Models of Physical Activity and Sedentary Behavior

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Abstract

This dissertation tested conceptual frameworks for models of physical activity and sedentary behavior based upon social cognitive theory and ecological models. The sample consisted of 527 7th and 8th graders from 3 rural schools in upstate New York. Structural equation modeling demonstrated that there were direct influences of environmental support, intrapersonal factors, parental modeling for physical activity, and physical health to levels of adolescent physical activity. Sedentary behavior was influenced by parental modeling for sedentary behavior and parental encouragement for sedentary behavior. In addition, using a mediating conceptual framework, intrapersonal factors mediated the relationships of environmental support, encouragement, mental health, and physical health to levels of physical activity. Studying physical activity and sedentary behavior should continue to use guided, theory-based approaches with sound statistical designs. This research supported the conceptualization that physical activity and sedentary behavior are not opposite ends of a spectrum, but are distinct behaviors with different factors of influence.

Keywords: physical activity, sedentary behavior, structural equation modeling
MODELS OF PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOR

by

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CHAPTER I

Introduction

Physical activity has been listed as one of the major health indicators for Healthy People 2020 (USDHHS, 2011). However, national indicators of physical activity indicated 63% of adolescents failed to meet national recommendations for moderate to vigorous exercise and still another 21% were completely inactive (CDC, 2010). According to the National Health and Nutrition Examination Survey, the percentage of overweight children 2-19 years old increased from 28.2% in 1999-2000 to 33.6% in 2003-2004, and then decreased slightly to 31.7% 2007-2008 (Ogden et al., 2006; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). As a result of inadequate physical activity and excessive caloric intake, overweight and obesity rates among children and adolescents have increased over the last decade (Molnár & Livingstone, 2000). The recommended amount of physical activity in children and adolescents improves cardiorespiratory and muscular fitness as well as bone health, and contributes to favorable body composition (USDHHS, 2008).

Providing opportunities for physical activity and encouraging adolescents to be physically active are important for increasing potential health benefits (Stensel, Gorely, & Biddle, 2008). Learning and adopting physical activity behaviors early in adolescence is associated with an active lifestyle in adulthood (Anderssen & Wold, 1992). Investigating why and under what conditions children choose to be physically active are important for identifying the opportunities and the barriers for activity. With greater information on the determinants and mechanisms of physical activity and sedentary behaviors, interventions can be developed to target increases in the levels of activity.
Hence, the purpose of this investigation is to examine the environmental, family, and individual level factors that facilitate or hinder physical activity.

In his review of recent advances and challenges to studying physical activity, Dubbert (2002) noted that in the 1990s “there were a number of developments indicating the study of exercise and physical activity had reached a new level of scientific sophistication and importance in public health” (p. 526). During this period our understanding of the psychosocial and environmental correlates of physical activity and the assessment methods for determining physical activity among various groups based on gender, age, and ethnicity was greatly enhanced. A key question raised in the literature in the 1990s was about the conceptualization of physical activity and sedentary behaviors. Researchers proposed physical activity and sedentary behaviors did not represent opposite ends of a spectrum, but represented two distinct domains of behavior (Gorely, Marshall, & Biddle, 2004; Henning Broderson, Steptoe, Williamson, & Wardle, 2005; Lindquist, Reynolds, & Goran, 1999; Marshall, Biddle, Sallis, McKenzie, & Conway, 2002; Wolf et al. 1993; Zakarian, Hovell, Hofstetter, Sallis, & Keating, 1994). Literature in the 1990s indicated adolescents engaged in high levels of sedentary behaviors such as watching TV and movies, using the computer, and playing video games (Owen, Leslie, Salmon, & Fotheringham, 2000). The lower levels of physical activity and the increased levels of sedentary behaviors raised issues. Physical activity and sedentary behaviors were found to be uncorrelated with each other and had different sets of correlates (Gordon-Larsen, McMurray, & Popkin, 2000; Owen et al., 2000). Hence, it has become important to move beyond understanding whether levels of physical activity are related to levels of sedentary behavior and give increased focus to the correlates that impact each
aspect of health behaviors. Still another area of focus suggested by Dubbert (2002) was the need for researchers to pay attention to the physical and psychosocial environment that may influence a person’s choice to be active or sedentary.

Identifying the factors and their mechanisms of influence are critical for increasing the effectiveness of interventions in the area of physical activity. Baranowski, Anderson, and Carmack (1998) reviewed 23 physical activity intervention programs and determined: 1) a substantial number of physical activity intervention programs had little to no impact on physical activity, and 2) demonstrated effects were indicated in some outcome measures, but not in others, or in some subgroups, but not in others. Further, in those programs where behavior modifications were noted, the participants were either volunteers or highly motivated to make changes. The authors were of the opinion that a mediating variable framework provided a systematic way of evaluating the role of theory in interventions and in determining how and why components of the intervention were more effective than others. Baranowski et al. (1998) made 3 overall recommendations for future research (each have several specific guidelines which will not be highlighted in this review): 1. Conduct substantially more basic behavioral and social science research to understand why (or why not) people engage in physical activity, emphasizing the overall predictiveness of the models; 2. Develop programs of research on methods for introducing change in mediating variables, including characteristics of individuals and organizations that make them receptive to change (moderator variables); 3. Develop intervention research that more carefully focuses on understanding mediating mechanisms.
Bauman, Sallis, Dzewaltowski, and Owen (2002) indicated there was also a need for greater clarification and specification in the research of physical activity. In their essay, they emphasized the need to use consistent terminology and outlined the definitions and use of determinants, correlates, causal variables, mediators, moderators, and confounders as applied to physical activity research. They indicated research on physical activity was still in its infancy. Bauman et al. emphasized that although correlational studies were still necessary and important in generating new hypotheses about possible causal relationships or potential mediated or moderated pathways, the importance of using theory to guide the next generation of hypotheses testing could not be overlooked.

Reflecting on a previous review by Sallis and Owen (1999), and including more recent research on the subject, Bauman et al. (2002) identified the correlates of physical activity and the theories used in this line of research. A large number of correlates (15) were consistently related to physical activity, but could not be linked together under a specific theoretical framework. These findings presented a challenge where the solutions required either developing new theories or modifying existing theories so as to better evaluate how specific constructs may influence physical activity behavior. The authors noted that future research may require the development or modification of social-cognitive, behavioral, and ecological theories to help understand the nature, patterns, and correlates of physical activity.

Researchers have utilized a broad spectrum of measurement, qualitative, and statistical analysis tools when researching physical activity (Mâsse, Dassa, Gauvin, Giles-Corti, & Motl, 2002). Mâsse and colleagues outlined four methodological techniques:
qualitative; psychometric; latent-variable structural equation modeling; and multilevel modeling. Similar to Bauman et al.’s (2002) article clarifying the use and definitions, this article suggested that research on physical activity was still in its infancy. Mâsse et al. (2002) stated “these approaches have not been used extensively by scientists interested in physical activity research but hold significant potential for advancing the understanding of physical activity” (p. 44).

Self-report instruments are widely used in physical activity research (Sallis & Saelens, 2000). Through the use of self-reports researchers have the ability to collect data from a large number of participants at a relatively low cost. Self-reports can be used for a variety of age groups and adapted to fit the needs of a particular population or research question. Further, self-reports do not alter the behaviors under study, but make it possible to assess where, when, why, and how physical activity was done (Sallis & Saelens, 2000). A weakness of self-report is social desirability bias, which happens when a person realizes the study is focusing on levels of physical activity and over-reports their activity. Recalling past physical activity is a highly complex cognitive task and it is important the questionnaire is age-appropriate to meet overall demands in terms of time and instructions and ensure reliability and validity (Baranowski, 1988; Sallis & Saelens, 2000). It is important for researchers and participants share a common understanding of the definitions and terms associated with physical activity. For example, in researching physical activity terms like “moderate intensity” versus “vigorous intensity” versus “leisure-time” activity must be clear and precise to insure validity. Appropriate measures can lead to more accurate prevalence estimates, may help to increase comparability
across diverse populations, and guide better evaluations of interventions (Sallis & Owen, 1999).

In a discussion of the future research agenda of physical activity, Sallis and Owen (1999) outlined the following as key areas for future research studies:

1. Determining what types, amounts, and intensities of physical activity are good for health
2. Biological mechanisms of health effects
3. Understanding the psychological effects of physical activity
4. Physical activity measurement
5. Understanding population prevalence and trends
6. Understanding physical activity determinants
7. Influencing individuals to be more active

The current investigation contributes to the field by addressing measurement issues and investigating determinants of both physical activity and sedentary behaviors in a sample of adolescents. The data and conclusions may help adolescents become more active and help with the development and evaluation of potential community interventions. “There is much scope for additional determinants research on physical activity, with a priority on examining factors that influence … readiness to be more active, and the ways in which environmental and structural factors may influence both sedentary behaviors and physical activity participation” (Sallis & Owen, 1999, p. 180).

The primary objective of this study is to investigate the environmental barriers/facilitators, family supports, and social cognitive determinants to be active or sedentary.

In an effort to advance the field of physical activity research, this study investigates environmental factors such as availability and quality of recreational facilities; family factors such as encouragement and parental modeling of physical
activity; and social cognitive factors like self-efficacy and attitudes toward physical activity. In addition this study advances our knowledge related to sedentary behavior patterns of adolescents. Determining the level of adolescent sedentary behaviors and why adolescents engage in sedentary behaviors versus physical activity will be important information for designing future interventions. Lastly, this study contributes to the field by testing both moderator and mediator effects based on ecological and social cognitive frameworks. The use of structural equation design versus correlational methods allows for the examination of multiple variables within one comprehensive model. The specific proposed models and relevant hypotheses are discussed later in this report following the literature review and the proposed conceptual framework.
CHAPTER II

Literature Review

In this section of the document, the extant literature on physical activity and sedentary behaviors will be reviewed. Particular attention is given to the constructs of environmental support, family support, attitude and self-efficacy as they relate to physical activity and sedentary behaviors.

Physical Activity

Physical activity is defined as any bodily movement produced by skeletal muscles resulting in energy expenditure above the basal level (Biddle, Sallis, & Cavill, 1998; Casperson, Powell, & Christensen; 1985; Cavill, Biddle, & Sallis, 2001; Kohl & Hobbs, 1998). Research on the determinants of physical activity in young people from a public health perspective is relatively new (De Bourdeaudhuij, 1998; Sallis et al., 1992).

Previously, physical activity research focused on adults under the assumption they were most at risk of having ill health effects from physical inactivity. The main reasons for an emphasis on researching physical activity patterns in children and adolescents are:

- Not all children exercise enough for health (Armstrong, Balding, Gentle, & Kirby, 1990; Davies, 1992; Kemper, 1994); an awareness that diseases related to sedentariness in adults, such as obesity, cardiovascular problems, osteoporosis and some types of cancer, originate in childhood (Frerich, Webber, Voors, Srinivasan, & Berenson, 1979; Sallis et al. 1992); the increase in prevalence of childhood obesity, due to a likely imbalance between energy expenditure and energy intake (Craig, Goldberg, & Dietz, 1996); and the widespread assumption that health-enhancing physical activity patterns in adults are established in youth (Blair, Clark, Cureton, & Powell, 1988; Simons-Morton et al., 1990; Stucky-Ropp & Delorenzo, 1993). (De Bourdeaudhuij, 1998, p.98)

Researchers have noted that there are difficulties in showing evidence for clear health-enhancing effects of physical activity in this age group, but emphasize the importance of knowing more about the factors associated with physical activity and how
to change the low level of participation (Biddle, Whitehead, O'Donovan, & Nevill, 2005; Riddoch, 1998). Studies involving adolescent physical activity have focused on behavioral, social, and environmental correlates. To date, there have been a number of literature review articles, meta-analyses, and books published summarizing the field (Ball, Timperio, & Crawford, 2006; Baranowski et al., 1998; Biddle et al., 1998; Biddle et al., 2005; Davison & Lawson, 2006; Gustafson & Rhodes, 2006; Kohl & Hobbs, 1998; Pugliese & Tinsley, 2007; Sallis & Owen, 1999; Sallis, Prochaska, & Taylor, 2000). These reviews along with other research articles on the subject will be discussed in this literature review.

Sallis and Owen (1999) outlined the need to develop theories, models, and hypotheses to help researchers focus on the specific variables believed to be the most highly related to adolescent physical activity. They outlined the intrapersonal, social, and physical environment constructs along with the major theories and models applied in studies of physical activity. Some of the theoretical perspectives used in this area include: the Health Belief Model (Becker & Maiman, 1975); the Theory of Planned Behavior (Ajzen, 1985); the Transtheoretical Model (Prochaska & Marcus, 1994); Social Cognitive Theory (Bandura, 1986); and ecological models (Sallis & Owen, 1997; Stokols, 1992). These authors indicated their preference for “broader” theories including social cognitive theory and ecological models, which encompassed the influence of intrapersonal, social, and physical variables on physical activity (p. 113).

The authors also emphasized the importance of identifying modifiable and non-modifiable variables. The non-modifiable variables are important because they could help identify groups at risk for inactivity, whereas the modifiable variables are important to
target in intervention designs. In studies done on physical activity of children, age and sex were identified as the two important non-modifiable variables with physical activity declining with age and boys consistently reporting more activity than girls. Modifiable variables of interest include self-efficacy, perceived barriers/benefits, parental influences, peer influences, outdoor opportunities for play, school physical education, and community programs.

Sallis, Prochaska, and Taylor (2000) reviewed 54 studies that investigated the correlates of physical activity in children and adolescents. The studies were coded on the following characteristics: sex, age, and ethnicity of the sample; study design; quality of physical activity measure; and association of variable (related or not related to physical activity based on statistical significance); and direction of association. Sallis et al. used a sample of papers ranging in publication dates from 1976-1999 (76% of the studies were published in the 1990’s). The authors found that a cross-sectional design was employed by 79.5% of the studies.

The review format used by Sallis et al. (2000) has been used as a template for other reviews of literature (Biddle et al. 2005; Davison & Lawson, 2006; Gustafson & Rhodes, 2006). In a review of environmental correlates published between 1990 and 2006, Davison and Lawson (2006) found that 31 out of 33 (94%) studies used cross-sectional designs. Biddle et al. (2005) in a review of papers published between 1999 and 2003 on the subject of physical activity among adolescent girls found 80.4% of the studies used cross-sectional designs. Finally, in a study of various parental correlates and physical activity by children and adolescents, only 5 out of 34 studies (15%) were found to use longitudinal designs (Gustafson & Rhodes, 2006). Similar to other fields
investigating human behavior, the lack of longitudinal studies in the field is a weakness in the investigation of physical activity.

The role of race and ethnicity in studies on physical activity is unclear. In their review, Sallis et al. (2000) noted that in studies conducted with children (ages 3-12), 30% of studies only included participants from one race (specifics as to race studied not provided), 26% did not report the race or ethnicity of the participants, and only one out of the 54 studies reported racial/ethnic differences in associations with physical activity. In studies conducted with adolescents, 57% of studies only included participants from one race (again specifics not provided), 9% did not report ethnicity, and only 7% reported associations separately by race or ethnicity. The only conclusion that could be reached was that adolescent non-Hispanic whites were more physically active than any other group. This review also found that socioeconomic status (SES) was not related to levels of physical activity, and indicated that SES was not included in many studies. The authors contended it would be valuable for studies to report on subgroups that differed on physical activity levels based on ethnicity, SES, and environmental characteristics (urban vs. rural).

Gustafson and Rhodes (2006) found that only 7 out of 34 reviewed studies examined ethnicity and more importantly none of these studies explained the mechanisms for the underlying ethnic differences found in adolescent physical activity. The authors indicated that it was possible that the differences in physical activity may have been due to SES than ethnicity. From the seven studies, no conclusions could be made regarding ethnicity and adolescent physical activity. However, in the review by Biddle et al. (2005) ethnicity classified as “white” was associated with higher levels of physical activity,
although the effect sizes were small. Higher family income/SES was associated with higher physical activity, but with a moderate effect size. Dubbert (2002) emphasized the need for researchers to improve measures appropriate (valid, reliable) for ethnic and cultural minorities. Also, if ethnicity is a determinant of physical activity, theoretical basis for its mechanism needs to be established. Further, common terminology clarifying ethnicity versus race must be a point of emphasis. The role of ethnicity is still an “under-explored” area of adolescent physical activity research (Gustafson & Rhodes, 2006).

Pugliese and Tinsley (2007) utilized a meta-analytic technique of analyzing the association between parental behaviors (modeling, encouragement, instrumental support, parent work habits, and general support) and child/adolescent physical activity. They found that encouragement, instrumental support and modeling behaviors had significant positive relationships with child and adolescent physical activity. The type of parental socialization behaviors, the age of the children/adolescents, the reporting method, and the sampling technique moderated the overall effect between parental socialization and physical activity. For example, the effect of parental modeling on child physical activity was moderated by participants’ age. The relationship between parental modeling and early adolescents’ physical activity was significantly lower than that of children and older adolescents. One explanation for this finding could be that parents are not salient models of behavior for this particular age group with peers possibly exerting greater influence. In addition, this meta-analysis found statistically significant differences by the methodology used in different studies. Having a parent or third party report on parental behavior (encouragement, modeling, and logistic support) yielded higher effect sizes than just the child or adolescent reporting parental behavior. Pugliese and Tinsley (2007)
contended that “youth appear to have discrepant perceptions compared to those of parents concerning the extent to which parents are engaging in these behaviors, possibly leading to significant youth underreporting of their magnitude or frequency” (p. 341).

Finally, it is important to note that the field has overwhelmingly relied on the use of correlation and regression techniques. Researchers have been recommending more advanced statistical designs based on theoretical hypotheses (Baranowski et al. 1998; Bauman et al. 2002; Mâsse et al., 2002). Mâsse et al. contended, “filling in the gaps in the literature also will require the judicious application of a broader array of measurement, qualitative, and statistical analysis tools. These approaches have not been used extensively by scientists interested in physical activity research, but hold significant potential for advancing the understanding of physical activity” (p. 44). The essay outlined that advancements in understanding physical activity behavior would only be achieved through the integration of theory, valid and reliable measurement tools, and advanced statistical design.

**Sedentary Behaviors**

Sedentary behaviors are a potential contributor to overweight or obesity among adolescents (USDHHS, 2011). Sedentary behaviors can be identified by their low metabolic equivalent (MET) intensity levels where the MET < 2 (Ainsworth et al., 2000). Common sedentary activities include watching television and videos, using the computer, reading, listening to music, relaxing/resting, and talking on the telephone. The Healthy People 2020 guidelines recommend 2 hours or less of television viewing time on school days for adolescents (USDHHS, 2011). The Healthy People 2020 report estimated that 21% of children age 6-14 watch television for more than 2 hours a day (National Survey
Whereas, 33% of student in grades 9-12 watched more than two hours of television time per day (YRBSS, 2009). The Healthy People 2020 goal objectives suggest television viewing for each age group should decrease by 10%. Norman, Schmid, Sallis, Calfas, and Patrick (2005) found on average adolescents engage in sedentary behaviors such as television for approximately 5 hours per day. Investigating levels of sedentary behaviors are important because one argument for children not exercising is that they do not having enough time to do so. Clearly, if children spend multiple hours watching television it demonstrates there is enough time in a day to exercise, but that adolescents are possibly showing a preference for sedentary behaviors over physical activity. Dietz (1996) indicated that sedentary behaviors are understudied and are associated with adverse health consequences and that “successful reductions in inactivity may provide the most cost-effective approach to the treatment of obesity and prevention of cardiovascular disease” (p.836).

Studies on sedentary behaviors can be organized into the following categories: 1) research of sedentary behaviors as a correlate/determinant of physical activity in which physical activity is the outcome variable and sedentary behaviors are shown to influence (or not influence) physical activity; 2) research of the correlates of sedentary behaviors in which sedentary behaviors are influenced by certain factors (e.g. environment, access, SES). Previous research involving sedentary behaviors have demonstrated equivocal findings. Trost, Kerr, Ward, and Pate (2001) investigated the hours spent watching television/playing video games as a potential deterrent for physical activity in an obese versus non-obese sample. Findings indicated that non-obese participants watched more than 3 hours/day (61.1% vs. 53.4%). However, the non-obese participants also recorded
significantly higher levels of moderate and vigorous activities. Zakarian, Hovell, Hofstetter, Sallis, and Keating (1994) also found no significant association between hours of television watched and levels of vigorous exercise in a study of 9th and 11th grade adolescents. Trost et al. (2001) did not address the inconsistency of having higher television viewing in the non-obese group; whereas Zakarian et al. (1994) noted that the lack of relationship between watching television to vigorous exercise/physical activity may be explained by the fact that most television viewing occurs in the evening while most physical activity occurs during the day.

Other researchers have suggested that physical activity competes with time spent on sedentary behaviors such as watching television as a behavioral choice. This competition for time is termed the “displacement” or “couch potato” hypothesis (Dietz, 1996; McElroy, 2008; Vandewater, Shim, & Caplovitz, 2004). In a qualitative study on the correlates of physical activity (Dwyer, Allison, Goldenberg, Fein, Yoshida, & Boutilier, 2006), involvement in technology-related activities was a prominent theme as a barrier for participating in physical activity. The authors noted that it was really not a matter of time availability, but greater preference for one activity over the other. The sample of adolescent girls preferred to spend time on the phone, computer, or watching TV, as opposed to engaging in physical activity. However, Feldman, Barnett, Shrier, Rossignol, and Abenhaim (2003) found that time spent watching television and playing video games was not associated with decreased physical activity. Further, they differentiated productive sedentary behaviors (working on computer, reading or doing homework) and unproductive sedentary behaviors (playing video games and watching television).
television) and found that students who spent more time in productive sedentary behaviors tended to be more physically active.

Three studies (Delva, Johnston, & O’Malley, 2007; Gillis, Kennedy, & Bar-Or, 2006; Vandewater et al., 2004) found significant relationships between TV viewing and weight with heavier participants indicating higher levels of sedentary behavior. Delva et al. (2007) found that being at or above the 85th percentile for BMI was positively associated with the number of hours of TV watched per day. Television viewing remained significant in the multivariate model for both boys and girls who were at or above the 85th percentile for BMI. Similarly, Gillis et al. (2006) found that participants above the 75th percentile watched significantly less TV than those above the 95th percentile. However, Vandewater et al. (2004) found that television use was not related to children’s weight status, but video game use was related to children’s weight status. Interestingly, children with higher weight status played moderate amounts of video games, but children with lower weight status either played very little or a lot of video games.

Another body of research investigated sedentary behaviors not as a correlate of physical activity, but as a domain separate from physical activity with its own determinants. Researchers (Gorely et al., 2004; Henning Broderson et al., 2005; Lindquist et al., 1999; Marshall et al., 2002; Zakarian et al., 1994; Wolf et al. 1993) have indicated that sedentary behaviors were generally uncorrelated or weakly correlated with physical activity among youth. It was also reported that the determinants of inactivity are distinct from those of physical activity (Gordon-Larsen, et al., 2000; Schmitz et al., 2002). In a study on patterns of sedentary behaviors, Zabinski, Norman, Sallis, Calfas,
and Patrick (2007) found sedentary behaviors clustered into 4 different types (low, medium, selective high, and high). The clusters were determined by the type and duration of the sedentary behaviors. The clusters also differed significantly by physical activity levels. For example, the low sedentary group and the selective high sedentary group had the highest average of minutes/day of moderate and vigorous physical activity, which differed significantly from the medium cluster of sedentary behaviors.

Sedentary behaviors and physical activity have also been studied as separate domains from the behavioral choice theoretical (BCT) point of view (Salmon, Owen, Crawford, Bauman, & Sallis, 2003). This study found that participants who reported cost and personal barriers (e.g., work commitments, tired) were less likely to be physically active. The preference for sedentary behaviors was associated with the decreased likelihood of being physically active, and inclement weather as a barrier to physical activity was associated with the increased likelihood of sedentary behaviors. The authors emphasized that the environmental barriers of inclement weather was associated with increased participation in sedentary activities, but was not associated with self-reported levels of physical activity. Whereas, the Salmon et al. (2003) study sampled adults, Gordon-Larsen et al. (2004) found a similar result with mother-daughter dyads in a qualitative study. They found a clear preference for sedentary activity with girls. Girls indicated that they did not want to play outside and preferred to watch TV. They also found a perceived lack of recreation-related facilities in the neighborhoods was not conducive to an active lifestyle.
Ecological, Family, and Individual Correlates of Physical Activity and Sedentary Behaviors

In this section of the review, the role of the physical environment (i.e., quality and access), family support (i.e., encouragement), and individual characteristics (i.e., self-efficacy, health) in relation to physical activity and sedentary behaviors will be examined.

**Environmental Factors**

An ecological perspective of physical activity considers the physical environment both as a potential contributor and a barrier to physical activity. Sallis (1993) conceptualized the opportunity for physical activity as the availability of relevant facilities, supplies or programs. Sallis, Bauman, and Pratt (1998) conceptualized a supportive environment as settings (e.g., neighborhoods, schools, worksites), facilities (e.g., health clubs, parks, paths), and programs (e.g., classes, teams, clubs, supervised recreation). Wold and Hendry (1999) emphasized the need to study the types of exercise facilities and the distance to facilities as possibly influencing levels of physical activity. Kahn et al. (2002) also noted several research issues regarding the effectiveness of environmental interventions. For example, does effectiveness vary by type of access (school facilities versus neighborhood facilities)? Does creating or improving access motivate people to become active or more active? Which neighborhood features (e.g., safety, sidewalks, proximity) are the most crucial in influencing activity levels? And simply, if “if you build it, will they come", is enhanced access enough to raise activity levels or are other supports and interventions needed? Booth et al. (2001) noted that the primary influences on physical activity included: public recreation facilities; commercial use of school facilities; physical activity promotion policy; after school physical activity
programs; physical education class availability; youth sports; “walkable” communities; physical education class content and training; crime and perceived safety; and sedentary stimuli for leisure. These are important questions that could guide communities to make sound economic decisions regarding increasing physical activity levels.

In a qualitative study assessing perceived barriers to participation in physical activity adolescent girls reported not using facilities they felt were unsafe (Dwyer et al., 2006). For example, they did not use a local basketball court because it was a “hang-out for gangs” (p.82). Another girl remarked “If you have a community center, if it’s got a bad name, you don’t want to go there. That’s because you don’t know what’s going to happen to you. If you go there someone is going to hurt you or something” (p.82). In contrast to Dwyer et al. (2006), Sallis et al. (2000) and Mota, Almeida, Santos, and Ribeiro (2005) found that neighborhood safety was unrelated to the level of physical activity. In another study of 8-10 year old African-American girls (Adkins, Sherwood, Story, & Davis, 2004), no associations were found between the girls’ activity levels and perceived neighborhood safety (reported by parent and female child). Interestingly, the questions regarding neighborhood facilities and their safety only asked whether the respondents thought that their neighborhoods were safe, but not whether they actually used the facilities. This study did not assess accessibility or costs which may have prohibited the use of neighborhood facilities.

In a review of correlates of physical activity, Sallis et al. (2000) found that access to facilities and programs and time spent outdoors were positively and consistently related to children’s physical activity. Dwyer et al. (2006) also found that inaccessibility and the cost of using facilities were barriers to adolescent girls’ physical activity. The
results of both studies emphasized the importance of providing environmental supports for activity. Both studies also indicated that promotion initiatives should focus on increasing the availability and accessibility of facilities and to get children outdoors where they could be active. In the study by Mota et al. (2005), the only variables associated with the level of physical activity were (a) the perceived amount of recreation facilities (asked by the question, “My neighborhood has several public recreation facilities such as parks, walking trails, bike paths, recreation centers, playgrounds, public swimming pools, etc.”, p. 835) and (b) the aesthetics of neighborhoods (asked by the question, “There are many interesting things to look at while walking in my neighborhood”, p.835). Mota et al. suggested that socio-economic status may be a variable of interest when researching neighborhood facilities because more affluent communities may have more (and better quality) facilities than the less affluent ones.

In a review of potential correlates of physical activity, Kohl and Hobbs (1998) also made the argument that the time spent outdoors was strongly related to physical activity but that an important environmental determinant may be the physical safety of neighborhoods. This review cited statistics from the 1993 YRBSS regarding student safety concerns. For example, 4.4% of students missed at least one day of school because they felt unsafe at school or traveling to and from school, and 41.8% had been in a fight in the past 12 months (Kann, Warren, & Harris, 1995). According to the most recent YRBSS data, 5.5% of students had missed at least one day of school because of safety reasons, and 35.5% had been in a fight in the previous 12 months (Eaton, Kann, Kinchen, Ross, Hawkins, Harris, et al., 2008). Kohl and Hobbs (1998) indicated that these factors may reduce motivation or be barriers to physical activity either by the decision of parents
or students themselves. It is possible that the null findings obtained in the study by Mota et al. (2005) regarding safety and physical activity may be due to questionnaire or method issues. It may also be possible that adolescents feel comfortable in organized events or activities with parental supervision. However, when it comes to unsupervised activities like walking to school or at a neighborhood playground, they may feel unsafe.

Powell, Chaloupka, Slater, Johnston and O’Malley (2007) researched the association between the availability of commercial physical activity related facilities and self-reported physical activity behavior. Using an economic and ecological model they hypothesized that physical activity behaviors are affected by preferences and are also constrained by income and the total cost of goods (price and other costs related to access). The ecological model highlighted the access and availability of opportunities in the neighborhood as influencing physical activity behaviors. One of the salient findings was the increasing availability in the number of commercially owned facilities from low (1) to high (8). This was associated with a 2.4% increase in frequent physical activity for 12th-grade girls and a 6.4% increase for 12-grade boys. Accounting for the number of facilities, a $10,000 increase in per capita income was associated with a 1.75% increase in frequent physical activity (total sample). The authors noted that much of the estimated associations with the number of commercial facilities to the level of physical activity were substantially reduced when per capita income was controlled. There was a lower density of commercial facilities oriented toward physical activity pursuits in low-income neighborhoods. One weakness of this study was the inclusion of commercially owned facilities and not parks or other public outdoor facilities. However, it is possible there is
also a greater concentration (or greater quality) of public facilities in more affluent neighborhoods.

Motl, Dishman, Saunders, Dowda, and Pate (2007) included environmental variables and their complex relationship with physical activity. This study investigated self-efficacy as a mediator of the relationship between the effects of perceived equipment accessibility, neighborhood safety, social support and physical activity. Using social cognitive theory, the study reasoned that environments lacking in accessible equipment or perceived unsafe may be negatively associated with self-efficacy, and this in turn was related to lower levels of physical activity. There were no direct effects from equipment accessibility or safety to physical activity, but there were direct effects from social support to physical activity and barriers self-efficacy to physical activity.

Bauman et al. (2002) discussed the importance of clarity and consistency with use of the terms moderator and mediator in studies of physical activity. Their essay was divided into four sections: 1) a description for the criteria for causal relationships; 2) definitions for key terms and examples; 3) investigation of correlates of physical activity and linking it back to theory; and 4) application of mediator/moderator concepts. This article contended that “studying mediating processes or third variables that influence the relationship between interventions and physical activity should allow for the continued application of existing behavioral theories as well as examining the roles of new environmental factors and less theoretically oriented personal and behavioral variables” (p.12).

The authors suggested that environments could function as mediators or moderators of physical activity. For example, a neighborhood may add a walking trail,
which could directly stimulate physical activity; however, perceptions about the trail could also mediate the effects of the change. Knowledge of the trail’s existence could be a moderator in the equation. For example, those who know of the trail’s existence could be the ones using the trail. The analysis of mediators and moderators could test the “if you build it, will they come” paradigm. There may be an interaction between the implemented environmental change and individual psychosocial variables that leads to the behavior change. Bauman et al. (2002) contended that these complex interactions needed further investigations so as to create effective interventions for increasing physical activity.

Sallis et al. (2001) used an ecological model to investigate the level of physical activity in schools with the criteria of adequate space, facilities, equipment, and supervision to stimulate physical activity. Both boys and girls were more active when there was high supervision. Environmental characteristics explained 42% of the variance for girls and 59% of the variance for boys in non-PE physical activity in the school setting. However, findings suggested that a low rate of students were physically active during unstructured time in the school setting: fewer than 2% of the girls and 6% of the boys. The authors contended that it was not clear how much further improvements in the school environment would enhance participation. It was possible that there were barriers to students who were choosing not to participate in non-PE physical activity in the school setting.

Trost et al. (1997) measured the activity level during specific blocks of time (in 30-minute intervals). Boys reported 3.7 ± 1.9 thirty-minute blocks and girls reported 2.6 ± 1.7 thirty-minute blocks of moderately vigorous physical activity. So on average,
students engaged in moderate vigorous activity for about 1 ½ hours a day. This activity level meets the American College of Sports Medicine’s recommendation for an hour of physical activity per day. Trost et al. also found that of the environmental variables, participation in community sports was the strongest predictor of vigorous and moderately vigorous activity for girls (8% and 10% of the variance, respectively). The model accounted for approximately 7% of the variance among boys. Participation in community sports was the only environmental variable that showed significance in the regression equations. The authors suggested that facilitating greater access to community-based physical activity outlets (e.g. YMCA programs, recreation clubs/sports teams) to increase activity levels.

Participants in the previously mentioned studies who chose to be inactive did so for a reason. Proponents of the ecological model contended that multiple aspects of the environment may influence physical activity, but that more research was needed to assess environmental barriers and facilitators of physical activity (Sallis, Kraft, & Linton, 2002). In an essay discussing the integration of theoretical approaches for promotion of physical activity, Epstein (1998) reinforced that the cost of being physically active was related to the accessibility of physical activity, which in turn was correlated to activity levels. In a study of male college students (Raynor, Coleman, & Epstein, 1998), the groups were varied by the proximity (same room versus 5-minute walk) of sedentary and physical activities. When sedentary activities were near and the physical activities distant, the participants chose sedentary activities. However, when the physical activities were near and the sedentary activities were distant, the participants spent the time engaged in
physical activity. Epstein contended that increasing the distance for sedentary activities would prompt people to be more active.

An example of research highlighting peoples’ choices in physical activity and sedentary behaviors was the stairs versus escalator sign prompt studies (Blamey, Mutrie, & Aitchison, 1995; Brownell, Stunkard, & Albaum, 1980). In these studies, a heart healthy sign was posted at the choice-point between the escalator and the stairs. Participants use of the stairs doubled and remained doubled over the period of 15 days. The use of the stairs decreased when the sign was removed. These results showed that prompts such as signs may alter peoples’ behavior to be more active. Epstein (1998) explained that from the perspective of Behavioral Choice Theory environmental changes increased the proximity and convenience of physical activity and decreased the access to sedentary activities, thereby leading to an increase in physical activity.

Many of the previously mentioned studies have investigated observed physical activity and assessed environmental supports. A study by Hume, Salmon, and Ball (2005) evaluated the children’s own perceptions of their environment in multiple settings while also assessing their participation in physical activity. Using two qualitative techniques of map drawing and photographic mapping, students were instructed to draw and take pictures of places and things in their home and neighborhood environment that were important to them. The themes that emerged were: 1) the family home; 2) opportunities for physical activity and sedentary pursuits; 3) food items and locations, at home and in the neighborhood; 4) green space and outside area, at home and in the neighborhood; 5) the school; 6) and opportunities for social interaction. From the themes, 11 variables were derived for quantitative analysis with physical activity.
measurements. Sedentary behaviors and vigorous intensity activity were not associated with any environmental constructs for girls. However, low intensity activity was positively associated with the physical activity opportunities in the neighborhood for girls. There were also no associations with environmental constructs for boys for low or moderate activity. Counter-intuitively, opportunities for sedentary behavior showed a positive association with vigorous activity and an inverse association with time spent sedentary. These findings contradicted the findings by Raynor et al. (1998) that proximity to sedentary pursuits would lead to choosing those options. Hume et al. acknowledged that their methods and small sample size (n=147) may have contributed to the lack of significant associations.

Family Environment

In addition to physical environmental supports (e.g., facilities, parks), the family environment affects levels of physical activity and sedentary behavior. Two aspects of the family environment are relevant in studies of physical activity. They include – parental encouragement and parental modeling.

Parental Encouragement.

Parental encouragement refers to the verbal or nonverbal forms of encouragement for physical activity (Welk, 1999). Studies mentioned previously in this review have included questions pertaining to encouragement as part of an overall construct of parental support (Adkins et al., 2004; Beets, Vogel, Chapman, Pitetti, & Cardinal, 2007; Duncan, Duncan, & Strycker, 2005; Prochaska, Rodgers, & Sallis, 2002; Saunders, Motl, Dowda, Dishman, & Pate, 2004; Trost et al. 2003).
Anderssen and Wold (1992) subdivided parental encouragement into – (a) direct help (logistic support) and (b) perceived value of physical activity. Logistic support refers to factors associated with facilitating physical activity for a child, for example, providing transportation to events or paying enrollment fees for activities (Davison, Cutting, & Birch 2003; Davison, Downs, & Birch, 2006; Hoefer, McKenzie, Sallis, Marshall, & Conway, 2001). In labeling the variable “direct support”, Anderssen and Wold (1992) asked questions pertaining to the frequency (times per week) significant others (mother, father, friends) encouraged the child to participate in fitness-related exercise and encouraged the child to exercise vigorously. For boys, direct help from parents to exercise vigorously, physical activity level of the best friend; and support (encouragement) in exercising vigorously from parents was strongly related to increased physical activity. For girls, direct help from parents to exercise vigorously and physical activity level of the best friend was strongly related to increased physical activity. Boys reported significantly higher levels of direct support for fitness-related exercise from the father and higher levels of direct support to exercise vigorously from both parents. Although there were no gender differences in the amount of direct help for exercising vigorously, girls received less support for fitness-related exercise than boys, but when girls became highly active, they got the support and encouragement they needed. It is possible that these relationships are also bi-directional. It is very possible that highly active adolescents elicit more encouragement from their parents.

Biddle and Goudas (1996) assessed children’s perceptions of the frequency and intensity of encouragement from their parents and teachers for participation in sports and physical activities in their leisure time. Using structural equation modeling techniques, it
was found that adult encouragement directly predicted intention to exercise and strenuous activity by the child. There was also an indirect path from adult encouragement through perceived sport competence to strenuous physical activity. It appears encouragement may both directly and indirectly (by increasing perceived competence) increase physical activity.

In a longitudinal study using a mediated model, DiNallo, Savage, and Downs (2007) investigated the relationships between encouragement, physical activity, and body satisfaction. Results showed that physical activity mediated the relationship between father’s encouragement and body satisfaction one year later. Girls who had higher encouragement from fathers had higher physical activity levels and higher levels of body satisfaction. Mother’s level of encouragement was not associated with higher levels of physical activity. In comparing these findings to Anderssen and Wold’s (1992) research, where boys received more direct support (encouragement) for fitness-related exercise from their fathers, it is possible that fathers offer more encouragement than mothers.

Results from a qualitative study by Dwyer et al. (2006) indicated that parents’ lack of encouragement was a barrier to physical activity. The following statements offer examples of the family being more supportive of sedentary pursuits.

“Some explained that their parents prefer them to be at home and to do homework, rather than physical activity. Other participants said that their parents not only do not encourage them but also discourage them from engaging in physical activity. For example:

“I also think parents come into it too because I wanted to take gym this year and you have to have a form your parents sign that says it’s okay to take these courses. But my dad didn’t want me taking gym. He thought that business courses were more important than gym.”
Similarly, another participant stated that she had to convince her parents to allow her to participate in physical activity. Another said, “Now that I’m older, I can’t just do what I want to do - play with my friends, go out, play sports. My father says I should be older and ‘settle down’.” (p.81).

Regarding the differing levels of encouragement provided by parents, it is important to note that two of the above examples specifically mention the father as being the one who judged the worthiness of the physical activity. In one scenario, physical activity is of little value and the father was of the opinion that business courses were more important than physical activity. In the other scenario, the father encouraged physical activity when the girl was younger but as the girl child grew older, he did not feel that it was appropriate. These scenarios are relevant especially in light of the fact that parents have been shown to be instrumental in increasing levels of activity (Anderssen & Wold, 1992; DiNallo et al., 2007). It is possible they may be responsible for inhibiting levels of physical activity as well.

**Parental modeling.**

Parental modeling refers to parents' efforts to model an active lifestyle to their children (Welk, 1999). Modeling is thought to promote self-efficacy (confidence in one’s ability to perform a behavior) and also informs children of what is important or valued (Bandura, 1997). The most extensively studied social influence on youth physical activity is parent activity habits (Sallis & Owen, 1999). The hypothesis rather simplistically states that active parents have active children. The results from these studies are mixed (Sallis et al., 2000).

In a review of correlates of physical activity (Sallis et al., 2000), parental physical activity level was found to be positively associated with child physical activity in 11
studies for children between 4-12 years. However, in 13 studies conducted with this age group parental physical activity was unrelated to children’s physical activity. For adolescents (13-18 years), parent physical activity was positively associated with adolescent physical activity in 9 studies, but unrelated in 18 studies. The authors contended that there may be some situations where parental modeling may be an important influence. The authors noted that the diversity of the variables, measures, subject samples, and analytic strategies may have accounted for the discrepancy in the findings across studies.

Kimiecik and Horn (1998) found no relationship between parents’ self-reported exercise behavior and their children’s self-reported moderately-vigorous physical activity. The authors indicated in general, studies that used self-report physical activity measures have found insignificant or weak parent-child physical activity correlations (Dempsey, Kimiecik, & Horn, 1993; McMurray et al., 1993; Sallis, Buono, Roby, Micale, & Nelson, 1993; Sallis, Alcaraz, et al., 1992), whereas studies that used more objective assessment procedures, such as the Caltrac accelerometer, have found a moderate-to-strong relation between parent-child physical activity patterns (Freedson & Evenson, 1991; Moore et al., 1991).

Three studies investigated the role of parental modeling as it related to obese children, with two using a mixed obese/non-obese comparison group (Fogelholm, Nuutinen, Pasanen, Myöhänen, & Säätelä, 1999; Kalakanis, Goldfield, Paluch, & Epstein, 2001), and one using a sample of obese children who were seeking treatment (Trost, Kerr, Ward, & Pate, 2001). Using an objective measurement technique with TriTrac® accelerometers on both parents and children, Kalakanis et al. (2001) found parents’
activity levels significantly and independently predicted and improved the prediction of
the child’s physical activity level and the number of moderately-vigorous physical
activities beyond any other determinant in this study (age, gender, SES, and the
percentage of overweight by the parent and the child).

Fogelholm et al. (1999) used parental and child self-reports of activity levels and
found that parent inactivity was a strong and positive predictor of child inactivity.
Broken down by parent-child dyad pairs, the mother-son (0.47) followed by the father-
son (0.38) demonstrated the highest correlations. In regards to vigorous physical activity
and physical activity, the mother-daughter correlation was the highest (0.28), followed by
the father-daughter (0.24), and then the mother-son (0.20). The father-son correlation
was insignificant for each category. What these results potentially demonstrated was that
parents may model sedentary behaviors more strongly than they model active behaviors.
It also indicated active children may be active for other reasons than their parents’
modeling of active behaviors. For example, the boys in this study were vigorously
active, but the correlations between their levels of physical activity and their parents’
activity levels were lower than for girls. Explanations could be that modeling of active
behaviors was more important for girls than for boys who may have received support in
other ways to be active (i.e. encouragement).

Trost et al. (2001) found perceived parent physical activity was strongly and
positively related to child physical activity; however, obese children were significantly
less likely to report their fathers or male guardians were physically active. Fogelholm et
al. (1999) found parental activity levels did predict children’s physical activity levels and
obese children may be impacted by their fathers' inactivity.
Davison et al. (2003) examined mother-daughter and father-daughter modeling relationships in a sample of 180 nine-year-old girls. They divided parental support variables into logistic support (transportation, paying of fees) and explicit modeling. Explicit modeling was conceptualized as “parents were intrinsically motivated to be active and intentionally used their behavior to encourage their child to be active” (p.1590). The results showed fathers reported significantly higher levels of explicit modeling than mothers. Mothers reported significantly higher levels of logistic support. Fathers’ explicit modeling and mothers’ logistic support were independently associated with higher levels of physical activity among daughters. Davison et al. noted that logistic support and modeling explained only a small amount of the variance (12%) in girls’ physical activity.

Vilhjalmsson and Thorlindsson (1998) investigated others’ physical activity (father, mother, older brother, older sister, best friend, and main teacher) and their effect on the adolescent’s physical activity. Consistent with previous findings, higher activity levels were positively correlated with the activity levels of the mother, father, older brother, and best friend. The older sister’s and main teacher’s activity levels were not significant predictors of adolescent physical activity. Fathers and the older brothers’ activity levels were related to higher activity levels. Friends’ physical activity interacted significantly with emotional support to predict adolescent physical activity suggesting that friends’ physical activity was inconsequential when the emotional support was low. When emotional support was high, friends’ physical activity positively affected the adolescents’ physical activity. The authors contended that modeling effects were
dependent on the agent (father vs. sister) as well as the context (emotional vs. non-emotional).

Using structural equation modeling, Trost et al. (2003) showed parental activity was important for child physical activity, but the model was impacted more by parental support. Trost et al. (2003) found age, gender, parental enjoyment of physical activity, parental importance of physical activity, and actual parent activity were all significantly and positively related to parental support (encouragement, transportation, watching child, doing activity with child, and telling child physical activity is good for his or her health). Parental support was positively and significantly associated with child physical activity and child self-efficacy. Child self-efficacy was also positively and significantly related to child physical activity. Age and gender of the parent were the only direct paths to child physical activity. Parental enjoyment, parental importance, and parental activity did not directly influence child physical activity. It appears from this study that it is not enough for parents to be active and to feel physical activity is important, it is also necessary for parents to provide support in the form of transportation and encouragement. In addition to parental modeling, other factors impact parental support, suggesting if a parent is more active, the level of support provided to the child may also increase.

**Intrapersonal Factors**

Intrapersonal factors are conceptualized as a multi-dimensional construct consisting of the adolescent’s attitudes toward physical activity and sedentary behaviors as well as self-efficacy.
Attitudes.

Attitude is commonly defined as an individual’s favorable or unfavorable evaluation of an object or target behavior (Ajzen, 1991; Eagly & Chaiken, 1993; Hagger & Chatzisarantis, 2008). Attitudes may be viewed as multi-dimensional with affective (emotional), instrumental (cognitive), and functional (behavioral) aspects (Hagger & Chatzisarantis, 2008). For example, an adolescent may play video games because they enjoy them (affective). They may also believe that playing video games has instrumental benefits for them like achieving the next level or making new friends while playing. Finally, they may also plan for these behaviors (i.e., after school or evenings) indicating a behavioral aspect of their attitude or preference for the activity.

In the literature on physical activity, attitude is commonly assessed through the affective dimension of enjoyment and the instrumental component of benefits for the child. For example, in modeling the components of the theories of reasoned action, planned behavior, and self-efficacy in regards to physical activity, Motl et al. (2002) used questions such as “If I were to be physically active during my free time on most days it would help me make new friends” and “If I were physically active during my free time on most days it would be fun” (p.461) to assess attitude. They found that attitude was positively related to intention for physical activity, but unfortunately, intention was unrelated to physical activity levels. Attitudes have also been measured along with other psychosocial variables (Trost et al., 2001). The researchers discriminated between social influences (social norms) for physical activity, self-efficacy for physical activity, and beliefs-outcomes (attitudes) for physical activity and found that only self-efficacy was a key variable between obese and non-obese children.
Few studies have examined participants attitudes and enjoyment of sedentary behaviors, (Norman, Schmid, Sallis, Calfas, & Patrick, 2005; Salmon, Owen, Crawford, Bauman, & Sallis, 2003; Zabinski, Norman, Sallis, Calfas, & Patrick, 2007). In two of the studies, enjoyment was measured using a single-item, “I enjoy doing sedentary habits like watching TV or playing computer/video games” (Norman et al., 2005; Zabinski et al., 2007). In bivariate correlations, high scores on enjoyment of sedentary behaviors was associated with increased likelihood of being in the high-sedentary group for girls; but interestingly, higher scores on enjoyment of sedentary behavior was related to a decreased likelihood of being in the high-sedentary group for boys (Norman et al., 2005). Enjoyment did not factor into the logistic regression for either boys or girls in this study. Using cluster analysis Zabinski et al. (2007) found the selective high sedentary and the high sedentary groups reported higher levels of enjoyment for sedentary behaviors and differed significantly from the low and medium sedentary groups.

Salmon et al. (2003) measured enjoyment of sedentary behavior by averaging participants scores on 9 sedentary behaviors measured on a 5-point Likert scale. The study also assessed enjoyment of different physical activities. Respondents indicated their preference for certain activities dependent on context or setting. For example, “In the morning, before work or other commitments, which of the following would you most prefer to do if you had your choice?” (p.180). Salmon et al. found that individuals who had high enjoyment and high preference for physical activity were more likely to report higher levels of this activity. The preference for sedentary behavior was associated with a decreased likelihood of being active. In the regression analysis for total sedentary
behavior, enjoyment of sedentary behavior explained the greatest percentage of the variance in sedentary behaviors.

**Self-Efficacy.**

Self-efficacy is defined as a person’s evaluation of his or her ability to overcome salient barriers (e.g. time constraints, lack of support) for a given behavior (physical activity) (Bandura, 1977). In their essay on the development of physical activity behaviors, Kohl and Hobbs (1998) defined self-efficacy as the confidence an individual has to change or maintain a certain action or behavior. Self-efficacy was proposed as a multidimensional construct by Ryan and Dzewaltowski (2002) and Saunders et al. (1997) and consisting of various sub dimensions (e.g. barrier, support seeking, competing activities, and environmental change). Self-efficacy perceptions were hypothesized to come from four principle sources of information: 1) past performances; 2) vicarious experiences (modeling); 3) verbal persuasion; 4) and physiological state (Bandura, 1986; Trost et al., 2001). In a review of correlates of physical activity (Sallis et al., 2000), self-efficacy had an indeterminate relationship with children’s (ages 4-12) and adolescents’ (ages 12-18) levels of physical activity. Specifically for children, 4 studies (44%) showed positive correlations between self-efficacy and physical activity. A similar trend was found among adolescents in 7 studies (53%).

In a study by Kimiecik and Horn (1998), it was found children whose parents believe they are more competent with physical activity are more active than those children whose parents hold lower perceptions of the child’s abilities. Trost et al. (2001) investigated self-efficacy beliefs in a sample of obese and non-obese 6th-grade children. They found a significant difference between obese and non-obese children with respect to
self-efficacy. Children classified as obese were significantly less confident in their ability to: 1) overcome barriers to be physically active, 2) ask parents to provide opportunities for physical activity, and 3) choose physically active pursuits over sedentary ones.

Many studies investigating the relationship between self-efficacy and physical activity have used mediating models (Beets, Pitetti, & Forlaw, 2007; Biddle & Goudas, 1996; Davison et al., 2006; Dishman et al., 2004; Dishman et al., 2005; Trost et al., 2003; Motl et al., 2002). The models demonstrate that self-efficacy has significant, positive, direct effects on physical activity and that self-efficacy can be mediated by other attitudes and behaviors, or self-efficacy may work as a mediator in a variety of relationships to physical activity.

Dishman et al. (2005) found that self-efficacy directly influenced physical activity in 6th grade girls, but not in 8th grade girls. With the 6th grade girls, self-management strategies (e.g., thoughts, goals, plans, and acts) partially mediated the relationship of self-efficacy to physical activity. In the 8th grade girls, self-efficacy had indirect effects on physical activity that were mediated by self-management strategies and perceived barriers (e.g., boring, bad weather, knowledge). This study showed that the development of self-management strategies like positive thoughts, thinking about the perceived benefits, and making physical activity more enjoyable may be a possible mechanism for how self-efficacy impacts physical activity. With older girls, strategies to overcome barriers like fear of embarrassment, lack of knowledge, or having a location to do physical activity may be important aspects in studies of the relationship between self-efficacy to physical activity.
Motl et al. (2002) tested a model where intention (conscious plan) and expectation (probability or likelihood) were hypothesized to mediate the relationships of self-efficacy, attitude, subjective norm, and perceived behavioral control to physical activity. The results showed that the previously mentioned variables were all significantly related to either (or both) intention or expectation; however, intention and expectation did not affect physical activity levels, thereby not demonstrating a mediated model according to the protocol of Baron and Kenny (1986). Self-efficacy and perceived behavioral control showed direct and positive relationship to physical activity.

Dishman et al. (2004) modeled intervention effects and the variables of self-efficacy, outcome-expectancy, goal setting, and satisfaction to physical activity levels. They found the intervention LEAP (Lifestyle Education for Activity Program) had a direct effect on physical activity, and direct effects on self-efficacy and goal setting. Self-efficacy also had a significant, direct effect on physical activity. The effect of the intervention on physical activity was partially mediated by self-efficacy. Dishman et al. reinforced the contribution of their study to the field by acknowledging that this was “the first and only experimental evidence showing that increased self-efficacy directly results in increased physical activity among adolescent girls” (p. 634).

Trost et al. (2003) tested a model where parental physical activity, parental enjoyment, parental support, and children’s self-efficacy perceptions affected physical activity. After some modifications to their hypothesized model, they found parental activity and parental enjoyment directly and positively impacted parental support. Parental support was significantly related to child physical activity and to child self-efficacy. Children’s self-efficacy was directly related to child physical activity. There
were two mediated relationships in this model; parental support fully mediated the relationship between the parental variables (activity and enjoyment) and child physical activity; and, self-efficacy partially mediated the relationship between parental support and child physical activity. Biddle and Goudas (1996) also supported a similar mediating effect in that perceived adult physical activity and encouragement for physical activity was directly and indirectly related to strenuous physical activity in children.

Beets et al. (2007) also modeled the relationship between social support, self-efficacy, and physical activity. Their study was slightly more complicated in that they divided social support into three categories (peer, mother, and father) and divided self-efficacy into three categories (support seeking, overcoming barriers, and resisting competing activities). Beets et al. tested two models: one where social support variables were hypothesized to influence the self-efficacy variables and the other where support seeking self-efficacy was specified to influence levels of support. With both models they found that self-efficacy partially mediated the relationship between peer social support and physical activity. In the second model they found that support-seeking self-efficacy positively impacted peer social support. The final mediation equation was expressed as: support seeking self-efficacy → peer social support → overcoming barriers self-efficacy → physical activity.

In a longitudinal study of girls (data from age 9 and age 11), Davison et al. (2006) tested the parental support pathway (parental support, age 9 → perceived athletic competence, age 11 → physical activity, age 11) versus the child elicitation pathway (perceived athletic competence, age 9 → parental support, age 11 → physical activity, age 11). Davison et al. examined the temporal order of support and self-efficacy in their
relationship with physical activity. Perceived athletic competence and parental support at age 11 were significant and independent predictors of girls’ physical activity (27% of the variance). Parental support at age 11 fully mediated the association between perceived competence at age 9 and physical activity at age 11 thereby providing support for the child elicitation pathway. There was no association with parental support at age 9 and perceived competence at age 11. So basically, girls who had higher levels of perceived athletic competence at age 9 received higher levels of support at age 11 and in turn, had higher levels of activity.

Ryan and Dzewaltowski (2002) contended that differences in the types of self-efficacy measured may be contributing to the equivocal findings in the field, and that theoretically differences in the types of self-efficacy were important for gaining a thorough understanding of its relationship with physical activity. The study created 4 different self-efficacy scales: 1) physical activity efficacy (1 item); 2) barrier efficacy (8 items); 3) asking efficacy (4 items); and 4) environmental-change efficacy (12 items). They hypothesized that each type of efficacy was related to the level of physical activity (categorized as moderately vigorous physical, MVPA; and vigorous physical activity, VPA). The study was conducted on two different samples of students with only the second sample receiving the environmental-change efficacy questions. The results from the first sample indicated that only asking efficacy was independently related to physical activity and only with MVPA. In the second sample, environmental-change efficacy was independently related to MVPA and VPA, and physical activity efficacy and asking efficacy were also independently related to the VPA standard. Barriers efficacy and physical activity was not significantly related to physical activity in either sample.
Conceptual Framework

Physical Activity

As previously stated, physical activity is defined as, “any bodily movement produced by skeletal muscles that result in energy expenditure” (Casperson, Powell, & Christensen, 1985; Sallis & Owen, 1999). Physical activity is bodily movement in the broadest of contexts and should not be interchanged with the term exercise. Physical activity is a multi-dimensional behavior that may vary by type, frequency, duration, and intensity. An acronym used to summarize the principles of physical activity is FITT, which stands for frequency, intensity, time, and type.

There are various types of physical activity and exercise behaviors. Various types of physical activity include walking, running, raking leaves, bicycling, gardening, and swimming. Exercise is a subset of physical activity usually done with the intent of improving or maintaining physical fitness or health. For example, a person may walk a mile not for exercise, but because she/he needed to go to the store to pick up milk and does not own a car. However, another person may walk a mile purely for the purpose of maintaining or improving physical fitness. There is a clear distinction in the motivation or reasons for the walking behavior. This is true for all forms of physical activity and exercise behavior. Some behaviors are purely for pleasure and enjoyment whereas others may result from necessity. It is important to study various types of physical activity and exercise behaviors along with motivational differences so appropriate interventions may be designed.

Physical activity may also vary by frequency and duration. Frequency is “how often” a person engages in physical activity or exercise. For example, an adolescent may
walk 5 days a week as a means of getting to school. That same person may also walk for pleasure on a Saturday making their frequency total 6 for the week. Duration refers to how long the activity lasts. This is usually reported in minutes. For measurement of youth physical activity, duration is a useful measurement, because certain activities (sport, play, etc.) cannot be measured by conventional distance measurements (miles, laps, etc.).

Physical activity may also vary by intensity. Intensity refers to the “magnitude of the physiologic response to physical activity and is often quantified by the amount of metabolic work performed (e.g. kilocalories expended)” (Marshall & Welk, 2008, p.8). It is difficult and expensive to measure metabolic work in large population studies therefore intensity is often measured by perceptual categories (e.g. very light, light, moderate, vigorous, and very vigorous). Moderate intensity physical activity is activity requiring 3 to 6 times more energy than expended at rest (Sallis & Owen, 1999). An example of moderate physical activity is brisk walking whereas, vigorous intensity physical activity requires 7 times or more energy use than at rest (Sallis & Owen, 199). An example of vigorous physical activity is jogging. In addition, participants may be asked to list their activities and researchers can convert the activity into METs, metabolic equivalents. METs are multiples of the resting VO2, which is a measure of oxygen intake. For example, walking at 4 mph (15-minute miles) has a MET equivalent of 6.5, whereas running at 6 mph (10-minute miles) has a MET equivalent of 10.0. Again, this is not measuring the metabolic work specifically in each subject, but is estimating the intensity of the activity.
The Center for Disease Control (CDC) uses frequency, intensity, and duration in their physical activity recommendation for children and adolescents. It is recommended that children and adolescents participate in at least 60 minutes of moderate-intensity physical activity most days of the week, preferably daily (http://www.cdc.gov/physicalactivity/everyone/guidelines/children.html). In addition, a goal from Healthy Goals 2020 includes “increasing the proportion of adolescents who engage in moderate physical activity for at least 30 minutes on five or more of the previous seven days (USDHHS, 2011). In 2009, only 18.4% of adolescents met the current physical activity guidelines for physical activity (YRBSS, 2009). It is important for the health and well-being of our adolescents that these recommendations and goals are achieved.

**Sedentary Behaviors**

Sedentary behavior is a complex multi-dimensional construct. Sedentary behavior is also described in terms of type, frequency, duration, and intensity. Sedentary behaviors can be conceptualized as those behaviors having a low-level of energy expenditure, defined as activities expending less than two metabolic equivalents (Ainsworth et al., 2000). Examples of common sedentary activities of children and adolescents include “screen time”, which may be watching television and videos, playing video games, and using the computer. Other activities would include studying, reading for pleasure, sitting talking with friends, sitting and talking on the phone, and motorized travel (sitting in a car, bus, or train).

The American Academy of Pediatrics (2001) recommends that children should not watch more than 2 hours of television a day. Specific official guidelines for computer
use have not been established, but previous studies have recommended no more than 1 hour per day (Janssen, et al., 2005). The Australian government (2005) recommends “children and young people should not spend more than 2 hours a day using electronic media for entertainment (e.g. computer games, Internet, TV), particularly during daylight hours” (paragraph 1). It is important to make the distinction that efforts aimed at reducing sedentary activity may not be the same as those targeted for increasing physical activity. This distinction and further investigation of sedentary behaviors is an important research agenda (Marshall & Welk, 2008).

**Environmental Support**

Environmental support is a multidimensional construct conceptualized as instrumental support and modeling behaviors for increasing physical activity. These supports and modeling behavior may occur in either the neighborhood or school setting.

It is important to distinguish between community and neighborhood for this study. Community is defined as “a group of youth and adults residing in a geographic neighborhood or multi-neighborhood area, no matter how they relate to one another (Ferguson & Dickens, 1999; Sampson, 2002)” (Dzewaltowski, 2008). Accordingly, the community involves the population within a given area, but the neighborhood is more a physical component. The neighborhood can also be assessed in social terms such as safety, social disorder, hazards, problems, and social connectedness. The neighborhood can also be conceptualized within the context of a physical environment regarding the quality of facilities, perceptions of safety of facilities, access and availability, neighborhood design, population density, physical disorder, road or traffic environment, topography, and aesthetics. For the purpose of this study, the term neighborhood will be
primarily used because of its inclusion of both social and physical aspects, unless differentiating the behavior by people within the neighborhood in which case community may be used.

Instrumental support from the neighborhood involves the number of parks, playgrounds, and open spaces in the neighborhood as well as the accessibility and quality of those venues. Accessibility means the areas are open when the child wants to go to them. For example, the neighborhood may have basketball courts, but maybe they are locked after 6 pm. If the only time available for the child to use the courts is after 6 pm, then the mere presence of these courts is not enough. They also have to be accessible. In addition to accessibility, the quality of the venues is important. Using the same analogy of the basketball courts, if the backboards or nets are broken, children may not want to use the courts at all. Other neighborhood supports may be offering instructional classes, having multiple numbers of sports teams reflecting a range of ages/abilities, or providing equipment for individuals to use (bats, balls, and nets). Again, with these programmatic supports, there is also the consideration of accessibility and quality.

In addition to the physical and programmatic aspects of neighborhood support, community modeling of activity levels will be conceptualized. For example, does one see a lot of people walking for pleasure, using playground space, and taking advantage of the programmatic offerings? This modeling behavior may entice others to use the facilities because of positive social aspects, and/or perceptions of acceptable quality and safety.

Instrumental support from the schools involves the offering of physical education, extracurricular activities, and the facilities of the school. For example, instrumental support may entail a school having outdoor basketball courts. Here again,
the perception of quality, safety, availability, and access of those courts may affect physical activity levels. If the location is not deemed safe or if the courts are not available outside of school hours, the use of those facilities may be limited.

Modeling behavior at the school level is also important because it would most often involve peers. In a study of perceived cues, barriers, and benefits of physical activity, Tergerson and King (2002) found that “having a friend to exercise with” and “having a friend encourages me to exercise” were among the top perceived cues for physical activity by both males and females.

**Family Factors**

Family factors were divided into four variables: 1) parental encouragement for physical activity; 2) parental encouragement for sedentary behaviors; 3) parental modeling of physical activity; and 4) parental modeling of sedentary behaviors.

Parental encouragement for physical activity is conceptualized as encouragement for the child to be active. For example, parents may encourage their child to try new activities, or demonstrate encouragement by attending practices or games. The parent may also offer value statements that show encouragement. For example saying, “I think it is great Johnny plays football. He is learning so much”, would be a positive value statement encouraging participation.

Parental encouragement for sedentary behaviors is conceptualized as encouragement for the child to be inactive. For example, the parent may encourage the child to watch television with them as a way of spending time together or as a “baby-sitter” while the parent is doing other things around the house. Permissiveness for watching television and playing video games would also be encouragement for sedentary
behaviors. Meaning, there are no household rules setting limits on television or video games. In addition, the parent may purchase video games for the child, or allow a television in the child’s room.

Parental modeling for physical activity and sedentary behaviors is simply the child’s awareness of what the parent chooses for their own activities. For example, how much does the parent formally exercise (walking, running) or participate in sports (soccer, baseball)? Parental modeling for sedentary activity is what the parent does in terms of sedentary activities, like playing video games, or watching television.

**Intrapersonal Factors**

Intrapersonal factors were conceptualized as a multidimensional construct and included two variables, attitude and self-efficacy.

Attitudes regarding sedentary behaviors and physical activity can be conceptualized as affective (emotional) responses to the behavior. Affective attitudes reflect emotions elicited while participating in certain behaviors. One may use response scales using endpoints such as “happy” versus “sad” or “pleasing” versus “unpleasing” for measuring how participating in a certain behavior makes someone feel (Hagger & Chatzisarantis, 2008). Affective attitudes may also involve having a preference to do one activity over another. Questions may be framed by rating certain activities. For example, Likert rating scales for a variety of activities (e.g. television, video games, sports, and walking) can demonstrate preferences by the child. The questions of “I enjoy doing sedentary habits like watching TV or playing computer/video games” and “I enjoy doing physical activity” had very high reliability and validity (Norman, Schmid, et al. 2005; Salmon et al., 2003; Zabinski et al. 2007).
Self-efficacy reflects beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments (Bandura, 1997). Self-efficacy in regards to physical activity refers to a person’s confidence to do physical activity in specific circumstances (Sallis & Owen, 1999). For example, a person who has high self-efficacy to be active may execute good time management by setting aside time to be active, exercising when sad or depressed, or when it is raining or cold. Self-efficacy in regards to sedentary behaviors is conceptualized by an individual’s ability to reduce sedentary activity (Norman, Sallis, & Gaskins, 2005; Norman, Schmid, et al. 2005; Norman, Vaughn, Roesch, Sallis, Calfas, & Patrick, 2004; Zabinski, et al., 2007). Examples of this self-efficacy would be how confident an adolescent may be at turning off the TV, limiting computer time, or setting limits on phone use.

**Health Factors**

Health factors that may impact physical activity and sedentary behaviors are comprised of physical and mental health variables.

Corbin, Welk, Corbin, and Welk (2009) define physical health as being “free from illnesses that affect the physiological systems of the body, such as the heart and nervous system. A person with good physical health possesses an adequate level of physical fitness and physical wellness” (p.5). Physical health dimensions include five components of health-related fitness: 1) cardiorespiratory endurance; 2) muscular strength; 3) muscular endurance; 4) flexibility; and 5) body composition (Corbin et al., 2009). In physical activity and sedentary research, body mass index (BMI) is commonly used as an indicator of body composition (Corbin et al., 2009; Stensel, Gorely, & Biddle, 2008). Using the anthropometric measures of height and weight, an individual’s body
mass index (BMI) may be calculated. A BMI between 26 and 30 is considered overweight and greater than 30 is classified as obese (Corbin et al., 2009).

Mental health dimensions may also affect levels of physical activity and sedentary behaviors. Specifically, depression and anxiety are two conditions potentially impacting levels of both physical activity and sedentary behaviors. In a study examining both physical activity and sedentary behaviors, boys with higher levels of emotional symptoms reported lower levels of physical activity; whereas girls with higher levels of emotional symptoms reported greater levels of sedentary behaviors (Henning Brodersen, et al., 2005). The emotional scale included five items given as part of the larger Strengths and Difficulties Questionnaire (SDQ), a measure of prosocial and psychopathology designed for epidemiological and clinical studies of children and adolescents (Goodman, 1999, 2001). Children and adolescents suffer from a wide range of diagnosable mental and emotional disorders including anxiety, depression, and attention deficit hyperactivity disorder (ADHD, ADD) (NIMH, 2009). The National Institute of Mental Health (2009) estimated that only one in ten children suffer from a mental disorder severe enough to cause some level of impairment in development or functioning. However, it should be emphasized that directionality is a key issue regarding emotional disorders and physical activity levels (Stensel et al., 2008). It is uncertain if adolescents are more physically active because they have higher levels of positive well-being, or if being physically active leads to higher levels of emotional health. Unfortunately, because of its cross-sectional design this dissertation does not address this key issue. This conceptualization of mental health assumes adolescents reporting higher levels of symptoms of depression, anxiety, or ADHD will be less physically active and report higher levels of sedentary behaviors.
Conceptual Models

The following proposed conceptual models will be used to investigate the relationship between environmental supports, family environment, intrapersonal factors, health factors and physical activity and sedentary behaviors. First, the models and hypotheses for physical activity are presented, followed by the models and hypotheses for sedentary behaviors.

Physical Activity Conceptual Model

Hypotheses for the Physical Activity Model – Direct, Mediator, and Moderator

Pathways

To test the proposed conceptual model of the direct and mediated relationships among environmental support, parental modeling, parental encouragement, mental and physical health levels of adolescent physical activity as mediated through intrapersonal factors.
(a) The direct relationship between environmental support and physical activity (Arrow A);

*It is hypothesized that higher levels of environmental support will be associated with higher levels of physical activity.*

(b) The direct relationship between parental modeling and physical activity (Arrow B); and the direct relationship between parental encouragement and physical activity (Arrow C).

*It is hypothesized that higher levels of parental modeling and parental encouragement will be associated with higher levels of physical activity.*

(c) The direct relationship between mental health and physical activity (Arrow D); and the direct relationship between physical health and physical activity (Arrow E).
It is hypothesized that higher levels of mental and physical health will be associated with higher levels of physical activity.

(d) The direct relationships between environmental support, parental modeling, parental encouragement, mental and physical health to levels of intrapersonal factors (Arrows F-J).

Higher levels of each of these variables will be associated with higher levels of intrapersonal factors.

(e) The direct relationship between intrapersonal factors and adolescent physical activity (Arrow K).

Higher levels of intrapersonal factors will be associated with higher levels of physical activity.

Figure 2: Physical Activity Conceptual Model – Moderated Pathways.
(f) The moderating role of environmental support in the relationship between intrapersonal factors and physical activity (Arrow G).

*It is hypothesized in this interaction term that as the level of environmental support increases, the relationship of intrapersonal factors to physical activity will be stronger.*

(g) The moderating role of environmental support in the relationship between parental modeling and physical activity (Arrow H).

*It is hypothesized in this interaction term that as the level of environmental support increases, the relationship of parental modeling to physical activity will be stronger.*

(h) The moderating role of environmental support in the relationship between parental encouragement and physical activity (Arrow I).

*It is hypothesized in this interaction term that as the level of environmental support increases, the relationship of parental encouragement to physical activity will be stronger.*

(i) The moderating role of parental modeling in the relationship between intrapersonal factors and physical activity (Arrow J).

*It is hypothesized in this interaction term that as levels of parental modeling increase, the relationship of intrapersonal factors to physical activity will be stronger.*

(j) The moderating role of parental encouragement in the relationship between intrapersonal factors and physical activity (Arrow K).

*It is hypothesized in this interaction term that as levels of parental encouragement increase, the relationship of intrapersonal factors to physical activity will be stronger.*
Sedentary Behavior Conceptual Model

Hypotheses for the Sedentary Behavior Model – Direct, Mediator, and Moderator Pathways

To test the proposed conceptual model (Figure 3) of the direct and mediated relationships among environmental support, parental modeling, parental encouragement, mental and physical health and levels of adolescent sedentary behaviors as mediated through intrapersonal factors.

Figure 3: Sedentary Behavior Conceptual Model – Direct Effects and Mediator Pathways

(a) The direct relationship between environmental support and sedentary behaviors (Arrow A).

*It is hypothesized that higher levels of environmental support will be associated with lower levels of sedentary behaviors.*
(b) The direct relationship between parental modeling and sedentary behaviors (Arrow B); and the direct relationship between parental encouragement and sedentary behaviors (Arrow C).

*It is hypothesized that higher levels of parental modeling and parental encouragement will be associated with higher levels of sedentary behaviors.*

(c) The direct relationship of mental health and sedentary behaviors (Arrow D); and the direct relationship between physical health and sedentary behaviors (Arrow E).

*It is hypothesized that higher levels of mental and physical health are associated with lower levels of sedentary behaviors.*

(d) The direct relationship between environmental support and intrapersonal factors (Arrow F); mental health and intrapersonal factors (Arrow I); and physical health and intrapersonal factors (Arrow J).

*Higher levels of each of these variables will be associated with higher levels of intrapersonal factors.*

(e) The direct relationships between parental modeling and intrapersonal factors; and the direct relationship between parental encouragement and intrapersonal factors (Arrows G & H).

*Higher levels of each of these variables will be associated with lower levels of intrapersonal factors.*

(f) The direct relationship between intrapersonal factors and adolescent sedentary behavior (Arrow K).

*Higher levels of intrapersonal factors will be associated with lower levels of sedentary behavior.*
(g) The moderating role of environmental support in the relationship between intrapersonal factors and sedentary behaviors (Arrow G).

*It is hypothesized in this interaction term that as levels of environmental support increase, the relationship of intrapersonal factors to sedentary behaviors will be weaker.*

(h) The moderating role of environmental support in the relationship between parental modeling and sedentary behaviors (Arrow H).

*It is hypothesized in this interaction term that as levels of environmental support increase, the relationship between parental modeling and sedentary behaviors will be weaker.*

(i) The moderating role of environmental support and the relationship between parental encouragement and sedentary behaviors (Arrow I).
It is hypothesized in this interaction term that as levels of environmental support increase, the relationship between parental encouragement and sedentary behaviors will be weaker.

(j) The moderating role of parental modeling for sedentary behaviors in the relationship between intrapersonal factors and adolescent sedentary behaviors (Arrow J).

It is hypothesized in this interaction term that as levels of parental modeling increase the relationship between intrapersonal factors and sedentary behaviors will be stronger.

(k) The moderating role of parental encouragement for sedentary behaviors in the relationship between intrapersonal factors and sedentary behaviors (Arrow K).

It is hypothesized in this interaction term that as levels of parental encouragement increase, the relationship between intrapersonal factors and sedentary behaviors will be stronger.
Theoretical Foundations

Social cognitive theory (Bandura, 1986) and ecological models (Bronfenbrenner, 1989; Sallis & Owen, 1997) can help to guide research and intervention strategies in the area of physical activity and sedentary behaviors.

Social Cognitive Theory

Social cognitive theory involves individual, social, and physical environment interactions. Bandura (1977, 1986) developed the model of reciprocal determinism which proposed a person’s behavior can act on the environment and vice-versa. This model is conceptualized with environmental, intrapersonal, and behavior all operating as interactive determinants of each other, or triadic reciprocity (Crosbie-Burnett & Lewis, 1993). In social cognitive theory, “the social portion of the terminology acknowledges the social origins of much human thought and action; the cognitive portion recognizes the influential causal contribution of thought processes to human motivation, affect, and action” (Bandura, 1986, p.xii). Social cognitive theory emphasizes certain human cognitive capabilities such as being able to symbolize, have forethought, learn vicariously, self-regulate, and self-reflect.

In a review of social cognitive models related to health and exercise behaviors, Maddux (1993) described the theory as “an approach to understanding human cognition, action, motivation, and emotion that assumes that people are capable of self-reflection and self-regulation and are active shapers of their environments rather than simply passive reactors to their environments” (p.116). In social cognitive theory, a consistent variable of interest is self-efficacy. Bandura (1997) described self-efficacy as a person’s belief in his or her capabilities to organize and execute the courses of action required to
produce given attainments. In the context of physical activity, self-efficacy is a person’s confidence in his or her ability to do specific physical activities in specific circumstances (Sallis & Owen, 1999). For example, a person may have high self-efficacy about exercising in their home with purchased equipment, but have low self-efficacy about going to a neighborhood fitness center for their exercise behavior. Research has generally found a positive relationship between social cognitive variables and physical activity, with exercise self-efficacy showing the strongest relationship to physical activity (Rovniak, Anderson, Winett, & Stephens, 2002). However, the review by Sallis et al. (2000) showed mixed results for self-efficacy being a determinant for physical activity in children and adolescents.

Dishman et al. (2005) outlined how self-efficacy influences the direction, intensity, and persistence of behavior. Specifically a person with high self-efficacy would perceive fewer barriers or would be less influenced by these barriers, and would be more likely to act on expectations for a desirable outcome, and also be more likely to enjoy the physical activity. Dishman et al. noted that based on their research, interventions should not only address fostering self-efficacy, but also teach people cognitive and behavioral strategies for increasing their self-management. This research highlights the complex relationships potentially occurring with a person’s choice to engage in physical activity. And, more importantly, highlights the need for further research in mediating/moderating models using a theoretical foundation to develop successful interventions aimed at increasing the levels of physical activity.

Similarly, social cognitive theory and self-efficacy can also be applied to sedentary behavior pursuits. The self-efficacy variable has commonly been
conceptualized as the ability to reduce sedentary behaviors (Norman, Schmid, et al., 2008; Norman et al., 2004; Zabinski et al., 2007), suggesting the person’s capability for decreasing the amount of time they spend watching television or playing computer games. Zabinski et al. (2007) found cluster differences in sedentary levels and self-efficacy with the participants with low levels of sedentary behaviors had the highest level of self-efficacy to reduce sedentary behavior.

Social cognitive theory also utilizes the social variables of reinforcement and observational (vicarious) learning. Crosbie-Burnett and Lewis (1993) highlighted that although Bandura’s theory lays the ground work for explaining individual behaviors; there is little emphasis for the influence of the family environment. Crosbie-Burnett and Lewis expanded the model “to show how family members relate to each other cognitively and behaviorally as they share a social and physical environment and usually the same cultural context” (p.539). Social reinforcement and observational learning of behavior are forms of social support. Social support for physical activity can take many different forms including direct (transportation, fees, providing equipment), emotional and motivational (encouragement, praise), or observational (modeling) (Prochaska et al., 2002). Springer, Kelder, and Heolscher (2006) examined two types of social support (social participation in and social encouragement for physical activity) and two social support sources (family and friends) with self-reported daily minutes of physical activity and sedentary behaviors. They found that friend physical activity participation and both friend and family encouragement were positively related to moderate-to-vigorous physical activity. Also, family participation in physical activity was the only variable significantly and inversely related to sedentary behavior levels. Fogelholm et al. (1999)
also found parent modeling of inactivity was stronger than their modeling of active behaviors. Understanding social support, both type and source, can be critical for developing effective interventions for increasing physical activity and decreasing sedentary behaviors.

**Ecological Framework**

Bronfenbrenner (1989) suggested that it is important to study human development in its broader context:

> Every human quality is inextricably embedded, and finds both its meaning and fullest expression, in particular environmental settings, of which the family is the prime example. As a result, there is always interplay between the psychological characteristics of the person and of a specific environment; the one cannot be defined without reference to the other. (p.255)

The ecological environment may be divided into four organizational concepts with the reference points defined from the viewpoint of the individual: the microsystem, the mesosystem, the exosystem, and the macrosystem. The systems are differentiated by their perceived immediacy to the person. For example, the family is a principal microsystem context. Next, the mesosystem may be two contexts interacting, like family and the school. The exosystem is conceptualized as the interaction between microsystem and/or mesosytems, but also including an external environment in which the person does not participate. For example, a parent’s workplace would be considered part of an exosystem for the child. Finally, the macrosystem is the cultural values or social norms impacting an individual. Bronfenbrenner’s model is not one necessarily explaining family process or family development, but provides a framework for investigating the impact of extrafamilial conditions and environments (Bubolz & Sontag, 1993).
Sallis and Owen (1999) contended ecological models may offer insight into behaviors of physical activity and inactivity. Sallis and Owen (1999) also suggested that “changes in the social and constructed physical environments are largely responsible for the epidemic of sedentary lifestyles” (Sallis & Owen, p.124). Ecological frameworks examine interactions between the individual (e.g. knowledge, cognitions) and multiple levels of the environment (social, organizational, community, and legislative) to understand when and how youth become physically active (Fein, Plotnikoff, Wild, & Spence, 2004). The interaction of the various systems creates an “ecological niche” which incorporates personal attributes, family and peer influences, school and community influences, and cultural values (Davison & Birch, 2001). Davison and Birch contended this provides a useful framework for understanding the development of obesity in children by identifying the context in which dietary, physical activity, and sedentary behavior patterns evolve. Physical activity and sedentary behaviors may be influenced by family and neighborhood characteristics. Neighborhood characteristics include streets easy for walking and open spaces for children to play, as well as constructed facilities like pools, courts, and parks. The convenience or cost of these facilities is important as well. Using this ecological framework, it is important to distinguish potential barriers for activity. For example, a neighborhood may have a wonderful neighborhood pool, but if special groups or teams use the pool during times when a child may want to use it, or if there is an admission fee the child cannot afford, then the mere existence of the pool does not positively impact that one child’s physical activity levels. The pool should not only exist, but also be available and accessible. Studying ecological variables involves
assessment of people’s perceptions as well as the objective characteristics of the environment (Sallis & Owen, 1999).

Welk’s (1999) Youth Physical Activity Promotion Model is based upon an ecological framework suggesting that multiple levels of the environment (physical, social, institutional, cultural) can directly and indirectly influence behavior. The framework also suggests how youth become predisposed to physical activity and how physical activity may be enabled and reinforced. For example, predisposing factors may include self-efficacy, enjoyment, and beliefs and attitudes about physical activity. Enabling factors may include environmental factors such as access to facilities or available equipment (balls, nets, bats, etc.). Reinforcing factors may include the influence of family, peers, teachers, and coaches (Nigg & Paxton, 2008). This framework also considers the specific population’s characteristics and needs (age, gender, race, socioeconomic status) for the program development. Ecological models are usually considered holistic and also suggest the influencing factors most proximal to the individual will have the greatest influence (Hohepa, Scragg, Schofield, Kolt, & Schaaf, 2007; Nigg & Paxton, 2008; Spence & Lee, 2003).

In their review of the literature investigating correlates of physical activity, Sallis and Owen (1999) investigated approximately 300 studies and emphasized consistent associations found in all categories. The categories were labeled as follows: 1) demographic and biological; 2) psychological, cognitive, and emotional; 3) behavioral attributes and skills; 4) social and cultural factors; 5) physical environment; and 6) physical activity characteristics. The authors contended that broad models such as social cognitive theory and ecological models should provide the foundation for the study of
activity patterns. They emphasized no single variable or category explains why people engage in physical activity and also noted the reasons or opportunities may change based on developmental period. Research should continue to investigate theoretical frameworks and variables which consistently demonstrate a relationship to physical activity and sedentary behaviors and to further investigate potential mediating and/or moderating relationships accounting for more of the variance as to why people are active.
CHAPTER III

Method

Participants

The sampling frame consisted of 7th and 8th grade adolescents drawn from three rural school districts in northern New York State. The study included adolescents from this age group because (a) adolescents in this age group are likely to engage in a wide range of physical (recreational activities as well as competitive junior varsity/varsity programs or individual fitness-based activities (running, biking) as well as sedentary activities, (b) during this period physical activity levels also show signs of decreasing (Brownson, Boehmer, & Luke, 2005; Casperson, Pereira, & Curran, 2000; Sirard & Barr-Anderson, 2008), and (c) during this age, youth also tend to increase their involvement in various sedentary behaviors (Gorely et al., 2004; McElroy, 2008).

The three schools included in the sampling frame were located in rural towns of northern New York State. According to the U.S. Census Bureau estimates (2010), the total population of each town where each school was located was as follows - School A - 12,883; School B – 11,128; and School C – 10,995, for a total of 35,006. All of the schools were located in the same county. The median household income for families in this county was $41,526 (U.S. Census Bureau, 2008). In the population of the 3 school systems, the total number of families with children ages 5-17 in poverty was 18.7% (U.S. Census Bureau, Estimates for New York School Districts, 2009).

The participants included a voluntary sample of adolescents. Parents were provided information about the study and informed consent forms requesting their adolescent’s participation (see Appendix A). These forms were given to the students at
school and the informed consent forms were returned to the school. Students also gave their assent prior to answering the survey (see Appendix B). All questionnaires for all grades were administered during their Physical Education/Health class in the spring semester (late March-early May). Surveys were administered by the researcher.

A total of 527 adolescents participated in the study. The sample consisted of 7th and 8th grade students from 3 public schools in northern New York State. The response rate was 57%. The average age was 13.2 years, and consisted of 280 8th graders (53.1%). The sample contained 265 females (50.3%). Participants in the study were predominantly white (82.9%), with 62 respondents indicating Native American (11.8%). Census data from the area indicates the total population of the three towns to be 35,006 with 91% being white and 1.8% Native American. Of the three school districts, two had less than 1% Native American, and the third reported 4% Native American population (http://2010.census.gov/2010census/popmap/). This sample contains a higher percentage of Native American students than the surrounding area.

**Instruments**

Face and content validity of the measures were established using procedures outlined by Carmines and Zellar (1979). The questionnaire (see Appendix C) included the domains of physical activity, sedentary behaviors, environmental supports, family supports, attitudes toward physical activity/sedentary behaviors, and physical and mental health factors. Factor validity was established for each construct prior to beginning the analysis. Reliability was assessed using internal consistency approach (Cronbach’s alpha). Demographic characteristics of age, gender, height and weight, and race/ethnicity of the participants was assessed.
Physical activity.

Physical activity was assessed using adolescent self-reports. Self-report techniques are commonly used for measuring physical activity because of their low financial cost and low participant burden (Dale, Welk, & Matthews, 2002). Adolescents were asked a question with three parts modified from the Physical Activity Questionnaire – Adolescents (PAQ-A) (Kowalski, Crocker, & Donen, 2004) and the Amherst Health and Activity Study (Trost et al., 2003). The PAQ-A and the Amherst Health and Activity Study have demonstrated adequate validity and reliability for adolescents (Dowda et al., 2007; Kowalski, Crocker, & Kowalski, 1997). First, this question includes a checklist of 24 specific physical activities (i.e., swimming, bicycling, and basketball) with a response indicating yes or no as to whether the adolescent engaged in that specific activity. Also included was a response scale of the number of times during the past 7 days the adolescent participated in each activity (1-2 days; 3-4 days; 5-6 days; everyday). In addition, the students also indicated approximately how long (in minutes) they participated in each activity. For each activity, the participants scores for days of participation*duration was calculated. These scores were summed across all activities.

Sedentary behaviors.

The measure for sedentary behaviors was drawn from the Active Where? Study (Kerr, Sallis, Rosenberg, Norman, Saelens, & Durant, 2008). This study has demonstrated adequate reliability with adolescents ages 12-19 (Kerr et al., 2008). First, participants were asked to indicate if they did or did not do the specific activity over the past week. If they reported yes, the adolescent indicated the number of days they engaged in the sedentary behaviors. In addition, participants indicated the time (in minutes) spent
in each. Scores were calculated by creating a days*duration score for each activity and summing across all activities.

**Environmental support.**

Environmental support was operationalized as consisting of four indices – community instrumental support, community modeling, school instrumental support, and school modeling.

To assess community support, participants were given a list of various recreational places (playing fields, courts, etc.) in their neighborhood (places within walking distance or a short drive of 10-15 minutes). Participants were asked whether or not these venues were present in their neighborhoods and scores were summed to create the Community Instrumental Support Index.

Next, participants reported on the modeling for physically active behaviors in the neighborhood (community modeling). Community modeling was assessed by three questions indicating how often adolescents see others engaging in physically active behaviors in various neighborhood recreational spaces (Sallis, Johnson, Calfas, Caparosa, & Nichols, 1997). For example, “how often do you see people walking or jogging in your neighborhood”? Participants responded to these items on a 5-point scale ranging from 1(never) to 5(always). The Cronbach’s alpha for this scale was 0.59.

School instrumental support was measured using 16 items which assessed the existence (yes/no) of indoor and outdoor facilities at school (School Health Policies and Practice Study, 2006). Participants were asked whether or not these venues were present in their schools and the scores were summed to create the School Instrumental Support Index.
School modeling was assessed by 3 questions assessing adolescent perceptions of classmates and teachers/administrators in the school (Kerr et al., 2008). This scale had low reliability - Cronbach’s alpha 0.33.

**Intrapersonal factors.**

Intrapersonal factors were operationalized as a multidimensional construct - self-efficacy and attitudes toward physical activity.

Self-efficacy was assessed by 9 questions (e.g., “I can be physically active during my free time on most days”, “I can be physically active during my free time on most days no matter how busy my day is”, I can be physically active during my free time on most days even if it is very hot or cold outside) based on research studies by Motl et al. (2000) and Saunders et al. (1997). Participants responded to the statements on a 5-point Likert scale ranging from 1 (disagree a lot) to 5 (agree a lot). The Cronbach’s alpha for this scale was 0.88.

Attitudes regarding physical activity were assessed using the 14-item Physical Activity Enjoyment Scale (Motl et al., 2001). Examples of items included “when I am physically active, it gives me energy”, or “…it’s not at all interesting”. Participants responded to the items on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Cronbach’s alpha for this scale was 0.90.

**Parental encouragement of physical activity.**

Parental encouragement of physical activity was measured by 6 items (e.g., amount of parental participation, amount of parental encouragement, and parental importance of physical activity) (Anderssen & Wold, 1992; Motl et al., 2002; Saunders et al, 1997). Mothers and fathers encouragement of physical activity was assessed
separately and combined to create an overall parental encouragement score, Cronbach’s alpha was 0.88.

**Parental modeling of physical activity.**

Parental modeling of physical activity was measured by providing participants with a list of different physical activities. Participants indicated whether their parents participated in each of the physical activities and the estimated frequency per week they participated in each of these activities. The frequency of participation in each activity was assessed on a 5-point Likert scale representing the number of days in the week the activity (1= never; 5= everyday). The frequency of participation in these activities for both participants was summed to create an overall parental modeling of physical activity score.

**Parental encouragement for sedentary behaviors.**

Parental encouragement for sedentary behaviors was assessed by 4 questions. Two questions were drawn from Adkins et al. (2004) study on the perception of permissiveness for sedentary behaviors (e.g., “my parents or other adult allow me to watch as much TV as I want”, “my parents allow me to play video games or computer games as much as I want”). These two questions were on a 5-point Likert scale (1 = never, 5= always). Two additional items were also included to assess how often the parent has provided money for or actually purchased handheld or TV/computer video games in the past year. Each of the items was assessed on a 5-point scale (1 = never, 5 = 6 times or more). The Cronbach’s alpha of this scale was .68.
Parental modeling for sedentary behaviors.

Parental modeling for sedentary behaviors was assessed by asking adolescents if their parents engaged in any of the 12 different sedentary behaviors. Adolescents were also asked to indicate how long parents engaged in each of the activities. The list of sedentary behaviors was adapted from the Active Where? Study (Kerr et al., 2008). An index was created based upon summing the days*duration for each activity.

Adolescent physical health.

Adolescent physical health was measured by a subscale of the SF-36 instrument (Ware and Sherbourne, 1992). The SF-36 provides an 8-scale profile of functional health and well-being scores (physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health), as well as overall physical and mental health summary measures. The physical functioning and bodily pain items (13 items) were used in this analysis to create the adolescent physical health scale. Questions asked how limited the adolescent felt in doing certain activities, or if pain or physical health has interfered with certain activities (e.g., walking a mile, climbing stairs, bodily pain interfering with work). Items were measured on a 3-point Likert scale (1 = limited a lot, 3 = no, not at all). Higher scores indicated fewer health problems and higher physical functioning. The Cronbach’s alpha for these items measured 0.94.

Adolescent mental health.

Adolescent mental health was measured by a subscale of the SF-36 instrument (Ware and Sherbourne, 1992). The overall mental health summary measure combines vitality, social functioning, role-emotional, and mental health scales. For this questionnaire, vitality and mental health items were used. These 9 items asked on a 5-
point scale (1 = all of the time, 5 = none of the time) how often a person experienced certain feelings (happiness, calmness) and their assessment of their functioning (tiredness, energy levels). Higher scores indicated fewer mental health problems and higher mental health functioning. The Cronbach’s alpha for this scale was 0.70.

**Analytical Strategy**

All data were first entered into PASW 19.0 (IBM SPSS, Inc., 2010). Descriptive statistics of means and standard deviations, and correlational analysis were calculated for each of the variables for the entire sample (Appendices D & E). The reliability was assessed and reported in the previous discussion of the questionnaire development.

Next, the factor structure of the latent variables was assessed. As mentioned previously, even though these items have been used previously in other instruments, this is the first time they have been assembled in this format. The factor structure was investigated using confirmatory factor analysis (CFA). Specifically, the variables should have critical ratios higher than ±1.96, and therefore significant p-values loading to their respective latent variables. To test all of the hypotheses, structural equation modeling (SEM) was performed using AMOS (Analysis of Moment Structures) 18.0 (Arbuckle, 2009). Discussion of the procedure for the structural equation modeling analysis follows in the results section.
CHAPTER IV

Results

Participants

A total of 527 adolescents participated in the study. The sample consisted of 7th and 8th grade students from 3 public schools in northern New York State. The response rate was 57%. The average age was 13.2 years, and consisted of 280 8th graders (53.1%). The sample contained 265 females (50.3%). Participants in the study were predominantly white (82.9%), with 62 respondents indicating Native American (11.8%). Census data from the area indicates the total population of the three towns to be 35,006 with 91% being white and 1.8% Native American. Of the three school districts, two had less than 1% Native American, and the third reported 4% Native American population (http://2010.census.gov/2010census/popmap/). This sample contains a higher percentage of Native American students than the surrounding area.

The students answered questions on their mother’s and father’s marital status. Combining the responses, the sample reported 47% being from biological, married households, with another 36% reporting their parents as either single or separated/divorced but not remarried. The remaining 17% reported either their parents were remarried or reported “other”. National data indicates 66% of children reported living in married two parent households and 29.5% reporting single parent households (U.S Census Bureau, 2010). This research sample contains fewer two-parent households and more single parent families.
Thirty-three percent of the students reported their mother’s highest education level as having a high school diploma or GED. Approximately 54% of the mothers were reported to have some college education (2-, 4-, or advanced degree). Only 6% reported their mother not having a high school diploma and 6% choose not answer the question. National census data indicates that for females approximately 12% do not have a high school diploma or GED; 31% have a high school diploma/GED; and 56% have some college or advanced degree (U.S. Census Bureau, 2010). In terms of the father’s highest education levels, 35% responded that their father had a high school diploma/GED, with 45% reporting the father having some college or an advanced degree. Ten percent of the sample indicated their father did not have a high school diploma/GED and 8% choose not to answer the question. National census data indicates that for males, 13% do not have a high school diploma/GED; 32% do have a high school diploma/GED; and 55% have some college or advanced degree (U.S. Census Bureau, 2010). This sample is similar to the national data with the exception of the number or men having some college as being 10% lower in this sample. Also, for both the mother and father, the percentages for not having a high school diploma/GED are below the national data, but when you consider the non-respondents as possibly being a part that category, the numbers become more similar.

The average height of the group was 64 inches, with a mean weight of 130 pounds. This equals a Body Mass Index of 22, which is considered in the healthy weight for height range (Corbin et al., 2009). However, 20.7% of the sample is considered overweight or obese with BMI levels above 25. This is higher than the national average of 16% for adolescents ages 6-19 (Ogden & Carroll, 2010).
Physical Activity

The students reported engaging in an average of 6 of the 25 physical activities listed, with a mean of 14 minutes for each activity and an average weekly sum of 360 minutes for all activities listed. The weekly sum breaks down to about 51 minutes/day of activity. Girls reported engaging in 6.3 of the activities listed, for an average of 13 minutes each activity, and a total weekly duration average of 329 minutes (47 min/day). Boys engaged in 6.1 of the activities listed, for 15 minutes each time, and a total weekly duration of 371 minutes (53 min/day). The American College of Sports Medicine (2010) recommends that children should engage in at least 60 minutes of physical activity on all or most days of the week. The average for this sample is 15% below the 60 minute guideline. Fifty percent of the sample gets less than 46 minutes per day. In this sample, 12% indicated not engaging in 60 minutes of activity on at least one day of the past week. In this sample, only 1% reported not engaging in any physical activity at all during the week, however, 14% reported engaging in only 10 minutes per day. Approximately, 41% of the sample averages 60 minutes of physical activity a day. National data indicates that 37% percent of adolescents are active 60 minutes or more at least 5 days a week (CDC, 2010). This same national survey indicates 23% of adolescents did not engage in at least one day of physical activity for 60 minutes. It is possible the difference with this sample not reporting as high a percentage is the nature in which the question was asked. This methodology offered the students a list of activities and they indicated which ones and for how long they did each activity. However, in the YRBS, the question is a more straightforward question asking on how many days in the past week was the student
active for at least 60 minutes, but does not prompt them with specific activities (CDC, 2010).

**Sedentary Behaviors**

For sedentary behaviors, the overall average sedentary activity index was 7.1 out of the list of 12 activities. The average duration for each activity was 43 minutes, and the weekly duration average was 512 minutes or 73 min/day. For girls, the average number of activities was 7.6 with 46 minutes per activity and a weekly total of 552 minutes (79 min/day). For boys, the index was 6.7 with an average of 39 minutes per activity and a weekly total of 472 minutes (67 min/day). Finding national trends for all types of sedentary behavior is difficult. However, specifically for watching television, the national average for more than 3 hours/day is 32.8% among adolescents (YRBS, 2009). In this study, sedentary behaviors were indexed across multiple sedentary behaviors. The results indicated the percentage of those watching more than three hours of television was only 7.2%. Again, the question listed multiple activities and students were to indicate which activities they participated in and how long in each. The YRBS question asks whether the student watched 3 hours or more of television, yes or no, but does not ask for a specific recall amount.

T-tests were performed to compare boys’ and girls’ aspects of physical activity and sedentary behaviors (see Table 1.) The only two significant t-tests were the number of sedentary activities and the overall levels of sedentary behaviors (days x duration). Girls report a higher number of overall sedentary activities (7.64 versus 6.66) as well as 5.7 more hours/week of sedentary behaviors. Generally, girls reported engagement with
more types of physical activities and boys reported longer durations of activity, but neither aspect reached significance levels ($p < .05$).

T-tests were also performed to compare ethnicity and aspects of physical activity and sedentary behaviors (see Table 2). The data was recoded to divide the sample as “white” and “other” ($n = 437$ for “white” and $n = 87$ for “other”). The only significant difference by ethnicity is the total duration per week of physical activity. The group classified as other engaged in an average of 2.4 hours/week more physical activity than the students who classified themselves as white. There were no differences by ethnicity with the number of overall physical activities, number of overall sedentary activities, or weekly duration of sedentary activity.

Table 1

Means and Standard Deviations and t-test Values for Physical Activity and Sedentary Behavior by Gender

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Total</th>
<th>Boys</th>
<th>Girls</th>
<th>$t$</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity Index</td>
<td>6.20</td>
<td>6.08</td>
<td>6.32</td>
<td>-.911</td>
<td>.363</td>
</tr>
<tr>
<td></td>
<td>(3.06)</td>
<td>(3.12)</td>
<td>(3.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Activity</td>
<td>8.44</td>
<td>8.96</td>
<td>7.92</td>
<td>1.30</td>
<td>.194</td>
</tr>
<tr>
<td>Duration</td>
<td>(9.24)</td>
<td>(9.28)</td>
<td>(9.18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary Index</td>
<td>7.16</td>
<td>6.66</td>
<td>7.64</td>
<td>-5.52</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>(2.10)</td>
<td>(2.12)</td>
<td>(1.97)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary Duration</td>
<td>25.07</td>
<td>22.19</td>
<td>27.89</td>
<td>-4.35</td>
<td>.000</td>
</tr>
<tr>
<td></td>
<td>(15.31)</td>
<td>(14.33)</td>
<td>(15.75)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Index is number of activities. Duration is hours/week. Total N = 527; Girls = 266; Boys = 261. Standard deviations are in parentheses.
Table 2
Means and Standard Deviations and t-test Values for Physical Activity and Sedentary Behavior by Ethnicity

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Total</th>
<th>White</th>
<th>Other</th>
<th>t</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Activity Index</td>
<td>6.20</td>
<td>6.11</td>
<td>6.68</td>
<td>-1.619</td>
<td>.106</td>
</tr>
<tr>
<td></td>
<td>(3.06)</td>
<td>(2.92)</td>
<td>(3.66)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Activity Duration</td>
<td>8.44</td>
<td>8.02</td>
<td>10.43</td>
<td>-2.254</td>
<td>.025</td>
</tr>
<tr>
<td></td>
<td>(9.24)</td>
<td>(8.66)</td>
<td>(11.49)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary Index</td>
<td>7.16</td>
<td>7.15</td>
<td>7.17</td>
<td>-.055</td>
<td>.956</td>
</tr>
<tr>
<td></td>
<td>(2.10)</td>
<td>(2.07)</td>
<td>(2.25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sedentary Duration</td>
<td>25.07</td>
<td>24.99</td>
<td>25.39</td>
<td>-.226</td>
<td>.822</td>
</tr>
<tr>
<td></td>
<td>(15.31)</td>
<td>(15.55)</td>
<td>(14.17)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Index is number of activities. Duration is hours/week. Total N=527; “white = 437; “other = 87. Standard deviations are in parentheses.

**Structural Equation Modeling**

Structural Equation Modeling (SEM) is a statistical methodology that takes a confirmatory (i.e., hypothesis testing) approach to the analysis of a structural theory bearing on some phenomenon (Byrne, 2001). Structural equation modeling is one of the most commonly used data analytic techniques in the social and behavioral sciences (Kenny, Kashy, & Cook, 2006); however applications of SEM to assess factors that influence physical activity are relatively new (Mâsse et. al, 2002). SEM provides information about the processes through which theoretical constructs influence physical activity, as it allows for calculation of a variable’s direct, indirect, and total effects on the outcome variable (Kline, 2005). It is expected these processes represent “causal” influences that generate observations on multiple variables (Bentler, 1988). Two aspects of the procedure are highlighted: “(a) that the causal processes under study are
represented by a series of structural (i.e. regression) equations, and (b) that these
structural relations can be modeled pictorially to enable a clearer conceptualization of the
theory under study” (Byrne, 2001, p. 3).

A structural equation model can be divided into two parts, the measurement
model and the structural model (Byrne, 2001). The measurement model is the
relationship between the observed (manifest) and the unobserved (latent) variables. This
indicates the link between the actual scores on a measuring instrument and the underlying
construct they are designed to measure. The structural model specifies the relationships
among the unobserved variables and which particular latent variables predict changes
(i.e., “cause”) in the values of certain other latent variables in the model (Byrne, 2001, p.
12). The overall model of these relationships, the structural model, may be analyzed in
terms of goodness of fit statistics.

The models were tested with maximum likelihood estimates using AMOS 18.0
software (Arbuckle, 2009). First, the variables within the latent factors were analyzed for
their confirmatory factor loadings. The variable of school modeling did not reach a
critical ratio on the environmental support factor and was dropped from the model.
School modeling was also the variable that had exceptionally low reliability (0.331). All
other variables within the environmental support and intrapersonal factors latent factors
loaded with significant critical ratios.

The parameter estimates were analyzed for correlations that are >1.00, negative
variances, and covariance or correlation matrices that are not positive definite. With
some of the models, there was negative variance and it was decided to change the
outcome variable to just the duration variable and not to include the index of physical activity (the overall number of activities). This makes theoretical sense as the overall duration of activity is important and not so much the number of specific activities. The standard errors were then analyzed. There is no definitive criterion for large or small standard errors (Byrne, 2001). This model contained standard errors that seemed too large, requiring the application of Blom’s transformations to create more normalized distribution scores. Finally, the significance of the parameter estimates is analyzed by the critical ratio (C.R.) test statistic. The C.R. should be >± 1.96 \( (p < .05) \) such that the parameter is significant in the model.

The path models were then analyzed as a whole using goodness-of-fit tests. First, although chi-square statistics are commonly used to determine model fit, this sample size is too large for the significant chi-square to be used as a reliable measure of model fit, or actually the misspecification of the model, as a non-significant chi-square would be preferred. The significant chi-square should not be used alone as an indicator to modify the model (Byrne, 2001; Garson, 2011; Kline, 2005). Therefore, other indices such as goodness-of-fit (GFI), adjusted goodness of fit (AGFI), comparative fit index (CFI), and the root mean square error of approximation (RMSEA) were analyzed to determine model fit. The GFI, AGFI, and CFI range from zero to 1.00 with values above .90 being representative of good model fit (Byrne, 2001). RMSEA values of less than .05 indicate good model fit and values up to .08 represent an adequate fit (Byrne, 2001). Hu and Bentler (1999) have suggested a value of .06 as a cutoff for good model fit. RMSEA values of .08-.10 indicate a mediocre fit and values above .10 are indicative of a poorly fitting model (Hu and Bentler, 1999). In addition to the actual RMSEA value, a 90%
confidence interval and a p value (pclose) is examined with this statistic. One would want to see narrow confidence intervals indicating better precision with the value suggesting better model fit (MacCallum, Browne, & Sugawara, 1996). In addition, the pclose value should be greater than .05 (Kenny, 2011). The pclose value tests the null hypothesis that the RMSEA value is not greater than .05. If the pclose value is less than .05, the null hypothesis is rejected and it is possible the computed RMSEA is greater than .05 indicating a poor fitting model.

**Bootstrapping**

In addition to the goodness-of-fit tests, the analysis also included bootstrap procedures. Bootstrap procedures allow for examination of the stability of the parameter estimates and thus allow for more confidence in their accuracy (Byrne, 2001). Even with large sample sizes, multivariate normality may not be an accurate assumption (Byrne, 2001; Preacher & Hayes, 2008; Yung & Bentler, 1996). “Empirical distributions resulting from bootstrap analysis are especially useful for estimating the confidence interval of a given population parameter” (Mallinckrodt, Abraham, Wei, & Russell, 2006). Should the resulting confidence intervals from the bootstrap methods not include zero, the path can be assumed to be statistically significant with greater accuracy. This would indicate that because the confidence interval does not contain zero, the hypothesis that the regression weight can equal zero in the population can be rejected (Byrne, 2001). In AMOS 18.0 (Arbuckle, 2009), the analysis was set at a bootstrap of 1,000 samples with a bias-corrected confidence interval of 90% (default). For examining the path models and parameter significance in this study, the bootstrap confidence intervals have all been confirmed as stable and supporting the initial significant regression weights.
Re-specification of the Models

Based upon the critical ratio parameter estimates and the different fit indices, the models were examined to decide whether or not to re-specify and re-estimate the model. It is important to note that the analysis is now exploratory, rather than confirmatory. The original hypothesized model has been rejected due to a lack of fit. This is termed “model generating” and occurs when the initial model does not fit the data and is modified by the researcher (Byrne, 2001; Kline, 2005). These changes are applied one at a time and the estimates and fit indices are re-examined. It is important to emphasize the post hoc modification indices are used only if each made theoretical sense.

Moderation

The latent variable structure of this model makes moderation analysis more complicated than just having two manifest variables where an interaction term can be created by multiplying each manifest variable. Two methods were considered. One creates a factor score from the manifest variables in a varimax rotation, and then the factor score is multiplied by the other variable to create the interaction term (Hopwood, 2007). The second method takes the manifest variable with the largest factor loading onto the latent variable and uses that in creating the interaction term (Wei, Mallinckrodt, Russell, and Abraham, 2004). This study chose the second method due its clarity of explanation and empirical support in its argument (Joreskog & Yang, 1996).

Variables in Structural Equation Analysis

Four models were developed: 1) direct effects model with mediated pathways for physical activity; 2) direct effects model with mediated pathways for sedentary
behaviors; 3) a moderated model for physical activity; and 4) a moderated model for sedentary behaviors. First, the direct effects models for both physical activity and sedentary behaviors consisted of Environmental Support (community instrumental support, community modeling, school instrumental support), Intrapersonal factors (attitudes, self-efficacy), Parental Modeling, Parental Encouragement, Mental Health, and Physical Health (see Figures 1 and 3). The model for sedentary behaviors contains the same variables; however, modeling and encouragement are specific for each activity. Meaning, the physical activity model has the parental modeling variable reflecting parent physical activity, whereas in the sedentary model, the variable is measuring parental modeling of sedentary behaviors. Similarly, the parental encouragement variable reflects encouragement for physical activity or encouragement for sedentary types of behavior. The mediating models consisted of Intrapersonal factors (attitudes and self-efficacy) mediating the relationships between Environmental Support, Parental Modeling, Parental Encouragement, Mental Health, Physical Health and Physical Activity/Sedentary Behavior (see Figures 1 and 3). Pearson-r correlations were conducted to determine whether the relationships between the variables were consistent with the theoretical predictions. A table of all means and standard deviations can be found in Table 3. Tables for correlations among the variables for the entire sample and for both boys and girls separately can be found in Table 4.
Physical Activity

Model 1: Direct effects for physical activity –Full Sample.

The initial structural model resulted in good model fit ($\chi^2 = 63.08, df=38, p < 0.006$, GFI = 0.977, AGFI = 0.933, CFI = 0.962, RMSEA = 0.035 [90% CI = 0.019, 0.051, PCLOSE = 0.943]). The model explained 19% of the variance in physical activity. The direct pathways from environmental support, intrapersonal factors, parental modeling, and adolescent physical health were significant predictors for physical activity. Higher levels of environmental support yielded higher levels of physical activity ($\beta = 0.170$, C.R. 2.184, $p = 0.029$). Higher levels of intrapersonal factors also indicated higher levels of physical activity ($\beta = .237$, C.R. 2.611, $p =0.009$). Parental modeling of physical activity was also positively related to adolescent physical activity ($\beta = 0.188$, C.R. = 3.780, $p < 0.001$). Adolescent physical health was inversely related to levels of physical activity ($\beta = -0.212$, C.R. = -4.733, $p <0.001$). Adolescent mental health and parental encouragement were not significantly related to adolescent physical activity levels. The complete structural model with the standardized regression coefficients and critical ratios for both the significant and insignificant pathways are presented in Figure 5.
Figure 5. Physical Activity Direct Effects - Full Sample.

Note. Solid lines represent significant paths ($p < 0.05$). Dashed lines are insignificant paths. The standardized regression coefficients are reported with critical ratio values in parentheses. Correlation paths between the variables and error terms have been omitted from the figure.

**Model 1(a): Direct effects for physical activity – Females.**

The structural model for the direct effects of the variables on physical activity for females resulted in good model fit ($\chi^2 = 32.59$, $df = 19$, $p = 0.027$, GFI = 0.976, AGFI = 0.931, CFI = 0.969, RMSEA = 0.052 [90% CI = 0.018, 0.082, PCLOSE = 0.422]). The model explained 14.5% of the variance of physical activity for girls. The direct pathways from intrapersonal factors, parental modeling, and adolescent physical health were significant. Higher levels of intrapersonal factors indicated higher levels of physical activity ($\beta = 0.231$, C.R. = 2.101, $p = 0.036$). Parental modeling was positively related to
levels of physical activity ($\beta = 0.201$, C.R. = 3.040, $p = 0.002$). Adolescent physical health was inversely related levels of physical activity ($\beta = -0.223$, C.R. = -3.600, $p < 0.001$). Environmental factors, encouragement, and adolescent mental health were not significantly related to levels of physical activity.

The complete structural model with the standardized regression coefficients and critical ratios for both the significant and insignificant pathways are presented in Figure 6.

Figure 6. Physical Activity Direct Effect – Females.

Note. Solid lines represent significant paths ($p < 0.05$). Dashed lines are insignificant paths. The standardized regression coefficients reported with critical ratio values in parentheses. Correlation paths between the variables and error terms have been omitted from the figure.
Model 1(b): Direct effects for physical activity – Males.

The structural model for the direct effects of the variables on the levels of physical activity for males resulted in good model fit ($\chi^2 = 30.49$, $df = 19$, $p = 0.046$, GFI = 0.977, AGFI = 0.934, CFI = 0.974, RMSEA = 0.048 [90% CI = 0.007, 0.079, PCLOSE = 0.500]). The model explained 32% of the variance of physical activity in boys. The direct pathways from environmental support and adolescent physical health were significantly related to levels of physical activity. Higher levels of environmental support indicated higher levels of physical activity ($\beta = 0.389$, C.R. = 2.446, $p = 0.014$). Adolescent physical health was inversely related to levels of physical activity ($\beta = -0.272$, C.R. = -3.725, $p < 0.001$). Intrapersonal factors, encouragement, adolescent mental health, and parental modeling were not significantly related to levels of physical activity. The complete structural model with the standardized regression coefficients and critical ratios for both the significant and insignificant pathways are presented in Figure 7.
Figure 7. Physical Activity Direct Effect – Males.

Note. Solid lines represent significant paths ($p < 0.05$). Dashed lines are insignificant paths. The standardized regression coefficients are reported with critical ratio values in parentheses. Correlation paths between the variables and error terms have been omitted from the figure.

Model 2 – Mediation Pathways for Physical Activity – Full Sample

For the full sample, intrapersonal factors mediated the relationships between environmental factors, parental encouragement, mental health, and physical health to levels of physical activity and represented a good fit for the data ($\chi^2 = 52.47$, $df=19$, $p = 0.000$, GFI=0.980, AGFI=0.943, CFI=0.962, RMSEA = 0.058 [90% CI = 0.040, 0.077, PCLOSE=0.223]). The two-tailed significance bias corrected p-values for the indirect effects are as follows: environmental factors, $p = 0.01$; parental encouragement, $p =$
0.023; mental health, \( p = 0.019 \); and physical health, \( p = 0.048 \). Direct pathways for environmental factors, physical health, and parental modeling to levels of physical activity are also significant in the model. The direct pathway for parental encouragement for physical activity was not significant.

The model explains 19% of the variance for physical activity in this sample. The final model with standardized regression coefficients and critical ratios for the significant and non-significant pathways is shown in Figure 8.

Figure 8: Mediated Model – Full Sample.
Note. Solid lines represent significant paths (\( p < 0.05 \)). Dashed lines are insignificant paths. The standardized regression coefficients are reported with critical ratio values in parentheses. Correlation paths between the variables and error terms have been omitted from the figure.
Model 2(a) – Mediation pathways for Physical Activity – Females

For girls, intrapersonal factors mediated the relationships between environmental factors, parental encouragement, mental health to levels of physical activity and represented a good fit for the data ($\chi^2 = 32.59$, $df = 19$, $p = 0.027$, GFI=0.976, AGFI=0.931, CFI=0.969, RMSEA = 0.052 [90% CI = 0.018, 0.082, PCLOSE=0.422]). The two-tailed significance bias corrected p-values for the indirect effects were as follows: environmental factors, $p = 0.033$; parental encouragement, $p = 0.048$; and mental health, $p = 0.025$. Direct pathways for environmental factors and encouragement were not significant in the model. Direct pathways for physical health and modeling for physical activity were significant.

The model explained 14.5% of the variance in girls’ physical activity. The final model with standardized regression coefficients and critical ratios for the significant and non-significant pathways is shown in Figure 9.
Figure 9: Mediated Model – Females. Solid lines represent significant paths (p<0.05).
Note. Dashed lines are insignificant paths. The standardized regression coefficients are reported with critical ratio values in parentheses. Correlation paths between the variables and error terms have been omitted from the figure.

**Model 2(b) – Mediation pathways for Physical Activity – Males**

For boys, intrapersonal factors were not a mediator in the model, therefore this model is not presented. Direct pathways from environmental factors and physical health to levels of physical activity were significant (see Figure 7), but the pathways from environmental factors and physical health to intrapersonal factors were not significant. Also, the pathway from intrapersonal factors to physical activity was not significant. Analysis of the two-tailed bias corrected indirect effects confirmed the insignificance of mediation for boys.
Moderation effects

The hypotheses of the role of environmental factors as moderators of the effects between intrapersonal factors, parental modeling, and parental encouragement on physical activity were tested based on the method outlined by Wei et al. (2004). There were no significant moderation effects in the full sample or separately for boys or girls.

Sedentary Behavior Models

Model 3: Direct effects for sedentary behaviors – Full sample.

The models for the direct effects of sedentary behaviors initially contained all of the variables as the physical activity model so as to compare and contrast the distinct indicators of each adolescent outcome behavior. However, the key differences were the modeling and encouragement variables for the sedentary models reflect the parents’ sedentary behaviors and parental encouragement for sedentary activities, whereas in the physical activity model, the variables are related to parental behavior in the context of physical activity. The overall model for sedentary behaviors indicated a good fitting model ($\chi^2 = 60.483, df = 19, p < 0.001, GFI = 0.977, AGFI = 0.935, CFI = 0.943, RMSEA = 0.064 [CI 90% = 0.047, 0.083, PCLOSE = 0.089]$). The only variables significantly related to levels of sedentary behaviors were parental encouragement for sedentary activity and parental modeling of sedentary activity. Parental encouragement for sedentary behaviors was positively associated with adolescent sedentary behaviors ($\beta = 0.185, C.R. = 4.760, p < 0.001$). Parental modeling for sedentary behaviors was a very strong predictor in adolescent sedentary behaviors ($\beta = 0.415, C.R. = 10.257, p < 0.001$). Environmental support, intrapersonal factors, adolescent physical health, and adolescent
mental health were all insignificant pathways in the complete model. The overall model explained 29% of the variance in adolescent sedentary levels. This model is represented in Figure 10.

Figure 10. Sedentary Direct Effects – Full Sample.

Note. Solid lines represent significant paths ($p < 0.05$). Dashed lines are insignificant paths. The standardized regression coefficients are reported with critical ratio values in parentheses. Correlation paths between the variables and error terms have been omitted from the figure.

**Model 3(a): Direct effects for sedentary behaviors – Females.**

The sedentary model for females was similar to the overall sedentary model representing a good fitting model ($\chi^2 = 36.81, df = 19, p =0.008, GFI= 0.974, AGFI = 0.925, CFI =0.950, RMSEA = 0.059 [90% CI = 0.029, 0.088, PCLOSE = 0.268]$). Parental encouragement for sedentary activity and parental modeling for sedentary
activity were the only significant pathways. Parental encouragement for sedentary behaviors was positively related to adolescent sedentary behavior levels ($\beta = 0.243$, C.R. $= 4.306$, $p < 0.001$). Parental modeling of sedentary behaviors was also positively related to adolescent sedentary behavior levels ($\beta = 0.386$, C.R. $6.983$, $p < 0.001$).

The model explains 27% of the variance of girls’ sedentary behaviors. The final model with standardized regression coefficients and critical ratios is shown in Figure 11.

Figure 11. Sedentary Direct Effects – Females.

Note. Solid lines represent significant paths ($p < 0.05$). Dashed lines are insignificant paths. The standardized regression coefficients are reported with critical ratio values in parentheses. Correlation paths between the variables and error terms have been omitted from the figure.
Model 3(b): Direct effects for sedentary behaviors – Males.

The model for boys was similar to the overall sedentary model and represented a good fit for the data ($\chi^2 = 34.89, df = 19, p = 0.014$, GFI=0.974, AGFI=0.923, CFI=0.955, RMSEA=0.057 [90% CI = 0.025, 0.086, PCLOSE=0.324]). Parental encouragement was positively related to boys’ sedentary levels ($\beta = 0.193$, C.R. =3.499, $p < 0.001$). Parental sedentary behaviors was also positively related to boys’ sedentary behavior levels ($\beta = 0.427$, C.R. = 7.117, $p < 0.001$). No other pathways were significant.

The model explained 32% of the variance in boys’ sedentary behaviors. The final model with standardized regression coefficients and critical ratios for the significant and non-significant pathways is shown in Figure 12.
Figure 12. Sedentary Direct Effects – Males.

Note. Solid lines represent significant paths ($p < 0.05$). Dashed lines are insignificant paths. The standardized regression coefficients are reported with critical ratio values in parentheses. Correlation paths between the variables and error terms have been omitted from the figure.

**Model 4 – Mediation Pathways for Sedentary Behaviors**

Intrapersonal factors did not mediate any of the relationships in the sedentary behaviors model. Environmental support had a significant pathway to Intrapersonal factors, but the pathway from intrapersonal factors to sedentary behaviors was not significant. Parental modeling and parental encouragement for sedentary behaviors still had strong direct effects for adolescent sedentary behaviors.
Moderation

The hypotheses of environmental factors moderating the effects of intrapersonal factors, parental modeling, and parental encouragement on sedentary behaviors were tested based upon the method outlined by Wei et al. (2004). In addition, moderation of each parental modeling and parental encouragement upon intrapersonal factors was also tested. There were no moderation effects in the full sample or separately for boys or girls.
CHAPTER V

Discussion

This discussion will first address the findings related to levels of adolescent physical activity and sedentary behaviors, along with the relevant correlational findings. Next, the significant findings of the path models for physical activity and sedentary behaviors will be highlighted. Then, strengths and weaknesses of this research, future directions, and public policy implications for research in this area will be discussed.

Levels of Physical Activity

On average, neither boys nor girls reported engaging in the recommended amount of 60 minutes of daily physical activity endorsed by the American College of Sports Medicine (ACSM, 2010). Boys reported engaging in an average of 51 minutes/day and girls reported 47 minutes/day. In this sample 12% of adolescents reported that they did not engage in at least one day of physical activity for 60 minutes versus a national average of 23% for this statistic (CDC, 2010).

As mentioned previously, measuring levels of physical activity is difficult and involves researchers weighing issues of accuracy and practicality. Particularly with self-reports, there are a variety of ways to measure physical activity (e.g., diaries, logs, interviews, questionnaires), but these methods all share a common reliance on the participants to estimate and recall their activity level (Marshall & Welk, 2008). The YRBS is considered a general measure of typical activity and asks a relatively simple, straightforward question of how many days in the past week was the student active for at least 60 minutes (CDC, 2010). However, critics of this self-report format indicate that
the participant may not remember everything that he/she did, or interpret the question as being continuously active for an entire 60 minute time-frame. Several adaptations were made to the YRBS in this study. The question on physical activity used in this study used a recall-based approach and asked participants if they participated in a particular set of different physical activities. Specific prompting was used to assess for how many days over the past week the participant had engaged in each activity (if they had participated in it) and another question regarding how long he/she may have participated in that specific activity. This was important because students may not have participated in one activity for 60 minutes, but engaged in a variety of activities which could have totaled 60 minutes - the recommended levels of physical activity suggested by the ACSM. However, the shortcomings of recall-based measures remain in that they often take longer to complete, the input of data is more burdensome, and the statistical calculations of overall levels of physical activity are more complicated (Marshall & Welk, 2008).

Specifically related to levels of physical activity, there was no statistical difference in the levels of physical activity between boys and girls. Generally, girls reported engagement with more types of physical activities and boys reported longer durations of activities, but neither reached levels of significance (refer to Table 1). Whereas several investigations have indicated that boys engage in more physical activity than girls (Armstrong & Biddle, 1992; Biddle, Gorely, & Stensel, 2004; Dolinsky, Namenek Brouwer, Evenson, Siega-Riz, & Ostbye, 2011; Jago, Fox, Page, Brockman, & Thompson, 2010; Kahn et al., 2008; Kowalski, Crocker, & Kowalski, 1997; Rosenkranz, Welk, Hastmann, & Dzewaltowski, 2011;Ross & Pate, 1987; Sallis, 1994; Santos, Page, Cooper, Ribeiro, & Mota, 2008; Trost et al., 2003; Van Mechelen, Twisk, & Post, 2000;
Zecevic, Tremblay, Lovsin, & Michel, 2010) other studies have reported no gender differences in levels of physical activity (Bauer, Nelson, Boutelle, & Neumark-Sztainer, 2008; Fummeler, Anderson, & Mässé, 2011; Smith, Rhodes, Naylor, & McKay, 2008). The inconsistency in research findings may be due to contextual differences in the measurement of physical activity. Boys are more active than girls in organized and non-organized competitive sports (basketball, baseball, football); however, other non-sport aerobic activities (e.g., skipping, bicycling, jogging, swimming) show no consistent gender differences (Malina, 2008). This dissertation used a recall format that had 24 different activities that included competitive sports and general aerobic activities which may have allowed girls to report higher levels of physical activity than if just competitive sports had been listed.

Levels of Sedentary Behavior

The average time spent on sedentary activities was 73 minutes/day, with girls spending 79 minutes/day and boys spending 67 minutes/day. On average, participants watched television for 72 minutes and 58.8% watched television for 60 minutes or less each day. Only 7.2% of participants watched television for 3 hours or longer each day. These numbers are lower than that reported in national surveys (32.8% of adolescents spend more than 3 hours/day watching television) (YRBS, 2010).

The reported differences between the findings from this investigation and the YRBS may be due to variations in the question format used in the two studies. In the YRBS, the question was asked in a yes/no as to whether the participant watched more than 3 hours of television on each of the previous days. In this questionnaire a list of sedentary activities was provided to the participant who was asked to indicate which
activities he/she participated in, and to report on how many days and for how long they
did each activity. It should be noted that in the administration of the questionnaire,
students found it difficult and onerous to complete this section of the questionnaire.
Some of the questions asked by the participants during the data collection process had to
do with “multi-tasking” of activities. For example, two questions asked of the
participants were the frequency and the length of time that they engaged in “watching
television, dvds, or videos” and “sitting to do homework”. Many students indicated they
watched TV at the same time they did their homework. So if the student answered the
question by indicating just the time they were doing their homework, but did not also
include the time spent watching television, the television viewing time would not be as
high. However, it is important to note that the strategy used in this study to measure
sedentary activities did not double-count the time spent in sedentary activities. It does
capture the overall time spent on sedentary activities by adolescents.

Specifically for sedentary behaviors, there was a gender difference in the both the
overall number of sedentary activities reported and the duration of sedentary behaviors.
Girls reported on average participating in at least one more activity and for about 5
minutes longer per session than boys. Some studies reported gender differences with
girls reporting more sedentary behaviors than boys (Byun, Dowda & Pate, 2011) whereas
others found no gender differences with sedentary behaviors (Bauer et al., 2008; Norman,
Schmid, et al., 2005; Smith et al., 2008). Further, in a review of correlates of sedentary
behaviors, Gorely et al. (2004) found that gender showed no association with television
viewing. The previously referenced study by Norman, Schmid, et al. (2005) found no
overall gender differences in sedentary behaviors, no differences in television/video time,
but did find that boys reported more time playing computer games whereas girls spent
more time sitting and listening to music and talking on the phone. Hence, the type of
sedentary behaviors being assessed matters and a focus on television alone will not
capture the full extent of the nature of sedentary behaviors.

**Comparing Levels of Physical Activity and Sedentary Behavior**

A key focus of this dissertation was to examine whether physical activity and
sedentary behaviors were not merely at opposite ends of a continuing spectrum, but to
also examine whether there were specified correlates and explanatory models for each
behavior. Physical activity and sedentary behaviors were positively correlated ($r = .185$,
$p < 0.01$) which suggests that adolescents can engage in high levels of physical activity as
well as sedentary behaviors (Jago, et al., 2010; Marshall & Welk, 2008; Zabinski et al.,
2007). Findings supported different correlates for physical activity and sedentary
behavior (refer to Table 4). Notably, physical activity was positively correlated with
adolescent self-efficacy ($r = .143$, $p < 0.01$) and sedentary behavior was not. If the two
behaviors were at opposite ends of a spectrum, one would expect sedentary behaviors to
be inversely correlated with self-efficacy. Also, adolescent mental health was not
correlated to physical activity. However, it was inversely correlated with sedentary
behaviors ($r = -.086$, $p < 0.05$). Adolescents with higher levels of positive mental health
engage in the lower levels of sedentary behaviors. Adolescent attitude towards physical
activity was not correlated to physical activity. However, it was inversely correlated with
sedentary behaviors ($r = -.137$, $p < 0.01$) suggesting that if an adolescent has a less
favorable attitude towards physical activity, he/she would be more sedentary. Similar to
findings from this study, previous research also showed that physical activity and
sedentary behaviors had different correlates (Byun, Dowda, & Pate, 2011; Gordon-Larsen et al., 2000; Norman, Schmid, et al., 2005; Smith et al., 2008).

It should be noted that physical health showed a significant negative correlation with both physical activity and sedentary behaviors. It makes sense for physical health to be negatively correlated with sedentary behaviors. This means the higher a person’s physical health, the lower their level of sedentary behaviors. However, it was expected that a high level of physical health would correlate with higher level of physical activity. The mean for the sample was 2.7 out of 3 and 50% of the sample had a mean score of 2.9 or higher. The distribution was highly negatively skewed. Therefore, most of the scores in the bottom 50% of the measure are not really considered poor physical health. The factor analysis and reliability statistics support the soundness of the measure; however, it is possible that it lacks the precision to analyze adolescent physical health. These questions on physical health were drawn from the SF-36 instrument (Ware & Sherbourne, 1992). The questions addressed how limited the adolescent was in performing certain activities (walking a mile, bending, climbing stairs, etc.). A re-examination of the measure indicated that the questions did not accurately reflect adolescent physical health. In future studies, a more appropriate adolescent health measure should be considered in place of the SF-36.

The two parental encouragement variables, one for physical activity and one for sedentary behaviors indicated a significant inverse relationship – in the expected direction. It was anticipated that parents who encouraged physical activity would have rules or set limits on sedentary behaviors.
Finally, in the full sample correlations, body mass index (BMI) was not significantly correlated to physical activity, but was significantly and positively related to sedentary behaviors ($r = .114, p < 0.01$). This meant that adolescents who had a high body mass index were more sedentary in this sample. This finding is important from an intervention perspective because it suggests that adolescents who have high BMI are perhaps more sedentary than their peers who have average or low BMIs. Previous research has supported the relationship between BMI and sedentary behaviors (Anastassia-Vlachou, Fryssira-Kanioura, Xipolita-Zachariadi, & Matsaniotis, 1996; Grund, Krause, Siewers, Rieckert, & Muller, 2001; Guillaume, Lapidus, Bjorntorp, & Lambert, 1997; Norman, Schmid, et al., 2005; Robinson, 1999).

**Correlation Comparisons between Boys and Girls**

In reviewing the correlation matrices for boys and girls, there were some notable differences. First, self-efficacy and attitudes towards physical activity were significantly correlated to levels of physical activity for boys ($r = .207, p < 0.01$), but not for girls. A review of correlates of physical activity in children and adolescents showed that self-efficacy had an “indeterminate” relationship to levels of physical activity (Sallis et al., 2000). More recent studies have shown that self-efficacy has strong correlations with levels of physical activity (Fein et al., 2004; Heitzler, Lytle, Erickson, Barr-Anderson, Sirard, & Story, 2010; Rovniak et al., 2002). In a study by Trost et al. (2001) where obese with non-obese participants were compared, non-obese students reported higher levels of physical activity and also reported higher levels of self-efficacy. In studies conducted with girl participants, self-efficacy was found to be positively related to levels
of physical activity (Motl et al. 2002; Motl et al., 2007; Dowda, Dishman, Pfeiffer, & Pate, 2007).

In the correlational analysis, parental encouragement and parental modeling were both significantly correlated with physical activity for boys ($r = .240, p < 0.01; r = .271, p < 0.01$), whereas the association between parental modeling (and not parental encouragement) and physical activity was significant for girls ($r = .258, p < 0.01$). In regards to both modeling and encouragement, previous research is equivocal. In the review by Sallis et al. (2000), parental modeling had an indeterminate relationship with youth physical activity and no association with adolescent physical activity. Also in this review, parental encouragement was not associated with youth physical activity, but did show a positive relationship to adolescent physical activity. In a more recent review of parental correlates, Gustafson and Rhodes (2006) found that in 56% of the studies reviewed, boys tended to receive more parental support to be active. Another meta-analysis showed no statistical difference between boys’ and girls’ reports of parental socialization variables in reference to physical activity (Pugliese & Tinsley, 2007)

**Structural Equation Models**

**Physical activity direct effects model.**

For the full sample, physical health showed the strongest relationship with physical activity, followed by parental modeling, intrapersonal factors, and environmental support. It is difficult to explain why physical health showed such a strong inverse relationship to adolescent physical activity. It was expected for physical health to positively impact physical activity, not vice versa. One possible explanation as
already outlined in the correlational discussion is that the questions assessing physical health as applied to this sample did not capture enough of a range to make the construct applicable. As indicated earlier, other measures of adolescent physical health may better capture its relationship to physical activity. For example, measuring barriers like asthma or disabilities may be more relevant for impacting levels of physical activity.

When comparing the physical activity models between boys and girls, there were three notable differences. Parental modeling had a significant direct effect for girls but not for boys. Intrapersonal factors were also significant for girls but not for boys. Environmental support had a significant direct effect for boys but not for girls. Both boys and girls still maintained significant direct effects for physical health. These findings indicated that there may be a very important gender distinction in the mechanisms related to physical activity. For boys, environmental supports were important. For girls, parental modeling and intrapersonal factors were important. It should be noted that parental encouragement and mental health were not a significant direct pathways for either boys or girls. Previous research has shown that parental support (measured as logistic support and modeling) was a significant pathway predicting physical activity in a sample of girls (Davison, Downs, & Birch, 2006). Taken together, findings from this investigation along with findings from prior research (e.g. Trost et al., 2003) suggest that parental modeling and other parental support variables (transportation and other logistic support) may be important variables for increasing physical activity for both boys and girls. Regarding the difference in the models that environmental factors was significant for boys but not for girls, previous research was very limited in supporting this finding. There was support for environmental factors supporting physical
activity, but little evidence supporting gender differences with these variables. Fein et al. (2004) found that school physical environments were more important to male students and that gender moderated the relationship between perceived importance of the school environment and physical activity. The researchers contended that their findings implied that female’s perceptions of the school’s physical environment may have limited influence on girls’ physical activity. In a review of correlates of physical activity, Sallis et al. (2000) found that access to facilities and programs were positively and consistently related to children’s physical activity, but unrelated to adolescent physical activity. In another review, Davison and Lawson (2006) found that the availability of facilities and the availability of play areas and permanent activity structures in school play areas were associated with higher physical activity. However, in another review of environmental correlates, the availability and accessibility to equipment and facilities was unrelated to levels of physical activity (Ferreira, van der Horst, Wendel-Vos, Kremers, van Lenthe, & Brug, 2006). Notably, in a study examining individual, social, and physical environment determinants of physical activity, Giles-Corti and Donovan (2002) found that individual and social determinants outweighed the influence of the physical environment in achieving recommended levels of physical activity. However, they suggested that environmental supports do aid in the achievement of recommended levels by providing the opportunity to be active. They also suggested that having good access to recreational facilities is necessary but insufficient for achieving recommended levels of physical activity. The findings by Giles-Corti and Donovan along with previous research and the current results support the use of ecological models along with social-cognitive theory in trying to explain why adolescents are physically active.
Intrapersonal factors (self-efficacy and attitudes) were salient contributors to the direct effects model for girls but not for boys (similar to findings by DiLorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Motl et al., 2002). This finding provides support for investigating social cognitive variables and their effect on physical activity. Simply put, the more adolescents perceive that they are competent with physical activity, the more likely they are to be engaged in physical activity.

**Mediated model for physical activity.**

In the full sample, environmental support, parental encouragement, adolescent mental and physical health were significantly related to intrapersonal factors, and intrapersonal factors was in turn related to physical activity. Adolescent physical health, environmental support, and parental modeling still maintained direct influences on physical activity. Parental encouragement and mental health were not shown to directly impact physical activity, but have indirect effects through the relationship to intrapersonal factors.

For girls, intrapersonal factors were a mediator in the relationships between environmental support, parental encouragement, mental health and adolescent physical activity. Physical health was not directly linked to physical activity through intrapersonal factors (only showed a direct relationship to physical activity). The direct effect of environmental support was fully mediated by intrapersonal factors. For girls environmental support did not show direct effects to adolescent physical activity in the mediated model.
Previous research had provided strong evidence for intrapersonal factors like self-efficacy and attitudes toward physical activity to be mediators in the relationships between various factors and physical activity. Biddle and Goudas (1996) found that perceived sport competence mediated the relationship between adult encouragement and adolescent strenuous physical activity. Wu, Pender, and Noureddine (2003) found that self-efficacy mediated the relationship between peer influences and perceived barriers to physical activity. Motl et al. (2007) found that barriers self-efficacy mediated the relationships between equipment accessibility and physical activity and between social support and physical activity. No gender differences were found in prior research in this area. In this sample, self-efficacy was seen as a mediator only for girls. Increasing parental encouragement, environmental supports for physical activity, and mental health may be important for increasing self-efficacy in girls, which may increase their levels of physical activity. Keep in mind that for girls none of these variables showed a direct effect to physical activity in the direct effects model. It was only through the mediated model that these relationships became evident.

**Sedentary behavior direct effects model.**

Parental modeling and parental encouragement showed significant pathways in the anticipated direction in the full model. Parental modeling of sedentary behaviors and parental encouragement for sedentary behaviors were positively related to higher levels of adolescent sedentary behaviors. In the review of literature, there were no studies using a structural equation analysis for modeling factors influencing sedentary behaviors. Therefore, similarities and differences with the findings will be discussed with previous research that used correlational or regression analysis.
Gorely et al., (2004) found that parent’s television viewing habits and the adolescent having a television in his/her bedroom was correlated to higher levels of sedentary behaviors. Jago et al. (2010) found that parents’ overall sedentary time also predicted levels of sedentary activity in girls, but not in boys. These findings showed that parental modeling of sedentary activity strongly influenced the children’s sedentary behaviors for both boys and girls.

The results of environmental support and intrapersonal factors being significant in the physical activity model but not significant in the sedentary model emphasize that physical activity and sedentary behaviors are two different behaviors with different influencing factors. If sedentary behaviors and physical activity were at opposite ends of a spectrum, one would have expected to see environmental support and intrapersonal factors having a significant inverse relationship to sedentary behaviors. This finding suggest that low levels of environmental support for physical activity and low levels of self-efficacy for physical activity are related to higher levels of sedentary behaviors. For boys intrapersonal factors was inversely related for boys (although not significant), but not for girls. And, environmental support was actually positively related to sedentary behaviors (again, not reaching significance). The models demonstrated that sedentary behaviors and physical activity had different sets of influencing factors.

**Moderator effects.**

For the physical activity and sedentary behavior models, levels of environmental support, parental modeling, and parental encouragement were tested as potential moderators in the relationships of the modeled variables to levels of physical activity and
sedentary behaviors. There were no moderator effects found with these variables. Prior research on the role of moderators in physical activity and sedentary behaviors has been limited. In a study exploring moderators using multiple regression techniques, the relationship between physical activity and sedentary behaviors demonstrated no evidence for the moderators of gender, ethnicity, structured physical activity and seasonality (Smith et al., 2008). Group differences were found in sedentary behaviors for gender and were able to be tested in the structural equation models for group differences. Even though the t-tests did not show group differences for physical activity, based upon the reviewed literature, the structural equations for physical activity were also analyzed separately by gender. Group differences were found for ethnicity, but because of the large disparity in the sample sizes for each group, the structural equation models could not be utilized for multiple group analysis. Research involving moderator effects for physical activity and sedentary behaviors is very limited and should be targeted for future studies.

**Strengths and Weaknesses**

A strength of the current research was its conceptual framework using an advanced statistical design to compare influencing factors of physical activity and sedentary behaviors. A foundation of this research was the contention that physical activity and sedentary behaviors are two separate constructs with different aspects of influence. It was shown that physical activity compared to sedentary behaviors was more impacted by environmental support and intrapersonal factors like self-efficacy. Whereas, parental encouragement for sedentary behaviors and parental modeling of sedentary behaviors were salient factors impacting levels of sedentary behaviors. Structural
equation modeling utilizes a confirmatory approach and outlines a “causal” process that underlies the theoretical assumptions (Byrne, 2001). This approach allows for a simultaneous analysis of multiple variables and tests this proposed framework to the data and determines the “fit” or the plausibility of the proposed relationships of the variables (Byrne, 2001). This analysis contributed to understanding the mechanisms impacting adolescent physical activity and sedentary behaviors stronger than correlational methods. Based in social cognitive theory and ecological theory, physical activity and sedentary behaviors are potentially impacted by the physical and family environment, as well as intrapersonal influences such as attitudes and self-efficacy. Better understanding of the mechanisms underlying adolescent behavior may help researchers and practitioners develop and implement more effective interventions.

As previously mentioned, this research was based upon social-cognitive theory and ecological models and it is important for research to be based upon theoretical assumptions. “There is a strong need for research that identifies correlates of physical activity levels and sedentary behaviors and for theories and frameworks that logically combine the correlates to increase our understanding of, and our ability to effectively and efficiently augment, physical activity levels and reduce sedentary behaviors” (Nigg & Paxton, 2008, p.79). In this research, social cognitive variables such as self-efficacy were important (direct and indirect effects) for predicting physical activity but did not directly (or indirectly) predict sedentary behaviors. Similarly, ecological variables like school and community environmental support were important for predicting physical activity, but did not predict levels of sedentary behaviors. This research included variables that have had mixed results with their relationships with physical activity and sedentary
behaviors and attempted to better demonstrate how the variables may directly or indirectly affect levels of physical activity and sedentary behaviors.

This research study was not without methodological weaknesses. One weakness was the sample was taken from predominantly white, rural communities that were centralized in one area of New York State. It is possible the relationships examined do not apply or fit to other cultures or ethnicities in the United States or worldwide. It is also plausible the environmental and family supports would be different in a suburban or urban sample. However, a strength of the study was the participants were representative of an area that is lower in socio-economic status than most of the state. In addition, the response rate was very high at 57%. The willingness of the schools, the parents, and the students to participate may indicate that they viewed this area of research as worthy of the time investment.

Also, this study was cross-sectional. Even though the methodology used more advanced statistical methods, cause and effect were only hypothesized. The directionality of the pathways was theoretical and not temporal in nature. Future studies can address causality using a longitudinal study. In addition, the structural equation models only examined of the included variables. These variables are based in theoretical assumptions, but model misspecification due to omitted variables (e.g., seasonality, maturation level, peer influence) was possible. These models explained a range of 15-32% of the variance related to the outcome variables of either physical activity or sedentary behaviors. Clearly, including other variables in models may be able to explain a greater percentage of the variance. However, it should be noted that compared to other studies involving
physical activity, the amount of variance explained was similar (McNeil, Wyrwich, Brownson, Clark, & Kreuter, 2006; Trost et al. 2003; Wu et al. 2003),

Another weakness of this study was the use of adolescent self-report alone. Self-reports are subject to social desirability bias and recall errors (Marshall & Welk, 2008). Other popular forms for assessing physical activity and sedentary behaviors are direct observation, doubly labeled water, pedometers, accelerometers, heart rate monitors, and multichannel activity monitors (Marshall & Welk, 2008). All of these techniques have respective strengths and weaknesses. Self-reports were chosen for this research because of the flexibility for including many of the social cognitive variables at the same time as assessing levels of physical activity and sedentary behaviors. Self-reports were also used because some of the other measures are extremely cost-prohibitive. Although the participants responded with self-report, it is important to note that responses were not anonymous. The participants had to put their name on the questionnaire, and by that process as well as the administration being in a school setting, one can make an argument that they may have taken a greater interest in replying openly and honestly.

Another weakness of this research was only having the adolescent as the participant. Parental data regarding assessments of the child’s daily activities would have provided richer analysis of the patterns of behavior. In addition, direct sampling of the parents could have also provided data regarding their own levels of behavior (for the modeling analysis) and their supportive behaviors toward their child’s activities (i.e., encouragement). Combining methods techniques (self-report and objective measures) with a multi-respondent analysis is considered a stronger research design (Rosenblatt & Fischer, 1993).
**Future Directions**

Future studies in this field should include longitudinal designs. Of the studies reviewed for this research only around 10% of them were longitudinal in nature. In order to better understand causality regarding these behaviors, longitudinal research designs should be implemented. It is a goal for this dissertation to foster a longitudinal research protocol. The relationships with the schools have been solidly established and they seem receptive to the research agenda. Tracking these current students exactly would not be possible because it would be considered outside of the guidelines approved by the IRB at the time of the original study approval. However, these 7th and 8th graders could be surveyed as 11th and 12th graders to understand any changes that may have occurred at the sample population level, but not necessarily with the individuals themselves.

Next, future research should also include a multi-method multi-respondent design. Assessing physical activity and sedentary behaviors by methods other than self-report have been strongly advocated by researchers (Byun et al., 2011; Heitzler et al. 2010; Trost, Ward, Moorehead, Watson, Riner, & Burke, 1998). Advances in technology have made products like accelerometers more affordable to use with larger sample sizes; however, they still are cost-prohibitive for most studies lacking grant funding. However, studies utilizing self-reports should look to include multi-respondents in the research design. For the study of physical activity and sedentary behaviors, parents or the primary caregivers would be the strongest candidates for gaining more robust data. Parents could report on their own behavior patterns, their child’s behavior, as well as how they perceive they influence their child’s behavior (i.e., rules, encouragement, purchasing behavior). Ideally, the parents could then be paired with their children to see the various dyadic
relationships that may take place. For example, if there was data available from both parents and the child, it may be possible to see which parent may have a stronger influence over behavior.

In the area of statistical design, structural equation modeling still should be given strong consideration for continued use. This area of research still heavily relies on correlational and regression analysis. Structural equation modeling allows for the simultaneous assessment of the variables and the respective fit of the data to the conceptualized framework. However, cluster analysis should be used when appropriate. Because physical activity and sedentary behaviors has been consistently shown to be different behaviors and not just opposite ends of a spectrum (Gorely et al., 2004; Henning Broderson et al., 2005; Lindquist et al., 1999; Marshall et al., 2002; Zakarian et al., 1994; Wolf et al., 1993), it is possible to look at the various configurations of the two behaviors together and try to determine how the influencing factors may differ between the groups. For example, are the factors of influence significantly different for adolescent boys who are high in levels of both physical activity and sedentary behaviors as compared to boys who may be high in physical activity but low in levels of sedentary behaviors? Cluster analysis would be one possible statistical mechanism for analyzing these group differences.

Specifically related to these findings, examining parental influence and gender effects by parent-child dyads, specifically as parental modeling of physical activity relates to girls may be of interest. This could be done comparing two parent households with the gender-of-the-parent to gender-of-the-child as well as single parent households to gender of the child. Some previous research has not found any interaction effects of
the gender-of-child to gender-of-parent for levels of physical activity (Fredericks & Eccles, 2005; Fuemmeler et al., 2011). Whereas, Davison, Cutting, and Birch (2003) found that mothers and fathers differ on their levels of the types of support they provide to their active daughters. Mothers provided higher levels of logistic support (transportation, fees, watching the child participate), and fathers provided higher levels of modeling behavior with their own physical activity. The same investigation could be done for adolescent sedentary behaviors as well.

Similarly, specifically related to these findings, examining the various types of environmental supports and their impact for boys’ physical activity may also be of interest for future research. How do changes in these supports affect levels of physical activity? And, are these environmental supports more a function of knowledge of their existence or are they related to the quality, access and safety of the perceived supports?

Future research models should also investigate potential barriers to physical activity and sedentary behaviors. This current research investigates self-efficacy and attitudes which may be seen as barriers if a person is low in either of them. However, ecological barriers such as perceived safety and weather should also be investigated further. In addition, programming variables related to cost and accessibility of physical activities was not investigated as a potential barrier. In addition, social variables such as peer influences and parental conflict may also be relevant variables for impacting levels of each behavior. This research did not assess the influence of peers with levels of physical activity and sedentary behavior. Aspects related to peers may span from peer support (structural, functional, perceptual), aspects of the friendship quality (close,
reciprocated), peer modeling, and overall social climate and subjective norm (Smith & McDonough, 2008).

Future research should also investigate factors related to physical activity and sedentary behavior in youth with disabilities. This research did not assess any disabilities the students’ may have had. It is important to gain understanding regarding how disabilities may potentially inhibit physical activity or foster greater levels of sedentary behavior. It would be interesting to see how parental encouragement or modeling may factor into adolescent behavior for adolescents with disabilities. In addition, the environmental supports may be of interest as well particularly for those students who may be in a wheelchair or need significant assistance with their mobility. Also, intrapersonal factors (attitude and self-efficacy) may also be very significant as previous research has shown perceived competence in doing activities is salient with students who may have disabilities (Harter, 1987).

Finally, it may be interesting to study physical activity and sedentary behaviors from the perspective of being a productive versus unproductive use of time. It should be emphasized that physical activity is not necessarily considered inherently good and sedentary behaviors are not necessarily inherently bad. Engaging in high levels of physical activity may leave little room for other extracurricular activities as well as not enough time to adequately complete school work. The participants may also perceive negative social aspects to engaging in physical activity. The perception of the time spent in structured physical activities may not be viewed as a productive use of time. And all sedentary behaviors are not “unproductive”. Engaging in sedentary behaviors for schoolwork, reading, relaxing, and socializing all have a productive element to them.
This is an area of research that does not seem prominent in the review of literature, but may be a potentially important aspect of each behavior.

**Implications for Policy Solutions**

These results would suggest that increased spending in the area of creating and improving public facilities and infrastructure would lead to increases in physical activity. Particularly, for the boys in the sample, the amount of community and school supports had a direct impact on levels of physical activity. In addition, for the girls in the sample improving existing facilities or adding facilities may improve their attitudes toward being active, thereby increasing their activity levels.

Programs that are also designed or targeted toward parents increasing their levels of activity (and decreasing levels of sedentary behavior) may potentially increase activity levels in their children. Increasing parents’ awareness of that their behaviors may inhibit or facilitate their children’s physical activity and sedentary behavior should be an important consideration when developing programs. For example, letting parents understand that household rules and not modeling sedentary behavior may reduce their child’s sedentary behavior may be an effective strategy. This research also supports that for girls increasing levels of parental encouragement leads to increasing levels of intrapersonal factors and thereby increasing levels of physical activity.

Finally physical education instructors and those involved with youth sport promotion should be focused on increasing attitudes and self-efficacy for physical activity, especially with the girls. These results showed that higher levels of intrapersonal factors lead to higher levels of physical activity. If a girl likes doing activity, she will do it. So asking questions and assessing the both community and school
activity programs are vital for gauging girls’ attitudes toward the physical education curriculum and sport experience.

**Conclusion**

This dissertation tested conceptual frameworks for models of physical activity and sedentary behaviors based upon social cognitive theory and ecological models. It was found that physical activity and sedentary behaviors are not opposite ends of a spectrum, but rather they are distinct behaviors with different predictors and pathways. Specifically, physical activity was predicted by environmental support, intrapersonal factors, parental modeling for physical activity, and physical health. Sedentary behavior was predicted by parental modeling for sedentary behaviors and parental encouragement for sedentary behaviors. In addition, using a mediating conceptual framework, intrapersonal factors mediated the relationships of environmental support, parental encouragement, mental health, and physical health to levels of physical activity. Studying physical activity and sedentary behaviors should continue to use guided theory based approaches with sound statistical designs.
Table 3

Means and Standard Deviations of the Major Study Variables

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N=527
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** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

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** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

n = 527
Table 6
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<tr>
<td>9. Adolescent Mental Health</td>
<td>.007</td>
<td>.047</td>
<td>.011</td>
<td>.070</td>
<td>.317</td>
<td>.322</td>
<td>.275</td>
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<td>10. Adolescent Physical Health</td>
<td>-.203</td>
<td>.126</td>
<td>.021</td>
<td>.072</td>
<td>.067</td>
<td>.052</td>
<td>.086</td>
<td>.117</td>
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<td>11. BMI</td>
<td>.085</td>
<td>.035</td>
<td>.062</td>
<td>-.097</td>
<td>-.095</td>
<td>-.172</td>
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<td>.010</td>
<td>-.087</td>
<td>-.030</td>
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<td>12. Adolescent Sedentary Total</td>
<td>.231</td>
<td>.024</td>
<td>.054</td>
<td>.069</td>
<td>-.043</td>
<td>-.051</td>
<td>-.005</td>
<td>.141</td>
<td>-.167</td>
<td>-.115</td>
<td>.100</td>
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<td>13. Encouragement for Sedentary Behavior</td>
<td>.094</td>
<td>-.080</td>
<td>.020</td>
<td>.055</td>
<td>-.152</td>
<td>-.232</td>
<td>-.052</td>
<td>-.074</td>
<td>-.228</td>
<td>-.063</td>
<td>-.020</td>
<td>.335</td>
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<tr>
<td>14. Parent Modeling for Sedentary Behavior</td>
<td>.134</td>
<td>-.006</td>
<td>.099</td>
<td>.041</td>
<td>-.123</td>
<td>-.029</td>
<td>-.004</td>
<td>.025</td>
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<td>-.110</td>
<td>.135</td>
<td>.419</td>
<td>.191</td>
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* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

n = 527
SYRACUSE UNIVERSITY

COLLEGE OF HUMAN ECeOLOGY
Department of Child and Family Studies

ADOLESCENT ASSENT FORM: Physical Activity and Sedentary Behavior, Facilitators & Barriers

ADOLESCENT ACTIVITY QUESTIONNAIRE

My name is Jodi Canfield, an employee of St. Lawrence University, and a graduate student at Syracuse University, requesting your participation in a research study involving health and families. This study is being conducted under the supervision of Dr. Ambika Krishnakumar, faculty member in the Child and Family Studies Program at Syracuse University. If you agree to participate in this study, you will be asked to complete a brief questionnaire.

You do not have to be in this study. No one will be mad at you if you decide not to do this study. Even if you start, you can stop later if you want. You may ask questions about the study.

If you decide to complete the questionnaire, I will not tell anyone else what you say or do in the study. Even if your parents or teachers ask, I will not tell them anything about your answers. The questionnaire should take about 30 minutes to complete. All information will be kept confidential.

Thank you for your time and effort. Your assistance makes it possible for us to better understand how family patterns are related to health. This information will hopefully benefit the growing field of family studies by adding to the research. A potential risk is a heightened awareness of one’s level of physical activity and sedentary behavior patterns. If you do not want to take part, you have the right to refuse to take part, without penalty. If you decide to take part and later no longer wish to continue, you have the right to withdraw from the study at any time, without penalty.

If you have any questions, concerns, complaints about the research, contact Jodi Canfield at 315-229-5874. If you have any questions about your rights as a research participant, or if you have questions, concerns, or complaints that you wish to address to someone other than the investigator, or if you cannot reach the investigator, contact the Syracuse University Institutional Review Board at 315-443-3013.

Please turn over for signatures and contact information. Please do not detach this sheet from the questionnaire. A separate copy of this consent form has been handed out with the questionnaire to keep for your own reference.
Thank you again for participating in this research. Signing here means that you have read this form and that you are willing to be in this study.

Student name (please print)__________________________

Student Signature ________________________________

Principal Investigator Jodi A. Canfield

Supervisor Dr. Ambika Krishnakumar

Contact Information:

Jodi A. Canfield
Augsbury Center
St. Lawrence University
Canton, NY 13617
(315) 229-5874

Dr. Ambika Krishnakumar
202 Slocum Hall
Syracuse University
Syracuse, NY 13244
(315) 443-2757


Department of Child and Family Studies
426 Ostrom Avenue / Syracuse, NY 13244-3540
315-443-2727 / Fax 315-443-9897 / http://HumanEcology.syr.edu
APPENDIX B

SYRACUSE UNIVERSITY
COLLEGE OF HUMAN ECOLOGY
Department of Child and Family Studies

PARENTAL CONSENT FORM – Physical Activity and Sedentary Behavior, Facilitators & Barriers

My name is Jodi Canfield, a graduate student at Syracuse University, requesting your child’s participation in a research study involving health and families. This study is being conducted under the supervision of Dr. Ambika Krishnakumar, faculty member in the Child and Family Studies Program at Syracuse University.

As part of the school day, your child will be asked to complete a questionnaire regarding their levels of physical activity and other daily activities. This questionnaire will take approximately 30 minutes and your child’s responses will be kept confidential. Your child’s participation in this study is voluntary. We are seeking parental permission for your child to complete the questionnaire.

Your assistance makes it possible for us to better understand how family patterns are related to health. This information will hopefully benefit the growing field of family studies by adding to the research. A potential risk is a heightened awareness of one’s level of physical activity and sedentary behavior patterns. If you do not want your child to take part, you have the right to refuse without penalty. Your child will also have the choice at the time the questionnaire is being administered to choose whether or not to participate. Your child’s participation is this study is voluntary.

If you have any questions, concerns, complaints about the research, contact Jodi Canfield at 315-229-5874. If you have any questions about your child’s rights as a research participant, you have questions, concerns, or complaints that you wish to address to someone other than the investigator, or if you cannot reach the investigator, contact the Syracuse University Institutional Review Board at 315-443-3013.

Your child should return this form to the school prior to

_________________________  ______________________
Signature of parent             Date

_________________________
Printed name of parent

_________________________
Printed name of oldest child in 7th-8th grade

A copy of this form has been included for your future reference. Contact information on back.

Departments of Child and Family Studies/Health and Wellness/Hospitality Management/Marriage and Family Therapy/
Nutrition Science and Dietetics/Sport Management/School of Social Work
CHAPTER VI

References


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Booth, S.L., Mayer, J., Sallis, J.F., Ritenbaugh, C., Hill, J.O., Birch, L.L., Frank, L.D.,


http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.pdf


School Health Policies and Practice Study (2006). Physical Education School Questionnaire, Centers for Disease Control, National Center for Chronic Disease
Prevention and Health Promotion.


school population. Preventive Medicine, 23, 314-321.


doi:10.1155/2010/468526
Curriculum Vita

Jodi Canfield

(effective: 4/26/12)

Work Address:

Augsbury 218
St. Lawrence University
Canton, NY 13617
jcanfield@stlawu.edu
315-229-5874

Education:

Doctor of Philosophy (expected graduation May 2012)
Syracuse University
Department: Child and Family Studies
David B. Falk College of Sport and Human Dynamics
Recipient of Dean Edith Smith Scholarship – Spring, 2010

Masters of Education, 2005
St. Lawrence University, Canton, NY
Major: Counseling

Bachelor of Science, 1991
St. Lawrence University, Canton, NY
Majors: Psychology and Sport and Leisure Studies
Honors: Phi Beta Kappa, 1991; Cum Laude

Research Interests:

- Adolescent Physical Activity – Correlates of physical activity and the gender disparities between boys and girls regarding activity levels.
- Obesity – Why our country has a 60% overweight and 30% obesity rate?
- Nutrition – Investigating family knowledge and patterns of nutrition.
- Parenting – Parental activity and nutrition habits and the socialization of their children.
- Counseling – Adolescent and young adult regarding social issues.

Papers Presented

- Dual-Earner Families – Comprehensive exam defense.
Professional Experience:

St. Lawrence University

- Coordinator of Sport Studies and Exercise Science minor Fall 2007-present
- Instructor in Sport Studies and Exercise Science (SSES)

Courses:
- SSES 100 Wellness
- SSES 116 Leisure Patterns
- SSES 248 Principles of Health and Wellness
- SSES 320 Coaching Theory
- SSES 390/391 Independent Studies/Internships

- Instructor in First-Year Program @ St. Lawrence University
  Course: FRPG 187M Lifestyles: Past, Present, and Future
  Team taught with a member of the Psychology Department (Fall 2009, Fall 2010)

- Head Women’s Lacrosse Coach (1999-present)
- Counselor – Health and Counseling Services; St. Lawrence University – Fall 2004

Committees and Campus Involvement:

Recession Response Phase 2 (RR-P2) - A 14-member task group of faculty and staff members leading a community discussion on structure, organization, and programs. This task group will produce a report with concrete recommendations and possible schedules of implementation that will center on making the quality and reputation of St. Lawrence’s numerous programs financially sustainable.

Innovation Grant (received fall 2010) - The St. Lawrence Innovation Grants program awarded up to $2500 per project for new initiatives proposed by faculty, staff and students. St. Lawrence Innovation Grants projects were assessed as providing a foundation for St. Lawrence’s future. Organized the Sport Studies and Exercise Science grant titled, “The Healthy Campus Initiative” which will be a campus-wide comprehensive health and fitness program based on universal practices of health and wellness education.

Middle States Review– Assessment of St. Lawrence University Athletic Department which includes 32-sport Athletic Department, the Sport Studies and Exercise Science minor, Intramural and Recreation Programming, and Health/Wellness Programming.

Assessment Committee – University committee formed as a follow-up committee of the Middle States process to examine learning goals of the university and departmental courses.
Wellness Initiative – Collaborative committee including members from Student Life, Athletics, Counseling Services, and Faculty members to discuss and implement educational programming regarding wellness like alcohol and drug use, sexual assault, and mental health on our campus.

Sexual Violence Advisory Board – Faculty, staff, and students who advise the Advocates program and review sexual assault policies on campus.

CHOICES – An NCAA committee to implement a $30,000 grant for alcohol education/programming on campus.

Long Range Planning – Committee from the Athletic department to assess mission and goals of the Academic minor, Intramural and Recreation, and entire Athletic Department.

NCAA Regional Ranking Committee – Weekly conference call in-season to rank New York State DIII Collegiate Lacrosse teams for submission to the national ranking committee.

Empire All-Region/All-America Committee – Selection of NCAA DIII women’s lacrosse players from New York State to be considered for National All-America status.

Multiple hiring committees for Intercollegiate Athletics and Recreation staff members.

Associations:

- American Alliance for Health, Physical Education, Recreation, and Dance - AAHPERD (August 2006-present)
- Intercollegiate Women’s Lacrosse Coach Association (August 1999-present)
- New York State Women’s Collegiate Athletic Association (August 1999-present)
- Secretary for Women’s Lacrosse Division (August 2001- May 2006)