite less-than-ideal circumstances (difficulties and inconsistencies in (S)Partners intervention implementation) further signifies the study findings.

Future directions

Although much is known about physical activity interventions in adolescents, more theory-based physical activity interventions with experimental designs using objective measures of physical activity are needed in preadolescent children. This study's findings should encourage the use of self-efficacy as a specific target variable in interventions designed to increase physical activity among children. More prospective studies are also needed in order to establish the role of self-efficacy as a determinant of physical activity behavior in children. Future studies should also further explore other correlates of physical activity in low socio-economic status children. Once identified, these correlates should be targeted for behavioral change in future intervention programs, including those specifically designed for the needs of low socio-economic status children. Future pediatric interventions should target self-efficacy as a mediator variable and include analysis of mediators across ecological domains in order to identify the most effective combination of factors in increasing physical activity in children (Perry et al., 2012). In addition, future research should focus on the development, validity, and reliability of self-efficacy measures overall (van Stralen et al., 2011). Finally, future interventions should explore the effects of (S)Partners for Heart Health in low physical activity self-efficacy children and children not meeting physical activity recommendations.

APPENDIX

]POST Lifestyle Survey First name ID #_________________

This survey will ask you some questions about health, eating habits or activities including exercise and the amount of time you spend watching TV or using the computer. If you have any questions, please ask a staff member for help. *All surveys will be held in strict confidence.* ***Thank you!***

1. What is your gender? a) Boy b) Girl

2. What is the date of your birthday Month________ Day________ Year_________

3. How important do you feel that nutrition is for your health (having energy, to avoid health problems)

   a) not important b) kind of important c) very important d) extremely important

4. How important do you feel exercise and physical activity is for your health (having energy, to avoid health problems)

   a) not important b) kind of important c) very important d) extremely important

5. On how many of the past 7 days did you do exercises to strengthen or tone your muscles, such as push-ups, sit-ups or weight lifting?

   a) 0 days b) 1 day c) 2 days d) 3 days e) 4 days f) 5 days

6. If you skip meals, what is your main reason for doing so?

   a) lack of time b) food not available c) not hungry d) to keep weight down e) I do not skip meals f) other please list-

7. How do you feel about your body weight?

   a) Too skinny b) about right c) Too heavy, too fat

8. Are you now trying to lose weight?

   a) Yes b) No

9. From the following, circle the conditions that increase a person's chances for having heart problems (for example, a heart attack or heart disease)

   a) high blood pressure b) high blood cholesterol (blood fats) c) low levels of exercise d) eating fruits and vegetables e) smoking f) being in the sun too much g) diabetes (high blood sugar) h) all of the above

10. True or False: Another name for clogging of the blood vessels with fat is "atherosclerosis"

11. Which of the following are considered healthy fats sources? (pick one or more)

    a) corn oil b) lard c) coconut oil d) olive oil e) peanut butter

12. Which of the following foods are a good source of dietary fiber? (pick one or more)

    a) apples b) white bread c) oatmeal d) chicken e) nuts (peanuts, almonds)

Physical Activity Related Habits

1. On a typical day, what time do you go to sleep? _______________

2. On a typical day, what time do you wake up? _____________

3. How much **television** do you watch on a typical **weekday?** (including video tapes or DVD's)

_______hours ________minutes

4. How much **television** do you watch on a typical **<u>weekend</u> day?** (including video tapes or DVD's)

_______hours ________minutes

5. How much time do you spend on a home **computer or laptop** (surfing the web, email, etc.) on a typical **weekday**? (not including video games)

_______hours ________minutes

6. How much time do you spend on a home **computer or laptop** (surfing the web, email, etc.) on a typical **<u>weekend</u> day**? (not including video games)

_______hours ________minutes

7. How much time do you spend **playing video games** (not included in television or video games above) on a typical **weekday**?

_______hours ________minutes

8. How much time do you spend **playing video games** (not included in television or video games above) on a typical **<u>weekend</u> day**?

_______hours ________minutes

9. During the past 7 days, how many days were you physically active for a total of at least **60 minutes per day?** (*Add up all the time you spend in any kind of physical activity that increases your heart rate and makes you breathe hard some of the time)*

a. 0 days b. 1 day c. 2 days d. 3 days
e. 4 days f. 5 days g. 6 days h. 7 days

The following questions will ask you *how sure you are that you can eat a certain number of servings of different food groups* over the next week. Please use the attached sheet to see what a serving is. Below is an an example. Jane Doe usally eats 2- servings of vegetables a day and hardly ever eats 4 or mores servings a day, so she selected that she was not sure.
* If she felt she would eat 4 or more servings of vegetables everyday she would have selected very sure.

EXAMPLE- VEGETABLES 4 or more servings of vegetables per day	NOT SURE		SURE		VERY SURE
	●	○	○	○	○

1. Please fill in the circle to show how sure you are that you can eat <u>4 or more servings of VEGETABLES</u> every day for the next week. See attached list for examples of servings

VEGETABLES 4 or more servings of vegetables per day	NOT SURE		SURE		VERY SURE
	○	○	○	○	○

2. Please fill in the circle to show how sure you are that you can eat <u>3 or more servings of FRUIT</u> every day for the next week. See attached list for examples of servings

FRUIT 3 or more servings of fruit per day	NOT SURE		SURE		VERY SURE
	○	○	○	○	○

3. Please fill in the circle to show how sure you are that you can eat <u>3 or more servings of Dairy (milk, yogurt, cheese)</u> every day for the next week. See attached list for examples of servings.

DAIRY 3 or more servings of dairy everyday	NOT SURE		SURE		VERY SURE
	○	○	○	○	○

Continue next page -->

Figure 7. Self-efficacy questions (nutrition and physical activity).

Figure 7 (cont'd)

4. Please Fill in the circle to show how sure you are that you can eat **3 or more servings of WHOLE GRAINS** every day for the next week. Examples of WHOLE GRAINS include whole-grain breads, high fiber cereals (Raisin Bran, Shredded Wheat, Oatmeal, Fiber-One), brown rice, whole-grain pasta,

WHOLE GRAIN	**NOT SURE**				**VERY SURE**
3 or more servings everyday	○	○	○	○	○

5. Please Fill in the circle to show how sure you can eat **LEAN MEATS, and or LEGUMES** (beans) **or MEAT SUBSTITUTES** (Soy, boca burgers etc.) please fill the circle to show how sure you are that you can eat this amount every day for the next week. Legumes include beans (navy, kidney, pinto, black) lentils, peas (black-eyed peas, split-peas). Servings size for beans is a 1/2 cup cooked. Lean meats include, chicken, fish, poultry ; serving size is 1 oz(see attached list for examples of servings)

Lean Meat & or Beans or Meat substitutes	**NOT SURE**				**VERY SURE**
5 or more servings everyday	○	○	○	○	○

6. For each number of **days listed, please fill in the circle to show how sure you are that you can be physically active for a total of at least 60 minutes per day? (Add up all the time you spend in any kind of physical activity that increases your heart rate and makes you breathe hard some of the time)**

Number of DAYS Per Week	**NOT SURE**				**VERY SURE**
1-2 days	○	○	○	○	○
	NOT SURE				**VERY SURE**
3-4 days	○	○	○	○	○
	NOT SURE				**VERY SURE**
5-6 days	○	○	○	○	○
	NOT SURE				**VERY SURE**
All 7 days	○	○	○	○	○

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