Abstract

PHYSICAL ACTIVITY, ACADEMIC PERFORMANCE, AND PHYSICAL SELF-DESCRIPTION IN ADOLESCENT FEMALES

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Despite the many health benefits of being physically active, nearly a quarter of U.S. adults and adolescents report no participation in leisure-time physical activity. It is recommended that children and adolescents participate in physical activity for at least 60 minutes daily at moderate or vigorous intensity. In addition to potentially enhancing academic performance, participation in physical activity may also influence perceptions of physical appearance and global self-esteem, which tend to decrease with age in adolescent females. The purposes of this study were to: (a) examine the prevalence of overweight and obesity and the percentage of adolescent females from a rural community that meets physical activity recommendations; (b) examine the relationship of body composition, physical activity, and sedentary behavior on academic performance; and (c) examine the relationship between physical activity and physical self-concept among adolescent females. Thirty adolescent females (mean age = 15.6 ± 1.3 years) wore an Actigraph GT1M accelerometer for seven consecutive days, set to measure in 15-second epochs. Age specific cutpoints were used to determine minutes of sedentary behavior and light, moderate, vigorous, and moderate-to-vigorous physical activity (MVPA).

Participants completed the Physical Self-Description Questionnaire (PSDQ) to assess how they perceive themselves physically. Height, weight, and percent body fat were measured. Grade point averages (GPA) were obtained from school records. Regression analysis was performed to predict GPA from measures of body composition, sedentary behavior, and MVPA. Measures of physical activity and sedentary behavior were correlated with PSDQ subscale scores with Pearson correlations. Thirty percent of participants ($n = 9$) were obese (BMI $\geq 95^{th}$ percentile) and another 36% ($n = 11$) were overweight (BMI between the 85^{th} and 94^{th} percentiles). None of the participants accumulated ≥ 60 minutes of MVPA per day. Daily MVPA averaged 9.7 (± 7.1) minutes. Percent fat ($r = -.51$), minutes of MVPA ($r = .34$), and time spent in sedentary behavior ($r = .32$) were significantly correlated ($p < .05$) with GPA. Together measures of body composition, physical activity, and sedentary behavior explained 36% of the variance (multiple $R = .60$) in GPA. The standard error of estimate for predicting GPA was 0.64. Minutes per day spent in light physical activity was negatively correlated ($p < .01$) with the Self-Esteem ($r = -.51$), Body Fat ($r = -.52$), and Global Physical Self-Concept ($r = -.48$) subscales of the PSDQ. Only the Physical Activity subscale of the PSDQ was significantly correlated with MVPA ($r = .36$). In conclusion, the current sample of adolescent females had a high prevalence of overweight and obesity and was physically inactive. Academic performance was significantly associated with measures of body composition, physical activity, and sedentary behavior. Time spent in light physical activity was associated with lower self-perceptions of body fat, global physical self-concept, and self-esteem. Measures of higher intensity physical activity were generally not associated with physical self-perception measures, possibly due to the low amount of time spent in MVPA. Interventions to increase physical activity and improve body composition in adolescent girls should be considered not only for their health effects, but also for their potential to impact academic performance and psychological profiles.

PHYSICAL ACTIVITY, ACADEMIC PERFORMANCE, AND PHYSICAL SELF-DESCRIPTION IN ADOLESCENT FEMALES

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CHAPTER 1: INTRODUCTION

The leading causes of death in the U.S., including heart disease, cancer, and stroke, are linked with obesity and low levels of physical activity (Heron, 2007). Physical activity reduces the risk of mortality from coronary heart disease, hypertension, colon cancer, and diabetes (U.S. Department of Health and Human Services [USDHHS], 1996). Despite the known benefits of physical activity, nearly a quarter of U.S. adults (Centers for Disease Control and Prevention [CDC], 2008c) and 25% of adolescents (CDC, 2008d) reported no participation in leisure-time physical activity in 2007.

Not only are low levels of physical activity personal health issues for citizens, but also an economic burden on the United States. Anderson et al. (2005) estimated that low levels of physical activity, overweight, and obesity account for 27% of national health care costs for adults over the age of 40 years. Colditz (1999) estimated that low levels of physical activity alone accounted for a direct cost of 24 billion dollars per year and obesity accounted for a cost of 70 billion dollars per year. From 1971 to 1999, the hospital costs related to childhood obesity increased by $92 billion (CDC, 2009).

Government-supported agencies have set forth objectives to improve the overall health of the U.S. population. These objectives are detailed in *Healthy People 2010* (USDHHS, 2000) and *Healthy Campus 2010* (American College Health Association, 2002). Several of the objectives center on physical activity. The American College of Sports Medicine (ACSM), CDC, American Heart Association (AHA), and the USDHHS have set forth physical activity recommendations developed for nearly every age and special population. Recommendations have been developed with the purpose of improving health and reducing morbidity and mortality caused by low levels of physical activity (ACSM, 2006; USDHHS, 1996; Pate et al., 1995; USDHHS, 2008; USDHHS and U.S. Department of Agriculture [USDA], 2005).

Despite numerous recommendations to increase physical activity, the majority of the U.S. population does not achieve enough activity. Thirty-five percent of high school students self-reported participating in the recommended amount of physical activity (Eaton et al., 2006). The percentage of the population that achieves the recommended level of physical activity declines with age (Adams, 2006; American College Health Association, 2002, 2008; Eaton et al., 2006; Huang et al., 2003; Suminski, Petosa, Utter, & Zhang, 2002). Data from the CDC's (2008d) Behavioral Risk Factor Surveillance System (BRFSS) suggest that 51% of U.S. adults do not attain 30 minutes a day of moderate physical activity five or more days of the week, or 20 minutes of vigorous intensity physical activity three or more days per week.

In addition to enhancing health, physical activity improves academic performance among students (Cooper, Valentine, Nye, & Lindsay, 1999; Field, Diego, & Sanders, 2001; Mahar et al., 2006). Academic performance measured by grade point average (GPA) and standardized test scores is increased slightly by participation in physical activity among children (Carlson et al., 2008) and adolescents (Field et al., 2001). Physical activity during the school day improves on-task behavior (Mahar et al., 2006) and results in less fidgety behavior during class (Jarrett et al., 1998) among children. Increased on-task behavior may be one of the mechanisms by which physical activity improves academic performance.

Weight status has also been demonstrated to be related to academic performance. Li, Dai, Jackson, and Zhang (2008) analyzed NHANES III data from 2,519 students between the ages of 8 and 16 years. Li et al. reported a significant relationship between weight status and academic performance/cognitive functioning. Higher levels of body mass index (BMI) were associated with lower test scores. Likewise, Huang, Goran, and Spruijt-Metz (2006) found that three measures of body composition (i.e., BMI, BMI classification [at risk for overweight vs. normal weight], and percent fat) were negatively related to self-reported grades among adolescents.

It is important to study the physical activity patterns of adolescent females and the link between physical activity and self-concept. Among U.S. female high school students, 10% were classified as overweight in 2005. Nearly four times that number (38%) perceived themselves as overweight (Eaton et al., 2006). Results from the 2007 Youth Risk Behavior Survey (YRBS) indicated that 60% of adolescent females reported they tried to lose weight and 67% reported they exercised to lose weight (CDC, 2008d). Brown et al. (1998) found that with age, perceptions of physical appearance and global self-concept decrease among females. The poor perception females have of body weight could lead to poor dietary behaviors. Further investigation of adolescent females can help identify appropriate intervention strategies to improve physical activity and self-concept.

Females' self-concept can be assessed with the Physical Self-Description Questionnaire (PSDQ) (Marsh, Richards, Johnson, Roche, & Tremayne, 1994). Marsh originally developed this questionnaire for adolescent females with the intention to measure how females view themselves physically. The PSDQ includes nine physical self-concept components, self-concept, and global esteem (Marsh et al., 1994). Reliability and validity of the PSDQ has been demonstrated among adolescents (Marsh, 1996).

To properly examine the relationship between self-concept and physical activity, an accurate measure of physical activity is necessary. Accelerometers are motion sensors that allow for assessment of physical activity during free-living conditions because they are unobtrusive and have the ability to store data over a lengthy period. The direct outcome variable from accelerometers is activity counts, which can be converted to caloric expenditure and time spent in various intensities of physical activity.

Accelerometers are considered a valid tool for measurement of energy expenditure when compared to oxygen consumption (Freedson, Melanson, & Sirard, 1998; Hendelman, Miller, Baggett, Debold, & Freedson, 2000; Welk, Blair, Wood, Jones, & Thompson, 2000). Evidence of the validity of accelerometers has been demonstrated in laboratory settings (Matthews, Ainsworth, Thompson, & Bassett, 2002; Welk et al., 2000) and during free-living activities (Sirard, Melanson, Li, & Freedson, 2000; Welk et al., 2000). Accelerometers provide a reliable measurement of physical activity (counts per minute) during free living conditions, including sport, occupational activities, and activities of daily living (Leenders, Sherman, & Nagaraja, 2000; McClain, Sisson, & Tudor-Locke, 2007; Sirard et al., 2000; Welk et al., 2000). Seven days of monitoring is suggested to attain a reliable measure of physical activity (Matthews et al., 2002; Trost, Pate, Freedson, Sallis, & Taylor, 2000). Trost et al. suggested 7 days of monitoring for adolescents.

The purposes of this study were to: (a) examine the prevalence of overweight and obesity and the percentage of adolescent females in the current sample that meets physical activity recommendations; (b) examine the relationship between physical activity, sedentary behavior, body composition, and academic performance; and (c) examine the relationship between physical activity and physical self-concept among adolescent females. It was hypothesized that the majority of female adolescents do not meet the recommended levels of physical activity. It was also hypothesized that physical self-concept and academic performance are related to physical activity among adolescent females.

Definition of Terms

For the purposes of this study, the following terms are defined:

Academic performance **–** Academic performance in this study is defined as grade point average (GPA) on a 0 to 4 scale, in which 4 is associated with higher academic performance. The participant's overall cumulative high school GPA was obtained from the school.

Light physical activity **–** Light physical activity is defined as activity above resting levels but below 4.0 METs.

MET **–** A MET is the metabolic equivalence of energy expenditure in which 1 MET is resting level. A MET is equivalent to 3.5 milliliters of oxygen per kilogram of body weight per minute (USDHHS, 2008).

Moderate physical activity (MPA) **–** Moderate physical activity is defined as activity of 4.0 to 6.99 METs.

Moderate-to-vigorous physical activity (MVPA) **–** MVPA is a combination of moderate and vigorous physical activity of 4.0 METs or greater.

Physical activity **–** Physical activity is any bodily movement produced by skeletal muscle that results in energy expenditure (Caspersen, Powell, & Christenson, 1985).

Physical self-concept **–** Physical self-concept is defined as a person's physical perception of him or herself. In the current study, physical self-concept was assessed by six PSDQ subscale scores, including Appearance, General Physical Self-Concept, Sport Competence, Body Fat, Physical Activity, and Health.

Self-esteem **–** Self-esteem is part of the evaluative process of developing self-concept. Self-esteem is "a self rating of how well the self is doing" (Fox, 2000, p. 89).

Vigorous physical activity (VPA) **–** Vigorous physical activity is defined as activity of 7.0 METs or greater.

Delimitations

The study was delimited by the following:

1. The sample consisted of female high school students.
2. Physical activity was objectively measured by accelerometers over a seven day period.
3. Overall grade point average was reported by the school to assess academic performance.

Limitations

The study included the following limitations:

1. Results cannot be generalized to adolescent males.

2. Accelerometers were not worn during some sport competition.
3. Accelerometers were not worn every day of the week by all participants.

CHAPTER 2: REVIEW OF LITERATURE

Low levels of physical activity and obesity are a public health concern. Examination of physical activity trends in specific populations can potentially lead to effective interventions to increase physical activity and decrease the prevalence of obesity. Rural adolescent females present an important understudied population. In this review of literature the follow topics will be discussed: (a) overweight and obesity; (b) physical activity; (c) sports participation; (d) academic achievement; and (e) physical activity and self-concept.

Overweight and Obesity

The CDC classifies children between 2 and 19 years old as overweight and obese by percentile rankings. Children with a BMI of ≥ 85th percentile and below the 95th percentile are considered overweight and children ≥ 95th percentile are considered obese. Adults, defined as 18 years old and older, are considered overweight by BMI classification of ≥ 25 $kg \cdot m^{-2}$ and obese ≥ 30 $kg \cdot m^{-2}$ (CDC, 2004).

In 2005, the Youth Risk Behavior Surveillance Survey (YRBSS) estimated that 16% of high school students nationwide were at risk for becoming overweight [currently termed ‘overweight’] and 13% were overweight [currently termed ‘obese’]. Although the prevalence of at risk males decreased as grade level increased from 18% in 9th grade to 14% in 12th grade, the prevalence of overweight males remained fairly steady across grades at 16%. Among female high school students, 10% were classified as overweight which remained steady from 9th to 12th grades. Nearly four times that number reported perceiving themselves as overweight, 38%. For females, the prevalence of at risk for overweight also remained similar across grades at 16% (CDC, 2006).

To asses weight status among the students, the YRBSS relies on self-reported height and weight to calculate body mass index ($kg \cdot m^{-2}$) (CDC, n.d.). Caution should be used when relying on self-reported measures from adolescents. Anthropometric researchers show that adolescents tend to significantly underestimate weight and significantly overestimate height when these values are self-reported (Brener, McManus, Galuska, Lowry, & Wechsler, 2003; Himes, Hannan, Wall, & Neumark-Sztainer, 2005). As a result, BMI is significantly underestimated due to inaccurate height and weight values. Incorrect self-reported height and weight will result in misclassification of weight status among adolescents. When relying on self-reported height and weight, such as values reported in the YRBSS, caution should be used when interpreting these results. Himes et al. demonstrated that independent variables, including age, gender, race/ethnicity, and sex, significantly influence the difference in self-reported height and weight.

The obesity trend in the United States among youth and adults is an increasing concern. As childhood obesity continues to increase, so does adult obesity. Overweight children are more likely than normal weight children to become overweight or obese adults (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). Adults are more likely to be obese if they were overweight or obese at a young age. Eighty-seven percent of overweight children under 8 years old became obese adults. Among children classified as overweight (BMI $\geq 95^{th}$ percentile), 77% remained obese as adults (BMI ≥ 30 $kg \cdot m^{-2}$) (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001).

As a transition into adulthood, college student's health status and lifestyle are often studied. The American College Health Association demonstrated that 33% of college females are overweight or obese (American College Health Association, 2008). Prevalence of overweight or obese college students has increased since establishment of *Healthy Campus 2010* objectives were set in 2000. An objective of *Healthy Campus 2010* was to decrease the overweight or obese prevalence rate from 29.5% in spring 2000 to 16% by 2010 (American College Health Association, 2002). Physical activity, sedentary activity, and energy intake have all been identified as contributing behavioral factors (CDC, 2008b).

Health Concerns of Obesity and Overweight

The leading causes of death in the U.S., heart disease, cancer, and stroke (Heron, 2007), are linked with obesity and low levels of physical activity. Obesity increases the risk for a multitude of other diseases including hypertension, dyslipidemia, osteoarthritis, diabetes, coronary heart disease, gallbladder disease, stroke, sleep apnea, and some cancers (USDHHS, 1996). However, even small increases in physical activity have been demonstrated to improve health among sedentary populations. Moderate intensity accumulated in short bouts (i.e., 10 minutes) throughout the day by activities of daily living, occupational activities, and exercise improves cardiovascular health. Further health improvements are found with higher intensity exercise (National Institutes of Health, 1995).

Not only is the impact of added weight a health issue for adults, but for children as well. The number of obese children continues to rise and so does the prevalence rate of type II diabetes. Previously termed adult onset diabetes, type II diabetes is becoming more prevalent in overweight children (CDC, 2008a; Must & Anderson, 2003). Much like adults, in addition to diabetes, health concerns among overweight children and adolescents include high cholesterol, hypertension, hepatic steatosis (Dietz, 1998), asthma, menstrual abnormalities (Must & Anderson, 2003), and sleep apnea (Dietz, 1998; Must & Anderson, 2003). As children are diagnosed with coronary heart disease risk factors early on, they are likely to carry diseases into adulthood. The continuation of disease from childhood into adulthood is likely as overweight children may become overweight or obese adults (Serdula et al., 1993; Sørenson & Sonne-Holm, 1988). The continuation of disease into adulthood not only has a personal health effect on people, but a psychological effect and an economic burden on the United States.

Economic Burden of Obesity

The effects of obesity extend to an increased cost for health care (Colditz, 1999; Pronk, Goodman, O'Connor, & Martinson, 1999), treatment of diseases, and loss of productivity. CDC reported in the year 2000, obesity related health care costs summed to over $117 billion. Obese employees cost companies between 29% and 117% more in medical costs than normal weight employees (CDC, 2009).

Anderson et al. (2005) estimated that overweight, obesity, and low levels of physical activity account for 27% of national health care costs for adults over the age of 40 years. Health care costs can be expected to decrease with an increase in physical activity and a decrease in weight (Pronk et al., 1999). Finkelstein, Feibelkorn, and Wang (2003) estimated the prevalence of overweight and obesity, on average, accounted for 54% of costs for insurance companies. Colditz (1999) estimated that low levels of physical activity alone accounted for a direct cost of 24 billion dollars, and obesity a cost of 70 billion dollars. Among those under the age of 65 years, expenditures are 36% higher for obese adults compared to adults of normal weight (Strum, 2002).

Pronk et al. (1999) investigated modifiable health risks on the cost of health care among adults over the age of 40 years. Those without health care charges were significantly younger and had better fitness levels, higher physical activity levels, and lower body mass index. Having modifiable risk factors significantly increases health care charges for individuals. Low levels of physical activity result in a 5% increase in health care charges compared to being physically active 1 day of the week. For each unit ($kg \cdot m^{-2}$) increase of body mass index, health care charges increase by 2%. Females and nonwhites experience higher health care costs, by 39% and 27% compared to males and whites, respectively. The highest costs are among those with diabetes and heart disease, 137% and 150% higher health care charges, respectively.

Evidence of higher health care costs is clearly associated with overweight and obesity in adults. However, little evidence is available regarding the economic costs for overweight and obese children and adolescents. The CDC reported a rise in childhood obesity-related annual hospital costs from $35 billion to $127 billion from 1971-1981 to 1997-1999 (CDC, 2009). It is predicted that childhood obesity and morbidity will increase in the future and continue into adulthood. It can be assumed that disease will follow with the growing number of overweight and obese youths; and health care expenditure and costs will likely increase.

Physical Activity

As the health status of the U.S. population declines and costs of healthcare increase, health promoting organizations and government agencies are beginning to intervene. U.S. government programs include HealthierUS.Gov, The President's Challenge, and Healthy Youth. Organizations such as these promote physically active lifestyles and the awareness of benefits of being physically active.

Recommendations

The American College of Sports Medicine (ACSM) and CDC released physical activity recommendations for adults in 1995 (Pate et al., 1995). These recommendations suggested adults should be physically active on most, if not all days, for a combination of 30 minutes or more at moderate-intensity (Pate et al., 1995). Physical activity recommendations remain dynamic with current research findings. Recently, the USDHHS released more specific recommendations for all populations. According to the 2008 Physical Activity Guidelines for Americans, for health benefits, adults should participate in aerobic activities at moderate intensity for at least 150 minutes, or in vigorous intensity for at least 75 minutes per week, or an equal combination of both. For added health benefits, the duration of moderate and vigorous intensity aerobic activities should be increased to 300 minutes and 150 minutes, respectively, or a combination of the two (USDHHS, 2008).

The updated recommendations clarify and explain physical activity with definitions of moderate and vigorous intensity. Physical activity may be accumulated throughout the week, in bouts of at least 10 minutes. In addition to aerobic physical activity, the USDHHS recommends muscle strengthening of all major muscles groups at moderate to high intensity at least 2 days per week (USDHHS, 2008).

Physical activity recommendations for adolescents and children are different than for adults. It is recommended that youth participate in physical activity for at least 60 minutes daily. Specifically, youth should accumulate the majority of 60 minutes from aerobic activity at moderate or vigorous intensity. At least 3 days a week should include vigorous intensity. It is also recommended that youth include bone and muscle strengthening activities in the 60 minutes of activity at least 3 days per week. Bone strengthening activities often produce an impact with the ground. Examples of bone strengthening activities are running, playing sports, hopscotch, and jumping rope. Muscle strengthening includes activities that produce an above normal stress on muscles, called overload. Muscle strengthening activities may be unstructured, such as playing on the jungle gym or tree climbing, or structured, for example lifting weights or using resistance bands (USDHHS, 2008).

In addition to physical activity, it is recommended that youth limit sedentary behavior. The American Academy of Pediatrics recommends that screen time be limited to less than 2 hours per day. Screen time includes television, computer, and video game usage (Council on Sports Medicine and Fitness & Council on School Health, 2006).

Physical Activity Prevalence Rates in Adolescents

The CDC biannually administers surveys to estimate physical activity levels and weight status, among other parameters, using the Youth Risk Behavior Survey (YRBS). Recent reports of the YRBS data collected in 2005 stated that only 36% of 9th through 12th grade students met the physical activity recommendations for youth. Males had a higher prevalence of meeting these physical activity recommendations compared to females, 44% versus 28% respectively (CDC, 2006). Based on ACSM's adult physical activity recommendations of at least 20 minutes of vigorous intensity on at least 3 days per week and/or at least 30 minutes of moderate intensity on at least 5 days per week (ACSM, 2006), 69% of 9th-12th graders met the guidelines. Females in 9th through 12th grade had a lower prevalence than males of meeting the adult physical activity recommendations (CDC, 2006).

Adolescents are more likely to meet the adult physical activity recommendations than those for youth. This could suggest that adult physical activity recommendations may better fit an adolescent's lifestyle. Between 9th and 12th grades, the prevalence of meeting adult physical activity recommendations changed 7% among males and 17% among females. The most noticeable prevalence difference was among females between the 11th and 12th grade years. Similarly, between 9th and 12th grades, the change in the prevalence of meeting the youth physical activity recommendations was greater among females than among males, 7% and 1% respectively (CDC, 2006).

The YRBS is also used to gather prevalence data of sedentary behaviors, including physical inactivity, computer usage, and television viewing. The prevalence of reporting no physical activity 7 days prior to the administered survey among high school students was 9%. Females were more likely to report no physical activity compared to males, 11% versus 8%, respectively. With an increase in grade level, more females report not participating in any physical activity; beginning with 8% in the 9th grade increasing to 15% in the 12th grade. The prevalence of males not participating in any physical activity was relatively similar throughout high school. In the 9th grade, 7% of males reported not participating in any physical activity, compared to 8% in the 12th grade (CDC, 2006).

The YRBS provides questions about the amount of computer use not related to school. Males reported a higher prevalence than females of computer use for 3 hours or more, 27% for males compared to 15% for females. The prevalence of adolescents reporting computer use decreased as grade level increased, from 30% to 25% for males, and from 17% to 12% for females. Similar trends are found for television viewing. Television screen time of 3 hours or more per day was reported by 37% of students. The prevalence of television viewing was high among males and females, but decreased with grade level (CDC, 2006).

Males are better at maintaining physical activity through high school years than females. Across grades, the prevalence of males meeting the youth physical activity recommendations remained stable compared to females. The prevalence of meeting physical activity recommendations throughout high school was greater for males than for females. The prevalence of females meeting physical activity recommendations was 31% in the 9th grade and 24% in the 12th grade. Comparatively, across grades the prevalence of males meeting physical activity recommendations decreased by 1% between 9th to 12th grades in 2005 (CDC, 2006). Although males have a higher prevalence of time spent in sedentary behaviors, they also spend more time in physical activity than females.

Physical Activity Patterns of Adolescents

Overall, high school students become less physically active as they get older. Along with the decreased prevalence of meeting physical activity recommendations, sedentary behaviors also decreased with grade level. Less physical activity and less reported time spent in sedentary activities leads to the inquiry of what activities high school students participate in (CDC, 2006). Pate, Dowda, O'Neill, and Ward (2007) identified the probability of continuing specific activities among adolescents, including both sport and lifestyle activities. Activities among females shifted from sport participation to more lifestyle and occupational activities between the 8^{th} and 12^{th} grades (Pate et al., 2007).

Across all grades, physical activity levels are lower in females than their male counterparts. Not only is female physical activity level lower than males, but females decrease activity at a much faster rate than males (CDC, 2006). Several authors have focused on female adolescent physical activity to understand the change in the pattern of physical activity with age. Adolescent females appear to have a decreased level of physical activity with increasing grade level during high school (Pate et al., 2007). During adolescence, females decrease sedentary behaviors but also decrease physical activity behavior (Adams, 2006; CDC, 2006; Pate et al., 2007).

Prevalence of Physical Activity in College Students

The American College Health Association implemented a health plan for college campuses to improve overall student health, called *Healthy Campus 2010*. *Healthy Campus 2010* is based on *Healthy People 2010*, national health objectives set every 10 years. *Healthy Campus 2010* focus areas include, but are not limited to, physical activity and fitness, heart disease and stroke, nutrition and overweight, health communication, and other disciplines. *Healthy Campus 2010* encourages a collaborative effort among departments to improve the health of college students. By 2010, *Healthy Campus* projects to decrease the proportion of college aged adults reporting no leisure time physical activity from 40% to 20% (American College Health Association, 2002).

In spring 2007, 26% of college students reported no leisure time physical activity. Since *Healthy Campus* objectives were established from spring 2000 reports, prevalence of inactivity has improved. By 2010, *Healthy Campus* strives to increase the prevalence of students participating in 30 minutes of moderate or 20 minutes of vigorous physical activity to 55%. Since the objective was set in 2000 with a prevalence baseline of 40%, achieving 30 minutes of MVPA or 20 minutes of vigorous physical activity, the prevalence has decreased. As of spring 2007, American College Health Survey results demonstrated that only 35% of college students were achieving this goal (American College Health Association, 2002, 2008).

In agreement with the finding that many college students do not meet physical activity recommendations, Suminski et al. (2002) reported that 53% of females and 40% of males did not achieve vigorous physical activity recommendations. Huang et al. (2003)

stated that older students were less likely than younger students to meet the moderate physical activity recommendation proposed by the CDC of 30 minutes most days of the week (Pate et al., 1995). Huang et al. reported that 16% of college students reported no physical activity. The trend of reporting no physical activity continues into adulthood, with an even greater prevalence rate. As stated by the CDC (2008c), 25% of U.S. adults reported no physical activity.

On average, college students reported participating in aerobic exercise 2.8 ± 2.1 days per week, based on YRBS results. Students reported on average 2.2 ± 2.1 days per week of strength training in the previous 7 days (Huang et al., 2003) and males reported a greater number of days per week of participation than females (Suminski et al., 2002). *Healthy Campus 2010* estimated that 47% of college students met the recommended amount of muscular strength and endurance activities. By the year 2010, the percentage of college students that meet muscular strength and endurance recommendations is anticipated to increase to 65% (American College Health Association, 2002).

Physical Activity Patterns of College Students

As college students move through their college careers, trends show an increase in weight coinciding with a decrease in physical activity and a diet lacking in essential nutrients. With increasing age through high school and college, physical activity continues to decrease into adulthood. Huang et al. (2003) surveyed over 700 college students between ages 18 and 27 years on two consecutive spring semesters. Students self-reported height and weight and BMI was calculated. Physical activity was determined by three YRBS questions pertaining to aerobic physical activity, muscle strengthening, and physical education class. Dietary habits were assessed by frequency of fruit, vegetables, and fiber intake of the previous week. Younger college students were found to be significantly more likely to report aerobic physical activity than older students. Younger college students were also more likely to participate in strength training than older students. As college students age, the prevalence of students reporting participation in aerobic activities and in strength activities decreases (Huang et al., 2003).

It is relatively clear that college-aged females have low levels of physical activity (American College Health Association, 2002; Huang et al., 2003; Suminski et al., 2002) and few meet physical activity and dietary recommendations (Huang et al., 2003; Suminski et al., 2002). Low levels of physical activity and poor diets could be causes of female weight gain (Huang et al., 2003). There has been a belief that upon entering college, weight gain is likely to occur during the first year. The general consensus is that a deficit in physical activity and an excess in caloric intake leads to an increase in weight. Jung, Bray, and Martin-Ginnis (2008) sought to identify the cause of weight gain in college freshman among 103 females. Height and weight of participants were measured, and body composition was assessed with a handheld bioelectrical impedance analyzer. Physical activity was assessed using the Leisure Time Exercise Questionnaire (LTEQ) (Godin & Shephard, 1985). Participants reported bouts per week spent in mild, moderate, and vigorous physical activities over the previous 3 months. METs were assigned to each intensity level and summed to calulate MET hours per week. Mild, moderate, and vigorous intensity were assigned 2, 4, and 7 METs, respectively. Participants were asked to record a 3-day food log over 2 weekdays and 1 weekend day. Using a diet database, mean daily caloric intake was summed for each participant. This protocol was followed at baseline and a year later at posttesting. Eight weeks and 25 weeks after baseline participants were mailed the LTEQ and 3-day food log. No significant dietary differences were found between female weight gainers and female weight losers. The analysis of the diet suggested that first year college females significantly decreased caloric intake between spring of the first year (baseline) and spring of the following year (posttesting). When the weight gainers and weight losers were examined, both groups reported significant and similar decreases in caloric consumption. Because the same dietary trends occurred among both weight gainers and weight losers, it was concluded that diet does not seem to account for weight gain in this sample. Therefore, the change in weight among freshman college females was probably due to changes in levels of physical activity (Jung et al., 2008).

Weight losers made little alteration to physical activity patterns, measured by MET hours/week scores between baseline and posttesting. Weight losers had a mean pretesting MET hours/week of 24.6 and posttesting MET hours/week of 23.2. Weight gainers significantly decreased physical activity between pretesting and posttesting. For weight gainers, pretesting MET hours/week was 21.5 and posttesting MET hours/week was 16.1. At baseline, physical activity levels between the two groups were similar. Time and group comparisons at week 8, week 25, and posttesting demonstrated physical activity among weight gainers and losers differed. Weight gainers had less physical activity compared to weight losers at weeks 8 and 25 (Jung et al., 2008).

Observations of dietary patterns suggest caloric intake decreases, although snacks, sodium enriched foods, and alcohol are available. Jung et al. (2008) concluded that dietary habits are not as influential as physical activity for weight gain in college females. With a decrease in caloric intake by weight gainers and weight losers, maintenance of physical activity appears to help prevent weight gain.

Prevalence of Physical Activity in Adults

Forty percent of adults and 43% of female adults aged 18 years and older report no leisure time physical activity. Forty-sex percent of high school graduates and 24% of college graduates report no leisure time physical activity, demonstrating a relationship between education level and physical activity. Only15% of adults meet the recommended amount of moderate intensity physical activity for 30 minutes, five or more days per week. One goal of *Healthy People 2010* is to decrease the number of adults who do not participate in any leisure time physical activity from 40% to 20%, while increasing the percentage of adults who meet the recommended amount of moderate intensity physical activity. One objective of *Healthy People 2010* is to increase the prevalence of adults that meet moderate physical activity recommendations from 15% to 30% (USDHHS, 2000).

An additional objective of *Healthy People 2010* is to increase the prevalence of adults meeting the vigorous physical activity recommendations to 30%. Nearly a quarter of adults, 23%, engage in the recommended level of vigorous physical activity of 20 minutes, 3 or more days per week. Twenty percent of females meet the recommended amount of vigorous physical activity. Eighteen percent of high school graduates and 32% of college graduates meet the recommended amount of vigorous physical activity, demonstrating a relationship between education level and physical activity for females (USDHHS, 2000).

The number of adults that meet the recommended amount of activity decreases with age and is lowest among those 75 years and older. The majority (65%) of adults aged 75 and older do not obtain any leisure time physical activity (USDHHS, 2000). The U.S. population is increasing in average age and is likely to increase in the number of adults over 65 years old between the years 2010 – 2030. The U.S. Census Bureau projects that by 2030, the population aged over 65 years will double compared to 2000 (He, Sengupta, Velkoff, & DeBarros, 2005). In the older adult population, heart disease, cancer, and stroke continue to be the leading causes of death, with 33% of deaths in this population caused by heart disease. Although more adults are living longer, quality of life and independent living is a concern. The World Health Organization recognizes the importance of maintaining flexibility, balance, coordination, endurance, and strength to sustain independence and well-being (World Health Organization, 2008).

Physical Activity Patterns of Adults (related to childhood)

The decreasing trend of physical activity seems to begin in the high school years and continue into adulthood (Adams, 2006; Eaton et al., 2006; Horn et al., 2008; Nelson, Gordon-Larsen, Adair, & Popkin, 2005; Pfeiffer et al., 2006; Telama et al., 2005). Nelson et al. identified patterns of physical activity and inactivity tracking into adulthood beginning with a sample of adolescents in 7^{th} to 12^{th} grades. Nelson et al. analyzed data among a final sample of 12,000 males and females from The National Longitudinal Study of Adolescent Health. Participants in this study were divided into three sample waves.

Wave I data collection occurred in 1994 to 1995 and consisted of parents and students. Students in Wave I were assessed with in-school physical activity surveys and also completed in-home surveys along with parents. Wave II measurement occurred in 1996 and consisted of Wave I participants that had not graduated from high school, including dropouts. Wave III survey data were collected in 2001 to 2002 and included all available Wave I respondents aged 18 to 26 years (Nelson et al., 2005).

Adolescent physical activity was measured using a 7-day recall questionnaire which included housework, hobbies, active play, sports, and exercise. Frequency and intensity of activities were calculated to total weekly MVPA. Adolescents reported participation in school physical education, school-based sports, academic clubs (number per year), use of neighborhood recreation centers, watching television/videos, playing video or computer games (hours/week), playing sports with a parent in the previous month, and parent regulated television viewing. In-home surveys were administered to the parent and adolescent to gather descriptive data about race/ethnicity, nationality, household, parent education, income, occupation, family structure, and school community. In Wave III, physical activity survey questions were adjusted to fit the change in lifestyle from adolescence to adulthood. Clusters were formed based on similar physical activity and sedentary behaviors during adolescence. Each cluster was analyzed when participants were young adults, ages 18 to 26 years (Nelson et al., 2005).

Nelson et al. (2005) found that certain groups of adolescents were more likely to meet moderate to vigorous physical activity recommendations as adults. Adults who were more likely to meet recommendations were identified during adolescence as skaters and gamers, and tended to have played sports with their parents, used recreation centers, and were active in school. Although these groups of adolescents were more likely to meet recommendations as adults, physical activity decreased from adolescence into adulthood. Sixty-four percent of adolescents who were skaters and gamers decreased physical activity as adults. Forty-two percent of adolescents who played sports with parents decreased activity as adults. Thirty-six percent of adolescents that were active in school decreased physical activity in adulthood. During adulthood, 35% of adolescents who utilized recreation centers decreased physical activity. Adolescents who controlled their own television viewing, but watched very little were more likely to maintain physical activity into adulthood. Only 3% of adolescents who controlled television viewing decreased physical activity as adults (Nelson et al., 2005). Although Nelson et al. demonstrated important physical activity patterns of a cohort, measurement of physical activity was different at each wave. Using different measurements of physical activity at each time point decreases the comparability of findings.

Telama et al. (2005) also evaluated childhood physical activity and attempted to predict physical activity during adulthood. Baseline measurements occurred between 1980 and 1989 when participants were 9 to 18 years old. Physical activity was measured by a self-report questionnaire containing information about frequency and intensity of leisure time physical activity, common activities of leisure time, sport participation, physical education, and mode of school transportation. Upon completion of the questionnaire, responses were coded as (a) inactive or very low activity, (b) moderately intensive or frequent activity, or (c) frequent or vigorous activity. A physical activity index (PAI) was calculated for each participant. Participants were measured again in 2001 when they were between the ages 24 and 39 years. The administered questionnaire in 2001 included frequency and intensity of physical activity, frequency of vigorous physical activity, hours spent in vigorous physical activity, average duration of a physical activity session, and participation in organized physical activity. Upon completion of the questionnaire, PAI was summed (Telama et al., 2005).

In agreement with the results reported by Nelson et al. (2005), a decrease in activity level in adulthood compared to adolescence was found by Telama et al. (2005). With increasing interval period between physical activity assessments, physical activity of females during childhood and adulthood became less related, especially between the ages of 9 to 27, $r = -.01$ (not significant). For females, adult physical activity was most closely related and unchanged throughout young adulthood. Between the ages of 21 to 33 years, physical activity of females was significantly related, $r = .41$ (Telama et al., 2005).

The odds of maintaining physical activity into adulthood are much lower among females than among males. Telama et al. (2005) found that active females aged 9 and 12 years were 7.2 times more likely to be active as adults than inactive females of the same age. However, overall the odds of females becoming active adults are much lower compared to males. At age 15 and 18 years, males that were active during adolescence over a 3 year period were reported to have 11.8 times greater odds than inactive males to be active adults. Active females at age 15 and 18 years had only 4.4 times higher odds than inactive females to be active adults. Among the same age group, males who were active adolescents over a 6 year period had 19.2 times greater odds of becoming active adults compared to inactive males. Females in the same age group who were active adolescents over a 6 year period had only 6.1 times greater odds to be active adults compared to inactive adolescents. Adolescent males were more likely to sustain physical activity and become an active adult than adolescent females.

Telama et al. (2005) also found that youth who maintained physical activity over a 6 year period had higher odds of being highly active adults compared to those who only maintained physical activity for a 3 year period. Therefore, the longer high levels of physical activity are maintained during childhood, the more likely individuals are to continue being physically active as adults. The likelihood of being an active adult increased even more if youth sustained physical activity at an older age. For example, males who maintained activity for 6 years at age 15 and 18 years old had higher odds (OR = 19.2) of being active as an adult than males who were inactive. Males who maintained activity for 6 years at 9 and 12 years old had higher odds (OR = 12.6) of being an active adult than inactive males. Among males, physical activity during adolescence is a better predictor of adult physical activity than physical activity during childhood.

Although attempts at increasing physical activity have been made through recommendations, policy changes, and continuing research, Americans generally are still not obtaining the recommended amount of physical activity. Beginning in adolescence, physical activity begins to decrease and this trend continues into adulthood (Nelson et al., 2005). Females particularly are at risk for not achieving the recommended physical activity levels during adolescence and adulthood (CDC, 2006; USDHHS, 2000).

Physical activity levels during adolescence are related to meeting physical activity recommendations in adulthood (Nelson et al., 2005). The longer physical activity is sustained during adolescence, the more likely it is that a person will become an active adult (Telama et al., 2005). Research findings can be used to target specific populations to increase physical activity. If physical activity can be increased during adolescence, particularly among females, the changes are greater that these individuals will be active as adults.

A popular way for parents to encourage physical activity among their children is by enrolling them in recreational sports. As children become adolescents they will most likely make their own decisions to continue or not to participate in sports in high school. Sports participation and its contribution to physical activity will be discussed in the following section.

Sports Participation

Results from the YRBS demonstrated that 56% of high school students played on at least one sports team (community or school) in the previous year (CDC, 2006). Consistent with this finding, the National Federation of High School Athletics reported a participation rate of 55% among the same grades (Howard & Gillis, 2009). Although over half of high school students participate in sports (CDC, 2006; Howard & Gillis, 2009), sports participation decreases dramatically throughout middle and high school grades. As students increase in grade level, sport participation decreases from 60% in 9th grade to 49% in 12th grade, a drop of 11% (CDC, 2006). The likelihood of adolescents discontinuing sports is 80% to 90% higher than continuing sports. It has been suggested that if adolescents do not participate in sports by middle school, they are not likely to start participating during high school (Aaron, Storti, Robertson, Kriska, & LaPorte, 2002).

Johnston, Delva, and O'Malley (2007) reported a significant decrease in intramural and club sport participation from 8th grade to 12th grade, but a fairly steady participation rate in varsity and junior varsity sports. Sport participation decreases severely during the transition from high school to college. The National Collegiate Athletic Association (NCAA) reported that of 15 million college students in 2006, only 2% of the college student population participated in NCAA sports (NCAA, 2006). The National College Health Risk Behavior Survey demonstrated a 47% decrease in sport participation among high school varsity athletes to intercollegiate athletes (CDC, 1997).

National Center for Education Statistics (NCES) (1996b) further analyzed data collected from the National Education Longitudinal Study (NELS:88) to explore longitudinal sport participation. The 8th grade class of 1988 was followed for 2 years after high school graduation. Students completed self-administered questionnaires with the purpose of identifying background characteristics, language proficiency, activities, school experiences, attitudes, and future plans at the baseline year. Students repeated these questionnaires for the follow up years in 1990 and 1992, during 10th and 12th grades, respectively. The second follow-up of the participants included high school dropouts. In the third year follow-up in 1994, students were analyzed as three groups selected from the 8th grade class of 1988; all students; high school graduates; and students who attended four year colleges. Questionnaires were administered for data collection after high school via one-on-one computer assisted telephone interviews (NCES, 1996a). Colleges attended by the NELS:88 participants were identified by a school code. Current participation in college sports, previous sports participation in high school, college enrollment, athletic skill level, socioeconomic status (SES), race, and gender were compared among the three groups (NCES, 1996b).

The data collected after high school indicated that it is not likely for students to achieve the next level of athletics beyond high school. This may be especially true among females. Nearly twice as many males than females participated in intercollegiate sports (NCAA, 2008; NCES, 1996b). Of the 8th grade males, 7% participated in intercollegiate sports, but only 4% of females participated. Among all of the students followed from 8th grade through 2 years after high school, males were more likely than females to participate in Division I collegiate sports. Of the 8th graders who graduated from high school, elite athletes only made up 12% of high school graduates. Among the group of elite athletes, 25% continued to Division I intercollegiate sports; equaling only 3% of all high school graduates. Of the group of 8th grade students who attended four year colleges, nearly 15% participated in intercollegiate sports at any division. Being a male, elite athlete, and having a high SES increased the likelihood of participation in intercollegiate sports (NCES, 1996b).

The National Federation of State High School Associations reported an increase of 183,006 high school athletes during the 2006-07 seasons from the previous 2005-06 season. Although sport participation remains greater among males than females at high school and intercollegiate levels, sport participation among females has been increasing.

Also, from the previous 2005-06 season, the number of female athletes exceeded the 3 million mark for the first time. With the increase in the number of female athletes, females now constitute 41% of high school sport participants (Howard & Gillis, 2009). Though sport participation among females is growing, the trend in sport participation has demonstrated a decrease with age, especially among females (Aaron et al., 2002; CDC, 2006).

Pfeiffer et al. (2006) sampled over 400 middle school females through high school. Participants were assessed in the spring of the 8th, 9th, and 12th grades. Sports participation was determined by answering “yes” to two YRBS survey questions. Respondents were categorized as nonparticipants, dropouts, or 3-year sport participants. Prevalence of sport participation among 8th and 9th graders was found to be similar. However, sport participation among 12th graders, similar to findings from previous studies, was lower than in earlier grades (CDC, 2006; Johnston et al., 2007). Sport participation among females was highest in 9th grade at 51%. Nearly 50% of the girls participated in sports at all three time periods. Drop out rate, however was 32% among high school females (Pfeiffer et al., 2006).

Gender Specific Change in Activities

The introduction of sports may come at an early age and be influenced by siblings, peers, and parents (Keresztes, Piko, Pluhar, & Page, 2008). However, a child experiences specific motivational factors around middle school to continue or not to continue participating in sports. Sirard, Pfeiffer, and Pate (2006) attempted to identify the gender specific factors on sports participation and attrition. One school in each of the following states was chosen to participate in the study: Colorado, California, Ohio, and Pennsylvania. The participating schools held a Hershey North American Youth Track and Field Program. Participants included 1,692 male and female students in the 7th and 8th grades. Questionnaires were distributed in a classroom setting consisting of questions from the 1997 YRBSS, a modified version of the Participation Motivation Questionnaire (PMQ), and a few additional questions pertaining to sport participation, motivational factors for participation and attrition, and physical activity. Questions from the YRBSS aimed to measure time spent in sedentary, stretching, strengthening, moderate and vigorous activity, and physical education participation. The modified PMQ identified factors associated with sports participation and attrition. Based on questionnaire responses, participants were classified as recent, former, or nonparticipants. If students reported participation on at least one sport team the previous year they were considered recent participants. Former sport participants were those who reported participation in the past but not the previous year. Nonparticipants were students that reported never participating in a sport. To analyze PMQ responses, authors used exploratory factor analysis separated by gender.

Sirard et al. (2006) found that 80% of study participants were recent sport participants and 10% were former participants. Males were significantly more likely than females to be recent or former sport participants. The top three motivational factors for sport participation identified among males included competition, social benefits, and fitness. Among females the top motivational factors for sport participation included social and skill benefits, competition, and fitness. “Staying in shape” and “to get exercise,” were identified as reasons that fitness impacted sport participation for both genders. “Time barriers”, “lack of interest”, and “coaching problems” were identified as reasons that affected sports attrition for both genders.

As children get older, the factors that serve as motivators may begin to shift away from enjoyable recreational activities. Simultaneously with age, sports participation decreases continuously. The middle school years can be identified as a crucial age marker for physical activity and sports participation. Aaron et al. (2002) demonstrated the transitional change in sports from middle to high school grades. The sample included over 1,200 7^{th} grade middle school students who were followed into the first year of high school. Aaron et al. used a questionnaire similar to that used by Sirard et al. (2006). The questionnaire was administered each spring over 4 years to explore leisure and competitive activities of the past year. The questionnaire included 26 team and individual recreational and leisure activities. Students were able to add activities not provided on the questionnaire. Students participated in an average of seven activities in year one and this decreased to three activities in year four. Recreational and leisure activities were found to significantly decrease by 56% over the 4 year study period. Over the 4 years, 85% of students reported a decrease in the number of activities. Total physical activity (hours per week) decreased by 26% over the 4 years. The significant decrease in hours per week was greater in males than in females, 43% and 26%, respectively. However, physical activity among males was significantly higher than among females each year monitored. It is possible that males achieved more physical activity at baseline than females, which accounted for the larger decrease for males (Aaron et al., 2006).

Among participants who reported the same activities at baseline and again after the 4 year period, physical activity time did not significantly change for activities maintained over the years. Similarly, time spent in sports did not significantly change for those participants who maintained sports from year one to year four. One exception to the significant decrease in time spent in physical activities was participation in basketball. Participation in basketball among males significantly increased regardless of whether it was reported at baseline. The decrease in physical activity among this age group is likely due to participation in fewer activities rather than to time spent in specific activities (Aaron et al., 2002).

Participation in different activities was gender specific and changed among both genders over the 4-year period. Males were likely to participate in baseball, basketball, football, street hockey, and weight lifting. Females participated more in aerobics and softball over the 4-year period. Specific to gender, some activities increased throughout the 4 years. Among females, an increase in participation was seen in aerobics and weight lifting. Among males, an increase in participation was seen in weight lifting, roller skating, and softball (Aaron et al., 2002).

Males were more likely than females to participate in team and vigorous activities, whereas females were more inclined to continue activities which occur year round. Aaron et al. (2002) found that students who did not participate in an activity in middle school were not likely to participate in high school. Among males, the activities that had a 50% chance or higher to be continued from middle school to high school were basketball, football, street hockey, and weight lifting. Activities that were most likely to be continued among females were aerobics (47% chance) and softball (45% chance). The shift from team sports to individual activities between middle school and high school years may be considered when designing physical activity interventions for females. It may be necessary for females to learn individual skills rather than team sports to maintain physical activity.

Physical Activity through Sports Participation

Participation in sports increases physical activity levels among children and adolescents, particularly for males (Sirard et al, 2006). Sirard et al. also found that males who engaged in sports spent significantly more time in sedentary behavior than females who participated in sports. However, males also reported participation in more vigorous physical activity and strengthening activities than females. Recent sport participants spent significantly more time than former sport participants in vigorous physical activity, stretching, and strengthening and less total time in sedentary behavior.

Pfeiffer et al. (2006) evaluated the relationship between sport participation and physical activity among adolescent females. Physical activity was measured using a 3-Day Physical Activity Recall (3DPAR). Over the course of the study, participants completed a 3DPAR every spring during the 8^{th}, 9^{th}, and 12^{th} grades. The 3DPAR required participants to recall their predominant activity in 30-minute time blocks for the previous 3 days. Participants were given a list of 55 activities to help them recall the predominant activity performed along with definitions and pictures of varying intensity levels. The activity of each 30-minute time block was assigned a MET intensity value from the Compendium of Physical Activities (Ainsworth et al., 2000). Activities with an intensity of 6 METs or greater were considered vigorous physical activities. Activities with an intensity of 3 METs or greater, but less than 6 METs, were considered moderate-to-vigorous physical activities (MVPA). Participants with two or more blocks of MVPA per day, or one or more blocks of vigorous physical activity per day, on all 3 days were considered active. Participants who did not meet criteria to be active were considered inactive. Height and weight were measured and BMI was calculated. The same protocol was repeated at follow-up measurement during 9th and 12th grades.

Pfeiffer et al. (2006) found that with sustained sport participation the odds of meeting physical activity recommendations became increasingly higher. Among females who dropped out of sports after 8th or 9th grades, the odds of meeting MVPA and vigorous physical activity recommendations in the 12th grade were lower than for sport participants at all three time periods. For example, sport participants in 8th grade only and 9th grade only had 0.51 and 0.63 odds, respectively, of obtaining at least two blocks of MVPA per day in the 12th grade. Females who participated in sports at all three time periods were twice as likely to engage in vigorous physical activity as those who did not. Females who participated in sports in both 8th and 9th grade were more likely to engage in MVPA in the 12th grade than those who only participated in one year or not at all.

The chances of meeting physical activity recommendations increased with sustained activity through the 9th grade. The time of dropout ultimately affects future physical activity participation among females. Females who dropped out of sports after the 8th or 9th grade reported significantly less physical activity compared to sports participants of all three years. Those who dropped out of sports in early grades had significantly lower prevalence rates of meeting MVPA and vigorous physical activity recommendations than sustained sports participants. Nonparticipants had significantly lower prevalence rates of meeting MVPA and vigorous physical activity recommendations compared to three year sport participants. Females who dropped out in the 8th grade reported an average of 0.90 ± 1.13 30-minute blocks of vigorous physical activity per day compared to 3-year participants who reported 1.45 ± 2.16 blocks per day (Pfeiffer et al., 2006).

Horn, O'Neill, Pfeiffer, Dowda, and Pate (2008) sampled the same females as Pfeiffer et al. (2006) a year to a year and a half after graduation. Data collected by Pfeiffer et al. included 12th grade sport participation using YRBSS questions and physical activity measured by the 3DPAR. The focus of the study by Horn et al. was to identify postgraduation factors associated with physical activity based on the previous findings. Over 300 girls from the original analysis completed the 12th grade and postgraduation measurements. Physical activity after graduation was assessed using the International Physical Activity Questionnaire Long 7 Day Version (IPAQ). The IPAQ assesses five domains of physical activity at moderate, vigorous, and walking intensities. The domains include occupational, transportational, housework/family caring, recreation/sport, and time spent sitting. The IPAQ was administered by phone interview and asks participants to recall activity for the previous 7 days. Participants were asked to recall specific activities, the number of days they spent in the activity, and the duration of the activity each day. MET minutes per week were calculated by the preassigned MET values for each activity. Participants were divided into tertiles according to physical activity level after graduation. The upper tertile was classified as “high active” and the two lowest tertiles were classified as “low active.” Height and weight were self-reported during the phone interview to calculate BMI. All other factors, including employment status, academic enrollment, pregnancy status, number of dependent children, and marital status, were self-reported.

Horn et al. (2008) found that females who were physically active and participated in sports in high school remained active after graduation. Females who obtained two or more blocks of MVPA in the 12^{th} grade were significantly more likely to be in the high active group after graduation. Previous sport participants in 12^{th} grade were 2.11 times more likely than nonsports participants to be highly active after graduation.

Participation in sports benefits adolescents by providing more opportunities for physical activity. The prevalence of female adolescents meeting physical activity recommendations increases with participation in physical activities or sports (Pfeiffer et al., 2006). As children and adolescents become older it is imperative to keep them engaged and active in sports. Dropout in sports and lack of participation in physical activity could have a negative effect on physical activity later in life, especially among adolescents (Aaron et al., 2002; Horn et al., 2008; Pfeiffer et al., 2006). Providing more opportunities for sport participation is a possible intervention strategy for adolescents for prevention of drop out. Sustained sport participation, especially among female adolescents, increases the likelihood they will become active adults (Horn et al., 2008; Pfeiffer et al., 2006).

Other Factors Influencing Sports Participation

Factors that may affect the decision for continuation in club or varsity sports and physical activity thereafter include socioeconomic status (SES) and race/ethnicity. Few studies have demonstrated the impact SES and race/ethnicity background have on sport participation among adolescents.

Johnston et al. (2007) investigated the relationship between school sponsored physical activities with participation by grade level, race/ethnicity, and socioeconomic status. School sponsored physical activities included participation in physical education and school sports. Data from two previous studies were analyzed: Monitoring the Future (MTF) (Johnston, O'Malley, Bachman, & Schulenberg, 2005), and Youth Education and Society (YES) (Johnston & O'Malley, 2003). MTF annually surveys a nationally representative sample of adolescents in middle school (8^{th} grade) and high school (10^{th} and 12^{th} grades). MTF collected data on students in over 400 schools. To obtain a nationally representative sample, selection was based on geographic locations, schools within the region, and random selection of classes in the selected grade. Students in the class completed a questionnaire to self-report gender, race/ethnicity, and parent education. Parent education was used to categorize socioeconomic status with one being of low socioeconomic status and six being of high socioeconomic status. Students reported each parent education level as one of the following: completed grade school or less, some high school, completed high school, some college, completed college, or graduate or professional school after college. The four regions of the United States were coded based on population density (large metropolitan statistical areas, other metropolitan statistical areas, or nonmetropolitan statistical areas).

YES data were obtained from a portion of the MTF sample consisting of 509 schools per year. School administrators of the participating schools completed a self-administered questionnaire. The questionnaire sought to obtain participation rates in physical education classes, varsity sports participation, intramural sports participation, and transportation mode to school (bicycling or walking). Johnston et al. (2007) analyzed data pertaining to the school physical education requirement for students. Specific to grade level, administrators were asked the percentage of students in the target grade that took physical education, frequency of physical education classes, and duration of physical education class to calculate total minutes of physical education. Sport participation was determined by asking administrators the percentage of males and females separately that participated in interscholastic or varsity sports and intramural sports or physical activity clubs. Administrators were also asked to report the percentage of students who walked or biked to school, if students were tested for physical fitness, and who was tested. Answer options to the fitness testing question included: all students in the target grade, only students in the target grade enrolled in physical education, and other. Administrators were asked if parents received the students' physical fitness test results.

Johnston et al. (2007) found the continuation of sports was prominent among those of high socioeconomic status. A 1.2% increase in intramural or club sports participation occurred with every one level increase on the one to five scale of socioeconomic status. Overall, higher socioeconomic status was related to participation in varsity and intramural sports for both genders. A significant linear relationship between SES and interscholastic or varsity sports participation was reported for lower grades, but not for higher grades (no values for the correlations were reported in the study). The NCES (NCES, 2005) reported that a similar relationship between sport participation and SES continues into college. Based on two separate survey years, NCES reported that 70% of high school sport participants were of high SES. Among all high school students that continued to intercollegiate athletics, students were five times more likely to be from high SES than low SES (NCES, 1996b).

Johnston et al. (2007) analyzed the relationship between interscholastic or varsity sports by grade level separately for males and females and found similar relationships for both genders. Interscholastic or varsity sport participation was linearly related with SES among 8^{th} grade students, but not for 12^{th} grade students. Aaron et al. (2002) reported similar results among adolescents using a different method of classifying socioeconomic status. In their study, socioeconomic status was classified by percentage of the population below the poverty level in the town of residence: participants were classified as low SES if the population was $\geq$ 20% below the poverty level, middle SES if 10-20% were below the poverty level, or high SES if $\leq$ 10% were below the poverty level. The sample included nearly 800 students in middle school and high school grades. A decrease in activities over the 4-year period was significantly associated with low socioeconomic status among males.

Johnston et al. (2007) found some relationship between sports and race/ethnicity as reported by administrators. Intramural and club sports participation was significantly higher among white students compared to blacks and Hispanics in all grades. In addition, significantly more white males and females participated in varsity sports than blacks and Hispanics across all grades, with the exception of 10th grade males. Although not statistically significant, blacks participated more in intramurals than whites and Hispanics. Among 12th grade students only, whites had a significantly higher participation rate in varsity or interscholastic sports than any other race; 39% white males, 32% black males, and 27% Hispanic males; 34% white females, 28% black females, and 24% Hispanic females.

Of the 1988 8th grade class followed by NCES, participation in high school sports was similar across race/ethnicity. NCES reported that 61% of whites and of blacks, and 54% of Hispanics participated in high school sports. When the transition from high school to college sports is made, a decrease in participation in sports occurs across all races/ethnicities. Among the entire sample, 6% white, 5% black, and 2% Hispanic reported participation in intercollegiate sports (NCES, 1996b).

Participation in sport could have a positive influence on current and future physical activity. Sports participation during adolescence increases the prevalence of meeting physical activity guidelines. If adolescents remain in sports throughout high school, then they are more likely to meet the recommended level of physical activity as adults. However, if adolescents drop out of sports between middle school and high school, they are not likely to attempt a new activity. Therefore, dropout of sports decreases the likelihood of meeting physical activity recommendations as an adult.

Although females have a higher prevalence of sport participation than in past years, they are still subject to higher dropout rates than males. It is integral to keep children and adolescents involved in physical activity, especially females. In future research and programming interventions, specific populations such as adolescent females should be targeted. Interventions may include the introduction of new activities or sports, either interscholastic or intramural level, to increase the likelihood of maintaining future activity.

Academic Achievement

In addition to promoting an overall improved quality of life, physical activity is also beneficial for the learning environment. Physical activity improves academic performance (Carlson et al., 2008; Field et al., 2001) and classroom behavior (Jarrett et al., 1998; Mahar et al., 2006). Although the academic benefits are apparent, two of the challenges that school districts are faced with while trying to improve physical activity and nutrition programs are: “1) intense pressure to raise standardized test scores accompanied by the conventional wisdom that this can best be achieved by a narrowing of the school’s focus and curriculum; and 2) limited budgets that make it difficult to find resources to implement program improvements” (Wechsler, McKenna, Lee, & Dietz, 2004, p. 4). The increased interest in standardized testing requires additional classroom time, limiting time for physical education and recess. However, organizations such as the National Association for Sport and Physical Education and the National Association of

State Boards of Education, promote physical activity in schools because of the known benefits it provides.

Physical Activity and Classroom Behavior

Participation in physical activity has been demonstrated to be beneficial in many arenas, including academic achievement. Physical activity leads to increased on-task behavior (Mahar et al., 2006), higher grades (Fredricks & Eccles, 2006), and higher standardized test scores (Cooper et al., 1999). Students as young as elementary school have demonstrated the benefits of physical activity in school behaviors. Mahar et al. measured the effectiveness of brief educational physical activities during school, called *Energizers,* on on-task behavior. *Energizers* are approximately 10 minutes in length and require minimal teacher preparation. *Energizers* incorporate grade appropriate educational lessons and physical activity. The sample included 243 students in kindergarten through 4th grade. Each teacher was asked to lead one *Energizers* activity per day for 12 weeks. Two classes per grade level served as the intervention classes and a third class at each grade level served as the control classes. The control classes began *Energizers* after week eight of the study (Mahar et al. 2006).

To measure physical activity, students in each grade wore pedometers during the school day for one week. Pedometers were distributed at the beginning of the school day and collected at the end of the school day. Students in the intervention classes recorded steps before beginning the *Energizers* activity, immediately after the *Energizers* activity, and at the end of school day. Students in the control classes recorded steps at the end of the school day (Mahar et al., 2006).

To measure on-task behavior, two classes in each the third and fourth grades were randomly chosen for direct observation. Direct observation occurred during academic instruction. The two intervention classes in each grade level began implementing *Energizers* at different times in a multiple baseline design. For example, one class began the intervention after week four and the other began after week eight. During the intervention, on-task behavior was assessed for 30 minutes prior to the *Energizers* activity and for 30 minutes after the activity. Each classroom observation was conducted by one primary and one secondary observer. Each student was observed for 5 minutes during the 30 minute observation period and again during the observation period after the *Energizers* activity. Observation intervals lasted 10 seconds. After a 10-second observation, the observer had 5 seconds to record if the predominant activity was on-task, motor off-task, noise off-task, or passive/other off-task. On-task behavior was considered verbal or motor behavior appropriate for the classroom setting and rules. Off-task behavior was any behavior not on-task. The outcome variable for on-task behavior was average percent time on-task (Mahar et al., 2006).

Results of the Mahar et al. (2006) study demonstrated significantly more in-school steps among the students in the intervention classes compared to the control classes. Students in the classes that performed one *Energizers* activity each day averaged 782 more daily in-school steps than students in classes that did not perform an *Energizers* activity. The mean difference for in-school steps between the two groups was moderate, with an effect size of 0.49. Students in the intervention group achieved between 160 and 1,223 steps during the 10-minute classroom-based activities.

Among 3rd and 4th grade classes, no difference was observed in on-task behavior during baseline when no physical activity was performed. Improvements in on-task behavior after participants performed an *Energizers* activity were statistically significant and of moderate size, with an effect size of 0.60. In addition, students with the lowest level of on-task behavior before *Energizers* activities were introduced showed the greatest improvements in on-task behavior. Students identified as low on-task, increased on-task behavior by 20% after participation in an *Energizers* activity. Mahar et al. (2006) demonstrated that classroom-based physical activity does not disrupt classroom behavior, but instead enhances it.

Although academic performance was not directly measured in the study by Mahar et al. (2006), on-task behavior is an important component to learning and may be one of the mechanisms by which physical activity increases academic performance. Even as little as 10 minutes of physical activity can help students perform better in the classroom (Mahar et al., 2006).

Additionally, *Energizers* provide an opportunity to increase in-school physical activity, as measured by pedometer steps. Students would accumulate between 0.5 to 3.0 additional miles per week if just one 10-minute activity was performed each day of the week. The authors reported that an additional 70 miles in steps per year could be accumulated if *Energizers* were performed once a day, every day in the classroom (Mahar et al., 2006).

Jarrett et al. (1998) also demonstrated the effects of physical activity on classroom behavior among elementary students. Elementary students were observed to assess the effectiveness of recess on work (on-task), fidgety, and listless behaviors. Two 4th grade classes were selected with 25 to 30 students in each class. The final sample included 43 students, 18 males, and 25 females. Five students were diagnosed with Attention Deficit Disorder (ADD). Six students were from transient, or temporary, housing. The school system policy required uninterrupted instructional time (i.e., no recess). The classes selected had physical education three out of five mornings each week. The other two mornings students did not participate in any physical activity. Recess was randomly assigned to one of the two nonactivity days for the first week. On the other nonactivity day recess did not take place. After the first week, recess and nonrecess days were alternated randomly. Students were not aware which days recess would occur. Recess took place either in a park playground across from the school or on the school playground. The two playgrounds had slightly different equipment, but both had swings and monkey bars (Jarrett et al., 1998).

Observations of the two different 4th grade classes took place during science and mathematics classes, taught by the same teacher. Class A was observed from 10:00 to 10:25 and again at 10:50 to 11:15 on recess and nonrecess days. Class B was not observed prerecess. Observations for Class B only took place from 11:20 to 11:40. Students were observed for 5-second intervals. After the interval time was indicated, observers coded each student's behavior as one of the following: work, fidgety, or listless. If the behavior observed was not applicable to the codes, nothing was recorded. Work was defined as on-task behavior, doing assigned work, discussing work with a partner, reciting in class, or attending to the teacher. Fidgety was considered excessive movement, tapping, arm or leg swinging, or partly out of the chair. A student with his or her head on the desk, staring out of the window, slumping and not attending, or with eyes shut was coded as listless. After watching one student for 5 seconds, the observer would watch a different student. There were a total of six observation periods. Each condition resulted in a cumulative percentage of behavior types for each student (Jarrett et al., 1998).

Comparison of postrecess behavior on recess and nonrecess days demonstrated that recess had significant effects on behavior. Students' work behavior significantly increased and fidgety behavior significantly decreased following recess. When students did not receive recess they were on task 85% of the time during the postrecess observation. However, when students did have recess they were on task 90% of the time postrecess. Listless behavior was not affected by recess (Jarrett et al., 1998).

Students who were the most fidgety benefited more from recess. Also, students with lower work behavior benefited more from recess. Recess was demonstrated to have a significant benefit for particular students. All five students with ADD benefited from recess (Jarrett et al., 1998). Although most students benefited from recess, some did not. A few students demonstrated substantially poorer work performance or fidgetiness after recess. Results demonstrated that only one student had an increase in fidgety behavior after recess. Among the six children who did not benefit from recess, four of them were from transient housing (Jarrett et al., 1998).

Jarrett et al. (1998) found that, overall, children benefited from recess. After a recess break, students were more on-task and less fidgety. Also an important finding was that the five students with ADD all benefited from recess by increasing work behavior, decreasing fidgety behavior, or a combination of both. Jarrett et al. concluded that recess is an important part of the school day for elementary students, and suggested that recess improves classroom behavior, which may lead to better academic performance.

Physical Activity and Grades

Physical activity has been shown to increase on-task behavior in school. It is logical to believe the more a student is focused and paying attention, the more academically successful the student will be. Few studies have directly measured the effect of physical activity on academic performance. Research shows mixed findings on the relationship between in-school physical activity and academic performance.

Sallis et al. (1999) assessed a 2-year health-related education program within elementary schools. Seven elementary schools were selected and included kindergarten through 5th grade. Their analysis only focused on the cohort of 4th grade students. Each school was assigned to one of three conditions: specialist condition, trained teacher condition, or control condition. The specialist condition school had a certified physical education specialist to implement the Sports, Play, and Active Recreation for Kids (SPARK) program. In the trained teacher condition, school teachers were trained to implement SPARK. In the schools assigned as the control condition, classroom teachers implemented the regular physical education program. Prior to this study, there was no physical education curriculum in the schools, nor were there teachers or staff to instruct physical education classes.

SPARK was created based on two components: a physical education program and self-management curriculum. The physical education program involves physical activity and teaching skills and was taught a minimum of 3 days per week throughout the school year. The self-management program promotes activity outside of school. In the self-management program students were taught behavior change skills versus strictly physical activity (Sallis et al., 1999).

Teachers received training on class management and instructional skills. The purpose of training teachers was so physical education and self-management curriculums could be properly implemented. Three physical education specialists implemented the physical education and self-management programs in two of the seven schools (Sallis et al., 1999).

The SPARK program was implemented among 4th and 5th grade students for two consecutive school years. Cohort 1 consisted of 330 students and cohort 2 consisted of 424 students. Achievement test scores were obtained from 2nd grade (baseline), 5th, and 6th grade. The academic achievement scores were from the Metropolitan Achievement Tests reading, mathematics, language, and composition score (Basic Battery). Scores reported were percentiles based on national norms. Cohort 1 test scores were from the 2nd grade and 5th grade. Cohort 2 test scores were from the 2nd grade and 6th grade. Test scores for each cohort were analyzed by one-way ANOVAs (Sallis et al., 1999). A significant difference was found between percentile scores at baseline (2nd grade) and 5th or 6th grade among all three conditions: specialist, trained teacher, and control. All test scores in cohort 1, with the exception of reading, got worse from baseline to 5th grade.

Language and reading scores were significantly different between the three conditions. Language scores decreased least among the group with the trained teacher. Reading scores increased from baseline to 5th grade in the experimental group with the specialist and decreased in the control condition. Among cohort 2, all test scores got worse for all conditions from baseline to 6th grade. Less decline from baseline for all tests occurred in the trained teacher classes compared to the control and specialist conditions. Results demonstrated the SPARK program implemented by a specialist or trained teacher may be better for academic performance compared to the schools with the regular physical education curriculum (Sallis et al., 1999).

Carlson et al. (2008) examined the influence of physical education on directly measured academic achievement among elementary students. Data for this study were obtained from the Early Childhood Longitudinal Study. Participants were from the kindergarten class of 1998 to 1999 and followed into the 5th grade. The sample was nationally representative based on geographic location. Schools were then selected within each geographic location, and finally students were chosen in each school. The final sample included 5,316 students among 1,280 schools. Physical education was measured by classroom teachers reporting frequency (times per week) and duration (minutes per day) students took part in class. The outcome variable for physical education was expressed as minutes per week (frequency x duration). Physical education minutes per week was then classified as one of the following tertiles, low (0-35 minutes per week), medium (36-69 minutes per week), or high (70-300 minutes per week). Academic achievement was assessed by standardized tests scores in mathematics and reading.

Analysis of data occurred at five different time points including fall of kindergarten, spring of kindergarten, 1st grade, 3rd grade, and 5th grade. Analyses compared mathematics and reading test scores at each grade level by physical education tertile and by gender (Carlson et al., 2008).

The final sample consisted of 52% females and 69% nonwhite Hispanic. Overall, teachers reported that physical education occurred 1-2 times per week and the duration was different for each grade level. For kindergarten and 1st grade, most teachers reported a duration of 16-30 minutes. The most often reported duration of class was 31-60 minutes for 3rd and 5th grades (Carlson et al., 2008).

With an increase in grade level, time in physical education class increased. The number of students classified in the high tertile (70-300 minutes per week) increased with grade level. For example, in kindergarten 3,165 students were categorized in the low tertile and only 1,202 students were categorized in the high tertile. When the same students were in 5th grade, 1,516 were placed in the low tertile and 1,357 in the high tertile. One explanation for the change in physical education tertile is half-day kindergarten. However, there was still a noticeable decrease in the number of students in the low tertile from 1st to 5th grade (Carlson et al., 2008).

Across physical education tertiles, no significant mean difference in mathematics and reading scores were found among males. Females standardized test scores, however, differed across tertiles. Mean reading scores among females in every grade, except 3rd, were significantly different between low and medium tertiles. Significant mean differences were also found between low and high tertiles for reading scores. That is, students who achieved 36 minutes or more of physical education had significantly higher reading scores than those with 35 minutes or fewer. Similar results were found among female students for mathematics scores in kindergarten and 1st grade. Kindergarteners categorized in the medium physical education tertile had significantly higher mean mathematics scores than those in the low tertile (Carlson et al., 2008).

Carlson et al. (2008) demonstrated that students who participated in as little as 36 to 69 minutes per week compared to 0 to 35 minutes per week, had higher academic achievement. An even greater increase in academic achievement can be achieved by a greater amount of physical education time per week. Significantly higher scores were obtained by students in classes that had physical education for 70 to 300 minutes per week compared to 0 to 35 minutes per week. Significant differences in test scores were only observed among females, which is an important finding. This finding could possibly lead to specific intervention strategies to get females more active in school, or possibly gender specific physical education classes for longer duration.

Limited research has examined the relationship between high school students' physical activity and academic performance. Field et al. (2001) examined the relationship between exercise frequency and academic performance among 89 high school seniors. Participants completed a Likert scale questionnaire about exercise frequency. Exercise frequency responses included rarely, sometimes, once a week, three or more times a week, or daily. Sport participation was surveyed on a similar format; Likert scale responses ranged from less than two hours per week to seven or more hours per week.

Students' self-reported grade point average (GPA) was based on a scale equivalent to grades ranging from A to D.

Results demonstrated that 60% (*n* = 36) of high school seniors were categorized in the low exercise group. The high exercise group had a significantly higher mean GPA than the low exercise group. Mean GPA for the high exercise group was 3.3 versus 2.9 for the low exercise group. The high exercise group also spent significantly more time in sports than the low exercise group. Based on Likert scale scores, the high exercise group averaged a score of 2.3 and the low exercise group averaged 1.8 (Field et al., 2001).

Physical activity and standardized test scores have been found to be significantly related (Carlson et al., 2008). Academic performance, as measured by GPA and standardized test scores, were increased slightly by participation in physical activity (Carlson et al., 2008; Field et al., 2001). However, some studies have found increased time in physical activity during school has not had a significant impact on academic performance, but has not hindered it either (Sallis et al., 1999).

Sports and Academic Achievement

It has been previously reviewed that physical activity during school has a significant impact on classroom behavior **(**Jarrett et al., 1998; Mahar et al., 2006). The effectiveness of increased physical activity time on academic achievement does not detract from academic performance measured by standardized test scores (Sallis et al., 1999). Increased physical activity has been found to be related with slight improvements in academic performance measured by GPA (Field et al., 2001) and standardized test scores **(**Carlson et al. 2008). Further research has examined the effects of specific activities, such as sports, on academic achievement. A few longitudinal studies have examined the relationship between academic performance and sport participation.

Cooper et al. (1999) examined the relationship between selected after-school activities and measures academic performance. Participants were selected from three large school districts, including metropolitan areas (two middle schools and one high school), suburban areas (two middle schools and three high schools), and rural areas (five middle schools and one high school). From the schools, 6th, 8th, 10th, 12th, and some 7th and 11th grade students and their parents were sampled. Questionnaires were mailed to the students' homes for parents to complete. Teachers administered questionnaires to students in school. Parents and students were asked how much time was spent on five after-school activities, including homework, weekday television viewing, extracurricular activities, structured groups outside of school, and employment. Students were asked if a parent was home when they arrived home after school. Parents were asked student ethnic background and if their child was eligible for a free-lunch program.

Agreement between parent and student responses was assessed by three different methods. First, the percent of exact matching responses between parents and students ranged from 27% to 60%. Second, percent agreement of exact response or within one response category ranged from 74% to 89%. Lastly, Cohen's kappa, which assesses the exact agreement correcting for chance, was used to assess parent and student response agreement. Results of the Cohen's kappa agreement analysis ranged from .06 to .31. Parents and students did not have a high level of agreement regarding time spent in activities, but the researchers considered these levels of agreement to be acceptable.

The statewide standard achievement tests (Tennessee Comprehensive Assessment Program (TCAP)) were administered to students in 2^{nd} through 8^{th} and 10^{th} grades. Cumulative raw scores for each grade level of math-related and language-related tests were used for the analysis. A second measure of academic achievement included teacher-assigned grades. Students took the TCAP toward the end of the semester in April. Teacher-assigned grades were collected after the TCAP, in June (Cooper et al., 1999).

The amount of time watching television was negatively related with TCAP scores (r = -.13) and teacher-assigned grades (r = -.11). The amount of time spent in extracurricular activities had a positive relationship with TCAP scores (r = .17). Time spent in extracurricular activities had a similar relationship with teacher assigned grades (r = .18). The amount of time spent in structured after-school groups with peers was also positively related with TCAP scores (r = .20) and teacher assigned grades (r = .12) (Cooper et al., 1999). After-school activities explained 11% of the variance in teacher assigned class grades, 7% of variance in TCAP scores, and 5% of the variance in teacher assigned grades, after controlling for background (Cooper et al., 1999).

Aside from time spent on homework, extracurricular activities and structured group participation had the highest association with standardized test scores and teacher assigned grades. After-school activities are related to academic achievement. Television viewing was negatively associated with academic achievement, whereas participation in structured groups and extracurricular activities were positively associated with academic achievement. In summary, involvement in sports and physical activity after school can help improve performance in school (Cooper et al., 1999).

Fredricks and Eccles (2006) examined data from the Maryland Adolescent Development in Context Study. The sample included 1,500 selected families from 23 schools within one county in Maryland. Longitudinal analysis was used to examine the relationship between extracurricular activities and developmental outcomes. All developmental outcomes were not discussed in the study.

Data were collected in five waves starting when the participating students were in 7^{th} grade. Participating students were followed until age 20 years. Fredricks and Eccles (2006) analyzed data from the third, fourth, and fifth waves. Wave three occurred during the participants' 8^{th} grade year after completion of the fall semester and following summer. Wave four occurred during the 11^{th} grade. Wave five occurred 1 year after participants finished high school. Wave three (8^{th} grade) and wave four (11^{th} grade) data were collected by interview or self-administered questionnaire in the home with the adolescent and guardian. Wave five data were collected by a mailed survey.

Extracurricular participation was reported during wave four (11^{th} grade). Students reported participation in extracurricular activities, such as school clubs, organized sports, and pro-social activities, over the past year. Questions allowed for "yes" or "no" responses. Sport participation was measured by asking the following questions: "Were you a member of any athletic or sports team at school?" and "Were you involved in any organized summer or after school sports or recreational program over the past twelve months?" (Fredricks & Eccles, 2006).

Academic achievement was measured at wave three (8^{th} grade) and wave four (11^{th} grade). Students reported the number of A's, B's, C's, D's, and F's on the first semesters report card and GPA was calculated. Students were also asked how far they thought they would go in school. Responses were coded into a category ranging from 1) graduate from high school or less to 4) obtaining a professional degree. At wave five, 1 year after high school, participants reported educational status or number of school years they completed coded from 1) did not graduate high school to 4) completing some college (Fredricks & Eccles, 2006).

Results demonstrated a significant relationship between sport participation and academic achievement. Sport participation was associated with a higher GPA in the 11th grade and with higher education expectations. In the 11th grade, students who reported participation in sports also reported lower levels of depression and higher levels of self-esteem than those who did not participate in sports. Compared to nonsport participants, those who participated in sports had significantly higher grades, higher education expectations, and higher self-esteem, and lower levels of depression in the 11th grade (Fredricks & Eccles, 2006).

One year after high school, 11th grade sport participants were significantly more likely to continue school than nonsport participants. Students who participated in school clubs and other social groups were also more likely to continue education 1 year after high school compared to those who did not participate (Fredricks & Eccles, 2006).

In a similar study, the relationship of sports participation and academic performance among African American and Hispanic high school students was examined (Melnick, Sabo, & Vanfossen, 1992). Data were obtained from the High School and Beyond Study. The original sample for the High School and Beyond Study consisted of over 1,000 secondary schools from which 36 seniors and 36 sophomores were selected from each school (Center for Education Statistics, 1987). Melnick et al. analyzed data from baseline and first year follow up of half of the participating sophomores from the High School and Beyond Study. The sample included over 14,000 high school sophomores in 1980, which was the baseline year. Follow up measurements of the same subjects took place in 1982, 1984, and 1986.

Some schools were oversampled to gain insight on the minority populations, including Hispanics, Catholic schools with a high population of minority students, alternative schools, and private schools with high achieving students. Dependent variables included popularity, extracurricular involvement, grades, standardized test performance, dropout rate, and educational expectations. A survey was used to measure athletic participation at baseline. Sophomores responded to the following question: “Have you participated on athletic teams either in or out of school this year?” During follow up, the same students were asked as seniors: “Have you participated on a varsity athletic team either in or out of school this year?” Response options included “have participated as a leader,” “have participated actively but not as a leader,” and “have not participated.” Responses to both questions were used to classify participants into one of seven groups: (a) nonparticipant in both sophomore and senior years; (b) sophomore participation but not a senior participant; (c) nonparticipant in sophomore year but senior participant; (d) senior nonvarsity nonleader and sophomore participant; (f) senior nonvarsity leader and sophomore participant; (g) senior varsity nonleader and sophomore participant; (h) senior varsity leader and sophomore participant (Melnick et al., 1992).

Academic achievement was measured by self-reported senior year GPA. Participants were asked “Which of the following best describes your grades so far in high school?” Response options included: “mostly A’s”; “about half A’s and half B’s”; “mostly B’s”; about half B’s and half C’s”; mostly C’s”; “about half C’s and half D’s”; “mostly D’s”; and “mostly below D”. Responses to the previous question were used to calculate GPA. Composite achievement test scores was a second academic achievement measure. Composite achievement tests included sophomore and senior year scores on reading, vocabulary, and mathematics (Melnick et al., 1992).

The first year follow up procedures were similar to the baseline year. Secondary school experiences, changes in attitudes and values since baseline year, work experiences, and plans for postsecondary education were measured by survey. Values including attitudes toward life goals and feeling about self were surveyed during the first year follow up. Standardized test scores were obtained during the baseline and follow up years (Center for Education Statistics, 1987).

All participants, including dropouts, transfers, and early graduates were surveyed. Dropouts, transfers, and early graduates received the same survey as current students, but their surveys included additional and modified questions. Dropouts, transfers, and early graduates were either mailed the survey or completed the survey at a convenient location in a group setting (Sebring et al., 1987).

Melnick et al. (1992) analyzed data from 14,366 participants, of which 3,336 were athletes. The sample included 957 black females (147 of which were athletes), 858 Hispanic females (293 athletes), and 5,435 white females (971 athletes). Hispanic females that resided in rural communities and black females in urban communities who played sports considered themselves more popular than other Hispanics and blacks in other communities. Participation in sports and popularity were found to be related among Hispanic and black females in rural communities, r = .25 and r = .19, respectively. Although not highly correlated, sports participation among Hispanic females in rural communities was related to dropping out school (r = .14) and test performance (r = .09). Among black females in rural communities, sports participation and involvement in extracurricular activities were related, r = .29 (Melnick et al., 1992).

Overall, sport participation was associated with academic performance determined by grades among black and Hispanic females. One exception included Hispanic females in rural communities in which grades and sport participation were negatively related, r = -.10. Although data from white females were not analyzed, a comparison between the three groups may have been useful for planning future intervention strategies.

Physical activity during school is related to GPA (Field et al., 2001; Fredricks & Eccles, 2006) and standardized test scores (Carlson et al. 2008; Cooper et al., 1999). Participation in physical activity during the school day can improve on-task behavior (Jarrett et al., 1998; Mahar et al., 2006). Participation in sports and after-school activities has also been found to be related to physical activity among minorities (Melnick et al., 1992). By promoting physical activity within the schools, academic performance can be improved, especially among students with low on-task behavior (Mahar et al., 2006). Physical activities during school may be increased by providing more structured classroom-based activities, physical education classes, or recess. Future research should consider use of objective measures of physical activity and academic performance to augment the data collected from self-reports.

Physical Activity and Mental Health

In 1996, the Surgeon General stated that physical activity may relieve symptoms of depression and anxiety and improve mood (USDHHS, 1996). Physical activity can impact several areas of mental health, including self-esteem, physical self-concept, confidence, and competence in abilities.

The CDC noted that in 2007 36% of adolescent females reported feeling sad or hopeless everyday for two or more weeks. The prevalence of feeling sad or hopeless was higher among females compared to males (CDC, 2008d). Adolescent females experience changes in mental health status, specifically perceptions of appearance and self-esteem (Brown et al., 1998). Many organizations target adolescent mental health including the National Youth Violence Prevention Resource Center, Center for Mental Health Services, Nemours Foundation, and American Academy of Child and Adolescent Psychiatry.

Self-Esteem

Self-esteem was defined by Fox as "a self rating of how well the self is doing" (Fox, 2000, p. 89). Self-esteem is determined by the individual and influenced by the culture surrounding him or her. Self-esteem is generated by a person's experiences, attributes, and achievements, which are dependent on cultural norms and cultural expectations (Fox, 2000). In relation to self-concept, self-esteem is considered part of the evaluation process of developing self-concept (Sonstroem, 1984), which will be defined later in this section. Self-esteem is at the apex of the hierarchical structure above self-concept (Fox, 2000).

Brown et al. (1998) examined mental changes among 2,379 girls from 9 to 14 years old. Specifically, Brown et al. examined the change in appearance and social domains of self-esteem. Annually, height, weight, and sexual maturation were measured. The Harter Self-Perception Profile for Children (Harter, 1988) was administered every other year to measure global self-worth, physical appearance, and social acceptance. Scores ranged from 1.00 to 4.00 on each of the three scales (Brown et al., 1998).

Self-worth and physical appearance were found to be moderately correlated. Between the ages of 9 and 14 years, self-worth and physical appearance had correlations between .57 and .68 among black girls and between .47 and .68 among white girls. Self-worth and social acceptance were also moderately correlated among both groups of females between 9 to 14 years old (r = .46 to .55 for blacks and r = .44 to .61 for whites) (Brown et al., 1998).

All scale scores were compared to the baseline age of 9 years. Black girls had higher scores on all three scales, physical appearance, social acceptance, and global self-worth. At baseline (age 9), black and white girls had significantly different global self-worth and physical appearance scores. Over time, compared to baseline, black girls significantly increased global self-worth scores starting at age 11 years. White girls significantly decreased global self-worth scores starting at age 13 years. Mean global self-worth scores significantly decreased in white girls from age 9 to 14 years, 3.17 to 2.96, respectively. Both groups of females significantly decreased mean physical appearance scores from age 9 to 14 years. Mean social acceptance scores significantly increased among both races. However, black girls had a greater increase from 2.86 at age 9 years to 3.30 at age 14 years compared to 2.91 to 3.19 for white girls (Brown et al., 1998).

The findings of Brown et al. (1998) are important because they demonstrate self-esteem changes among females are specific to race. As females get older, physical appearance and global self-worth decrease but social acceptance increase. Despite having a higher mean BMI, black girls had more favorable physical appearance scores than white girls.

Physical Activity and Self-Esteem

A few studies have examined girls’ physical activity, self-esteem, and competence and confidence in sports and physical activity. Jaffee and Manzer (1992) followed girls through middle school and high school grades (Jaffee & Ricker, 1993) and collected quantitative and qualitative information about activity level and its association with self-esteem and self-concept. Data were collected in two phases, which were presented as two different studies. The first phase included a total of 76 females between the ages of 9 and 12 years in grades four through seven (Jaffee & Manzer, 1992). The second phase consisted of 67 girls between the ages of 12 and 17 years in seventh through twelfth grades (Jaffee & Ricker, 1993).

The same methods were used for both phases. Participants first completed a questionnaire, which consisted of three sections. The first section asked participants to answer questions about confidence and perceived competence on a five point scale. The responses were summed based on the Molpome Confidence/Competence Scale. This scale assessed self-esteem and confidence and competence in sports, math, science, and school. The Confidence/Competence scale also measured confidence in oneself, competence in abilities, and self-esteem. The Confidence/Competence Scale was the sum of the questionnaire scores. Items from the Confidence/Competence Scale related to the self-esteem index created by the American Association of University Women (1994). The self-esteem index score measured self-confidence alone. The second section asked about level of physical activity, participation in sports, reasons for being physically active, and obstacles to being active. Physical activity included the number of activities, the number of days, and the number of hours each week in which one participated. The average physical activity level was calculated by totaling the three values and dividing by three (Jaffee & Manzer, 1992).

In Phase I each focus group consisted of eight to fifteen girls (Jaffee & Manzer, 1992) and in Phase II each focus group consisted of three to twelve girls (Jaffee & Ricker, 1993). Focus group discussions included confidence and risk-taking, concerns about becoming older, and views on physical education, sports, and recess. The discussions were recorded and then transcribed. Each discussion was coded based on reoccurring themes presented by the girls (Jaffee & Manzer, 1992; Jaffee & Ricker, 1993).

Younger girls were more physically active compared to the older girls (Jaffee & Ricker, 1993). Among girls 12 to 17 years old, 13% participated in physical activity seven or more times per week compared to 25% of the younger girls. Younger girls also reported being physically active more hours per week compared to the older girls. Thirty-one percent of the younger girls reported activity for seven or more hours per week (Jaffee & Manzer, 1992), compared to 24% of older girls (Jaffee & Ricker, 1993).

Older girls had a slightly lower mean self-esteem index score compared to the younger girls, 3.03 (Jaffee & Ricker, 1993) and 3.32 (Jaffee & Manzer, 1992), respectively. Confidence/Competence mean scores were similar between younger (mean = 84.7) and older (mean = 82.2) girls (Jaffee & Manzer, 1992; Jaffee & Ricker, 1993). Across fourth to seventh grade girls, Competence/Confidence and self-esteem scores were highest among girls in the fifth and sixth grades. The Confidence/Competence scale and self-esteem index results demonstrated that self-esteem, confidence, and competence among 12 to 17 year old girls decrease until age 15 years when both begin to increase. Self-esteem and Confidence/Competence scores were highest at age 17 years. African American girls had higher mean self-esteem index and Confidence/Competence scores than Asians and Caucasians (Jaffee & Ricker, 1993).

A significant relationship was found between the number of physical activities reported and scores on the Confidence/Competence scale. Girls who reported participation in few activities scored lower on Confidence/Competence than girls who reported participation in more activities (Jaffee & Ricker, 1993). Scores for girls in the three Confidence/Competence tertiles (highest, mid, and lowest) were compared. Older girls who scored in the highest tertile reported a mean of 3.27 activities compared to older girls in the lowest tertile who averaged 1.45 activities (Jaffee & Ricker, 1993). A similar trend was apparent among younger girls, where girls in the highest

Confidence/Competence tertile reported 6.04 activities compared to girls in the lowest scoring tertile who reported 4.52 activities (Jaffee & Manzer, 1992). Younger girls reported more activities than older girls (Jaffee & Ricker, 1993).

Physical activity level (combination of number of activities, days per week, and hours per week) and Confidence/Competence had a similar relationship among older and younger girls. Older girls that scored in the highest tertile of Confidence/Competence scores had a mean physical activity level of 3.42, while girls scoring in the lowest tertile had an average physical activity level of 1.86 (Jaffee & Ricker, 1993). Among younger girls, those in the highest tertile had a mean physical activity level of 4.61 and girls in the lowest tertile had a mean physical activity level of 3.80 (Jaffee & Manzer, 1992).

Focus group discussions from older (Jaffee & Ricker, 1993) and younger (Jaffee & Manzer, 1992) girls both demonstrated physical activity and sport challenge, achievement, risk taking, and skill development contributed to positive self-esteem, confidence, and competence. Older girls also discussed in focus groups that sports gave them positive feelings by providing approval from others. Older and younger girls both expressed the opinion that boys inhibited physical activity by controlling play (Jaffee & Manzer, 1992; Jaffee & Ricker, 1993). Another common theme revealed through focus group discussions was that older girls had few choices, limited equipment, and felt they were not taken seriously. Questionnaire results showed that 12% of girls reported that time was an obstacle to being physically active. Conflict with other activities was reported as an obstacle to physical activity by 10% of the older girls (Jaffee & Ricker, 1993). Thirty percent of younger girls also agreed that conflict with other activities was an obstacle to being physically active (Jaffee & Manzer, 1992).

It was concluded that, in both older and younger girls, self-reported participation in more activities and higher physical activity levels may be associated with higher perceived competence and confidence in one's abilities (Jaffee & Manzer, 1992; Jaffee & Ricker, 1993). Among younger girls only, higher physical activity levels were associated with higher levels of self-esteem (Jaffee & Manzer, 1992). Older and younger girls felt that their self-esteem would be enhanced with activities that were challenging, improved skill level, and allowed them to take risks (Jaffee & Manzer, 1992; Jaffee & Ricker, 1993). Older girls felt that their self-esteem would be enhanced from physical activities that allowed them to gain acceptance from others and activities in which they felt capable (Jaffee & Ricker, 1993). The qualitative data could be used to develop appropriate physical activity interventions, programs, and physical education classes for this age group. Creating the appropriate atmosphere for girls to be physically active could improve self-esteem, confidence, and competence. Providing girls with choices of challenging and fun activities that would develop skills appears to be important for girls of all ages.

Self-Concept

Self-concept is a broad term of how one views himself or herself in a general sense. Self-concept is influenced by behaviors, evaluations by others, and reinforcements (Shavelson, Hubner, & Stanton, 1976). Self-concept is hierarchically organized with perceptions of subareas at the base, which lead to academic and nonacademic self-concepts. Subareas are described as roles in the life a person identifies with (Fox, 2000). Academic self-concept may include history, math, and science at the base level. Nonacademic self-concept is broken down into social, emotional, and physical self-concepts. Social self-concept would include subareas, such as peers and significant others at the base level. Physical ability and appearance are subareas for physical self-concept. Emotional states are subareas for emotional self-concept. Academic and nonacademic self-concepts contribute to the general self-concept (Marsh & Shavelson, 1985).

Physical Self-Concept

A domain of self-concept and its relationship to physical activity that is often studied is physical self-concept. Marsh (1996) defined physical self-concept as “feeling positive about one’s physical self” (Marsh, 1996, p. 253). Marsh developed the Physical Self-Description Questionnaire (PSDQ) to measure how a person views oneself physically. The PSDQ includes nine Physical Self-Concept components, Global Physical Self-Concept, and Global Esteem. Each of the scales is treated individually with separate scores (Marsh et al., 1994). The PSDQ originated from the Self-Description Questionnaire (SDQ) also developed by Marsh (1990). The SDQ measures self-concept of four different scales including Physical Abilities, Parent Relationships, Math, and General Self-Concept (Marsh, 1990).

Dishman et al. (2006) examined the validity of the PSDQ subscales against external criterion measures. The total sample consisted of 658 black females and 479 white females in the twelfth grade. Participants were administered a 3-Day Physical Activity Recall on the first day of data collection to measure physical activity. From the

3-Day Physical Activity Recall, total METs were calculated by summing 30-minute blocks each day. One week later participants completed a physical fitness test, sport participation questionnaire, and PSDQ. Height and weight were measured and BMI was calculated to estimate fatness. Physical fitness was measured by a submaximal cycle ergometer test. Participants pedaled at three submaximal rates of power output. Heart rate was measured at each stage to estimate physical work capacity at 170 beats per minute (PWC_{170}). Sport participation was the sum of responses of two YRBS questions: “During the past 12 months, how many sports teams run by your school did you play on? (Do not include PE classes.)” and “During the past 12 months, how many sports teams run by organizations outside your school did you play on?” Black and white girls differed significantly on several variables. Black girls had higher BMI, 25.3 $kg \cdot m^{-2}$ versus 23.7 $kg \cdot m^{-2}$; lower physical fitness, 10.64 $kg \cdot m \cdot min^{-1} \cdot kg^{-1}$ versus 12.18 $kg \cdot m \cdot min^{-1} \cdot kg^{-1}$, and lower physical activity, 61.03 total METs versus 63.38 total METs (Dishman et al., 2006).

The PSDQ consisted of 11 subscales, including Global Physical Self-concept, Self-Esteem, Physical Activity, Flexibility, Strength, Endurance, Coordination, Sport Competence, Appearance, Body Fat, and Health. Internal consistency reliability of all 11 subscales on the PSDQ approximated or exceeded R = .80 among white and black girls. Reliability coefficients of all 11 subscales were slightly lower among black girls. PSDQ scales and equivalent external criteria measures were found to be significantly related for both groups of girls. Physical activity measured by 3-Day Physical Activity Recall was hypothesized to be most highly correlated with the Physical Activity subscale. Among black and white girls, physical activity was significantly correlated with the Physical Activity subscale, $r = .37$ and $r = .50$ respectively. Estimated body fat from BMI was negatively correlated with the Body Fat subscale among black and white females, $r = -.75$ and $r = -.67$ respectively. The negative correlation between BMI and the Body Fat subscale indicated that higher BMIs were associated with lower perceptions of body fat. Physical fitness was correlated with the Endurance subscale among white girls, $r = .46$, and with the Sport Competence subscale for black girls, $r = .29$. Sport participation was correlated with the Sport Competence subscale for black and white girls, $r = .46$ and $r = .60$, respectively (Dishman et al., 2006).

The correlation between Global Physical Self-Concept and BMI was similar for white girls, $r = -.34$, and black girls, $r = -.33$. In addition, Global Physical Self-Concept was significantly correlated with Sport Participation among white girls ($r = .40$). The only scale that did not significantly relate to any external criterion measure was the Health subscale among black girls. The Health subscale was significantly correlated with sport participation ($r = .23$) and physical fitness ($r = .23$) among white girls (Dishman et al., 2006).

Dishman et al. (2006) provided evidence of validity and reliability for the PSDQ among black and white adolescent girls. Additionally, Dishman et al. demonstrated some important self-concept findings among black and white girls. Black girls had a higher self-esteem and global physical self-concept than did white girls, despite a wider range of scores. Although black girls had a significantly higher mean BMI than white girls, black girls had a more positive view of their appearance and body fat.

Physical Activity and Self-Concept

The PSDQ has been used to investigate the relationship between physical activity and physical self-concept (Davison & Schmalz, 2006; Schneider, Dunton, & Cooper, 2008). Schneider et al. examined the effect of a physical activity intervention within a school environment and its relationship with physical self-concept. Sixty-one females were in the intervention school and 59 females were in the comparison school. Data were collected over a 3-year period among different cohorts each year. Participants were required to meet the following criteria at baseline: insufficient physical activity to maintain fitness, cardiovascular fitness below the 75th percentile of predicted fitness level, and ability to exercise (Schneider et al., 2008).

One high school was assigned as the intervention school and the second as the comparison school. Students at the intervention school enrolled in a physical education class specifically for participants. The physical education class met five times a week for 60 minutes, in which 40 minutes were devoted to activity time. One day a week the lecture focused on topics pertaining to the health benefits of physical activity and strategies to become more active. The physical education class was specifically for females and participation was highly encouraged every day. The same physical education instructor and lecturer taught throughout the 3 years, which allowed for control of frequency, duration, intensity, and activities throughout the study. Participants at the comparison school were given no guidance for physical activity. Some participants were enrolled in a physical education class at the same time the study took place. The physical education classes for the comparison and intervention schools met five times per week for 60 minutes (Schneider et al., 2008).

Physical activity, cardiovascular fitness, body composition, and physical self-concept were measured at three time points. Within one year measurements took place during the summer (baseline), end of fall semester, and end of the spring semester. Physical activity was self-reported using the 3-Day Physical Activity Recall. From the 3-Day Physical Activity Recall, average daily minutes expended in vigorous physical activity was used as the physical activity variable. Cardiovascular fitness was measured with a progressive cycle ergometer test. The Physical Self-Description Questionnaire (Marsh et al., 1994) was used to measure physical self-concept. For this study, eight subscales of the PSDQ used to measure self-concept included Body Fat, Appearance, Endurance, Strength, Coordination, Flexibility, Sports Competence, and Health. Two subscales were used to measure global self-concept: Global Physical Self-Concept and Global Self-Esteem. The Physical Activity subscale was removed for this particular study. Each individual subscale was summed and averaged. Height, weight, and body composition were also measured. Body composition was measured using dual X-ray absorptiometry. Heart rates were measured every other week during one class period at the intervention school to obtain an average heart rate during the class period. Heart rate monitors also recorded the duration the heart rate was at least 120 beats per minute, which was associated with 60% of maximum heart rate from the cardiovascular fitness test at baseline (Schneider et al., 2008).

Participation in vigorous physical activity was similar between the intervention and comparison groups. At baseline, 43% of the comparison group and 51% in the intervention group reported participating in vigorous physical activity. Cardiovascular fitness and body composition did not significantly differ between groups at baseline. Heart rate monitors were worn for an average of 34.1 minutes per class. Participants stayed at or above 120 beats per minute for an average of 18.7 minutes per class. No significant changes in body fat and BMI were found among either group over 9 months. However, the intervention group had significantly greater improvements in cardiovascular fitness than the comparison group. The intervention group significantly increased vigorous physical activity from baseline to 9 months later. At baseline, 51% of participants reported participation in vigorous physical activity. The prevalence of participation in vigorous physical activity increased to 83% in the intervention group after 9 months. Vigorous physical activity increased slightly among the comparison group, from 43% at baseline to 58% at 9 months (Schneider et al., 2008).

In the intervention group, participants who increased cardiovascular fitness improved their Global Physical Self-Concept subscale score. At baseline, the average score on the Global Physical Self-Concept subscale among participants in the intervention group that increased cardiovascular fitness was 3.00. This score increased to 3.64 after 9 months. Global physical self-concept did not improve among participants in the intervention group that did not increase cardiovascular fitness (Schneider et al., 2008).

Among the intervention group, improvements in cardiovascular fitness, physical activity, and global physical self-concept were found. However, Schneider et al. (2008) did not find a significant relationship between physical activity and self-concept after 9 months of the physical education intervention.

In summary, examinations of the relationship of physical activity and physical self-concept have produced mixed results (Dishman et al., 2006; Schneider et al., 2008). Improvements in fitness levels were associated with improved physical self-concept among adolescent females (Schneider et al., 2008). Dishman et al. found that physical activity was correlated with Global Physical Self-Concept subscale scores among white girls (r = .52) and black girls (r = .47). Physical fitness and physical activity are positively related to self-concept. A program of increased physical activity, which impacts physical fitness, may be a useful approach to improve self-concept among females.

CHAPTER 3: METHODS

Participants

Participants were recruited from four classes of 9th to 12th grade students from a public high school in eastern North Carolina. The classes included two Physical Education/Health and two Family/Consumer Sciences classes. These four classed were comprised of approximately 80 to 100 students. The purpose, protocol, benefits, and risks of the study were explained to the students. Interested students received informed consent forms and were instructed that a parent/guardian needed to read and sign the consent form before their participation. Participants completed a minor assent document. The first 45 females to return required papers to the classroom teacher were selected to participate in the study. To be included in the study, participants needed to be female and have the ability to participate in ambulatory physical activity. All procedures were approved by the East Carolina University Medical Center Institutional Review Board.

Participants who completed the study received a t-shirt. In addition, 4-week after-school activity program was provided to the school as an incentive to allow the study to be conducted. All study participants were eligible to take part in the after-school activity program. The HOPSports multimedia system was used in the after-school activity program to lead students through various physical activities, including yoga, martial arts, aerobics, and dance. In addition, discussions were conducted with participants about variables that lead to adoption of healthy lifestyles, such as goal setting, benefits of physical activity, and barriers to physical activity.

Protocol

Physical activity data collection took place over 7 days. All questionnaires and anthropometric measurements occurred on a single occasion. Demographic data, including gender, age, date of birth, race and ethnicity, grade level, and socioeconomic status, were collected via questionnaire. The highest level of education achieved by the parent(s) or guardian(s) was used as a proxy measure of socioeconomic status (Pfeiffer et al., 2006). Participants were asked to complete a demographic questionnaire that included items about sport participation and plans after high school (see Appendix A). To assess academic performance, GPA was obtained from school records. Grade point average obtained was the participant's overall cumulative high school grade point average until the previous semester.

Anthropometric measurements were taken at the school location. Height was measured with a stadiometer (Seca model 214 Portable Stadiometer, Chiba City, Japan) and weight was measured with a portable scale (Health-o-Meter model 349KLX Medical Scale, Bridgeview, IL). Body mass index (BMI) was calculated as weight (kg) divided by the square of height (meters^2). Percent body fat was measured by bioelectrical impedance analysis (Omron model HBF-306, Bannockburn, IL).

After all anthropometric measurements, participants completed a modified version of the Physical Self-Description Questionnaire (PSDQ; see Appendix B) (Marsh et al., 1994). The PSDQ measures how individuals perceive themselves physically and self-esteem. As a group, participants were instructed on how to complete the questionnaire. Participants were informed that answers show how each participant feels about herself and were kept confidential. Each question had six options ranging from "False" to "True". Participants were instructed to circle their response to the corresponding question. The questionnaire began with three examples of how to answer the questions along with written instructions.

To measure physical activity, each participant was asked to wear an Actigraph GT1M accelerometer (Actigraph, LLC, Pensacola, FL) for 7 consecutive days during all waking hours. The accelerometer was attached to an elastic belt, which was sized to fit each participant. Wearing instructions were explained and provided to participants. Instructions included the monitor should be put on in the morning and removed at night before bed. The accelerometer was worn at the right hip in line with the mid-line of the thigh, attached to the elastic belt. Participants were instructed to wear the monitor for the entire day, except during bathing or swimming. A log was provided for participants to record the time the monitor was put on, taken off and any time the monitor was removed throughout the day. Participants returned the accelerometer and log sheet to their homeroom teachers after 7 days.

To assist with compliance of wearing the accelerometer, primary preferred contact information was obtained from each participant. The primary telephone number, either home or personal cell phone, was recorded. If a cell phone number was provided, participants were asked if they could receive free text messaging. Participants were also asked to provide an email address and if they had a Facebook account. Participants indicated by which method they preferred to be contacted: phone, email, or Facebook.

A mass text message was sent to participants between 5:30 and 6:00 am on weekdays prior to school and between 9:00 and 9:30 am on weekend days. Participant's cell phone numbers were entered into an online account through a cell phone service. Participant responses were checked via the online account.

Instrumentation

Actigraph Accelerometers

The Actigraph GT1M accelerometer was used to measure physical activity. The Actigraph accelerometer measures and filters movement at a frequency range of 0.25 to 2.5 Hz. The device is unobtrusive due to its small dimensions, 27 grams and 3.8 cm x 3.7 cm x 1.8 cm.

Prior to distribution, the Actigraph GT1M accelerometers were initialized to begin recording data at 7:00 am on the day it was distributed and to continue recording for the proceeding 7 days. Epoch length was set at 15 seconds. Once the accelerometers were returned, each monitor was downloaded using the Actisoft Lifestyle Monitoring System Version 3.3.0 as .dat and Excel files. The .dat file was input and analyzed using MAHUffe MAHPolar Software (Cambridge, United Kingdom). Nonwear time was determined as 60 minutes of consecutive activity counts of zeros (Troiano et al., 2008). The minimum wear time required was 3 days for 10 hours during the week days and 8 hours during the weekend days. Participants who did not meet the minimum wear time were excluded from the physical activity analysis.

Cut-points were established specific to age and corresponding MET level for moderate intensity (4 METs) and vigorous intensity (7 METs) (Troiano et al., 2008). The following age specific equation, from the Freedson group (Freedson, Sirard, Debold, Pate, Dowda, & Sallis, 1997) as published by Trost et al. (2002), was used to determine intensity of activity based on counts per minute ($counts \cdot min^{-1}$): METs = 2.757 + ($0.0015 * counts \cdot min^{-1}$) – (0.08957*age [years]) – ($0.000038 * counts \cdot min^{-1} *$age [years]). Counts per minute were used to establish time spent in various intensities of physical activity.

Physical Self-Description Questionnaire

The Physical Self-Description Questionnaire (PSDQ) is an assessment of how individuals perceive themselves physically. The PSDQ includes nine physical self-concept components, Global Physical Self-Concept, and Self-Esteem (Marsh et al., 1994). Global Physical Self-Concept is defined as “feeling positive about one’s physical self” (Marsh, 1996, p. 253). Self-Esteem is defined as “overall positive feelings about oneself” (Marsh, 1996, p. 253). For the purposes of this study, PSDQ subscales included Physical Activity, Health, Body Fat, Sport Competence, General Physical Self-Concept, Appearance, and Self-Esteem. Strength, Endurance/Fitness, Coordination, and Flexibility subscales were removed from the original PSDQ for the purposes of this study because physical fitness components were not assessed (Marsh et al., 1994). Definitions of each subscale are located in Appendix B.

Reliability of the PSDQ subscales was previously examined by Marsh (1996) among 141 students 13 to 15 years of age on four different occasions over the course of 14 months. Internal consistency estimates of PSDQ subscales were considered acceptable across all testing occasions. With the exception of the Health scale, all scales had reliability estimates across trials of greater than .90. The Health scale was considered reasonably reliable across measurement trials, R = .82 to .87. PSDQ measurement trials occurred about three months apart and overall were stable, R = .83. PSDQ stability reliability from the first trial to the last trial was .69 (Marsh, 1996). The PSDQ was demonstrated by Dishman et al. (2006) to be a valid and reliable measure among black and white adolescent girls.

Accelerometer Compliance

Daily text messages were sent to 25 students who indicated they could receive free text messaging. Students who received a text message were asked to respond indicating they were wearing the monitor. Twenty-nine students were emailed each day. Some students received an email in addition to another method of contact since email may not have been checked daily. Four students received a message on Facebook as a reminder to wear the accelerometer. When participants received a message via email or Facebook they were also instructed to call the phone number provided and leave a message that they were wearing the accelerometer. If a student did not leave a message or respond via text message, a phone call was made that evening to the primary phone number provided. One participant did not provide a phone number and two had phone numbers that were disconnected.

Outcome Measures

Based on the 2008 Physical Activity Guidelines for Americans (USDHHS, 2008), participants were categorized as meeting physical activity recommendations for children and adolescents if they accumulated 60 minutes or more of MVPA per day. The physical activity guidelines for children and adolescents also include muscle strengthening activities and bone strengthening activities within the recommendation for 60 minutes of physical activity. For the purposes of this study, only the aerobic physical activity recommendations were assessed.

Amount of time participants spent in light, moderate, and vigorous intensity was determined by accelerometer cut-points. Sedentary time was considered minutes with activity counts less than 100 counts per minute. Light intensity activity was computed by cut-points below moderate intensity cut-points, but equal to or above 100 $counts \cdot min^{-1}$. Moderate and vigorous intensity activity were summed to calculate MVPA. Total daily time spent in moderate, vigorous, and moderate-to-vigorous intensity was expressed in minutes per day.

PSDQ scores were computed based on the recommendations of Marsh et al. (1994). Scores for each subscale were calculated and averaged based on the number of questions. A higher score on the PSDQ subscale was indicative of a more positive physical self-description. Selected questions indicated by Marsh et al. (1994) were reverse scored.

Data Analysis

Data analysis was completed with SPSS 16.0 (SPSS, Inc., Chicago, IL). Internal consistencies of the PSDQ subscales were analyzed using Cronbach's alpha reliability. Time spent in sedentary behavior, and light, moderate, vigorous, and moderate-to-vigorous physical activity were correlated with PSDQ subscale scores using Pearson correlations. Regression analysis was performed to predict GPA from a combination of independent variables including percent body fat, BMI z-score, minutes of sedentary behavior, and minutes of MVPA.

CHAPTER 4: RESULTS

Participants

The total sample consisted of 42 females in 9^{th} through 12^{th}. Twelve participants were excluded because of inadequate accelerometer wear time, which resulted in a final sample of 30 participants. All participants (*n* = 42) were included in the PSDQ reliability analysis. The average age was 15.6 (± 1.3) years. The mean (± SD) BMI was 27.0 (± 6.0) $kg \cdot m^2$ and the mean percent body fat was 29.9% (± 7.6%). Thirty percent (*n* = 9) of the final sample were obese with a BMI at or above the 95^{th} percentile and another 36% (*n* = 11) were overweight (between 85^{th} and 95^{th} percentiles). Forty-seven percent were black and 30% reported their parents did not graduate from high school. All but one participant reported they planned to attend college. The average GPA was 2.38 on a 4-point scale. On the 4-point scale, a GPA of 4.0 is equivalent to an “A” letter grade, 3.0 is equivalent to a “B”, 2.0 is equivalent to a “C”, and 1.0 is equivalent to a “D”. Descriptive statistics for participants can be found in Table 1.

PSDQ Reliability

The reliability of the PSDQ subscales was analyzed for the entire sample of 42 participants using Cronbach’s alpha reliability. All subscales demonstrated adequate reliability ($R > .80$). Reliability results are presented in Table 2. Sport Competence ($R = .95$), Global Physical Self-Concept ($R = .94$), and Appearance ($R = .91$) subscales were found to be the most reliable. Physical Activity and Body Fat subscales both resulted in a reliability estimate of $R = .89$. Health and Self-Esteem subscales had reliability estimates of $R = .84$ and $R = .82$, respectively.

Table 1.
Participant Characteristics

	Total *N*=30			
Variable	*M* ± *SD*	Range	% of Sample	*N*
Age (yrs)	15.6 ± 1.3	14 – 19		
Height (cm)	163.1 ± 5.0	152.4 – 172.7		
Weight (kg)	71.9 ± 16.4	49.9 – 118.0		
Body mass index (kg·m^2)	27.0 ± 6.0	18.0 – 45.0		
BMI Z-score	1.18 ± 0.77	-0.82 – 2.53		
Percent Fat (%)	29.9 ± 7.6	9.30 – 45.4		
GPA	2.38 ± 0.8	0.67 – 3.72		
Weight Status				
Normal weight			33.3%	10
Overweight			36.3%	11
Obese			29.7%	9
Race				
White			30.0%	9
Black			46.7%	14
Other			23.2%	7
Parent Education				
Not a high school			30.0%	9
graduate			16.7%	5
High school graduate			26.7%	8
Some college			23.3%	7
College graduate			3.3%	1
Graduate school				
Plan to Attend College			96.7%	29

Note. BMI is body mass index; percent fat is from Omron model HBF-306. BMI < 85th percentile is considered normal weight status; BMI ≥ 85th to 94th percentile is considered overweight; BMI ≥ 95th percentile is considered obese.

Physical Activity

Participants who did not meet the minimum wear time of 3 days for 10 hours during week days and 8 hours during weekend days were excluded from the physical activity analysis. Among the entire sample of 42 participants, 9 wore the accelerometer for the entire 7 days, which was 21% of the sample. Twelve participants (29% of the entire sample) did not wear the accelerometers for at least 3 days and were not used for the physical activity data analysis. Of the final sample (*n* = 30), 30% wore the accelerometer for 7 days, and 27% wore it for 3 days. Table 3 presents the accelerometer wear time frequency.

Table 2.
Internal Consistency Reliability of PSDQ Subscales

PSDQ Subscale	*M* ± *SD*	*R*	95% CI
Health	4.37 ± 0.6	.84	.75, .90
Physical Activity	3.59 ± 0.4	.89	.83, .94
Body Fat	3.58 ± 0.2	.89	.84, .94
Sport Competence	3.64 ± 0.4	.95	.92, .97
Appearance	4.80 ± 0.5	.91	.87, .95
Self-Esteem	4.89 ± 0.4	.82	.72, .89
Global Physical Self-Concept	4.02 ± 0.2	.94	.91, .97

Table 3.
Accelerometer Wear Time Frequency

Wear Time	*N*	% of Final Sample *N* = 30	% of Total Sample *N* = 42
[a]< 3 Days	12		28.6
3 Days	8	26.7	19.0
4 Days	4	13.3	9.5
5 Days	5	16.7	11.9
6 Days	4	13.3	9.5
7 Days	9	30.0	21.4

[a]Less than 3 days of wear time was not accepted in the final sample.

Participants wore the accelerometers for a mean of 5.1 (± 1.6) days. To calculate time in sedentary behavior, active time (light, moderate, and vigorous) was subtracted from wear time in minutes. On average, participants spent 653 (± 116) minutes of the day, or 10 hours and 54 minutes, in sedentary behavior. Sedentary behavior ranged from a minimum of 466 minutes per day (7 hours and 46 minutes) to as much as 938 minutes per day (15 hours and 38 minutes). Table 4 presents mean wear time and time spent in sedentary behavior and in various physical activity intensities.

Table 4.
Time (minutes per day) Spent in Sedentary Behavior and in Various Physical Activity Intensities

Category	*M* ± *SD*
Wear Time	858.8 ± 130.8
Sedentary	653.3 ± 116.4
Light	195.7 ± 53.2
Moderate	9.0 ± 6.5
Vigorous	0.7 ± 0.8
MVPA	9.7 ± 7.1

Note: Physical activity intensity and wear time is expressed as minutes per day. MVPA is moderate-to-vigorous physical activity.

Participants spent on average 9.0 (± 6.5) minutes in moderate intensity physical activity per day. The minimum time spent in moderate physical activity was 1.5 minutes per day and the maximum time spent in moderate physical activity was 31.9 minutes per day. Only one participant was moderately physically active for at least 30 minutes per day. Eleven participants, or 37% of the final sample, accumulated at least 10 minutes of moderate physical activity per day. None of the participants accumulated 60 minutes of moderate physical activity per day.

An average of less than 1 minute per day was spent in vigorous physical activity. The maximum time spent in vigorous physical activity among the participants was 4.2 minutes per day. Three participants, 10% of the final sample, were not vigorously physically active on any of the days.

The mean MVPA was 9.7 (± 7.1) minutes per day. The minimum time spent in MVPA was 1.6 minutes per day and the maximum time spent in MVPA was 34 minutes per day. Only one participant accumulated an average of at least 30 minutes per day of

MVPA and 13 participants accumulated an average of at least 10 minutes per day of MVPA. No participants achieved 60 minutes per day of MVPA.

Relationship between GPA, Body Composition, Sedentary Behavior, and Physical Activity

In an attempt to examine measures of body composition, sedentary behavior, and physical activity that might serve as potential predictors of GPA, GPA was regressed on body composition (percent fat), time spent in sedentary behavior, and minutes of MVPA. Multiple regression results are presented in Table 5. All independent variables, percent fat (r = -.51), minutes of MVPA (r = .34), and time spent in sedentary behavior (r = .32), were significantly correlated ($p < .05$) with GPA. Together these measures of body composition, sedentary behavior, and physical activity explained 36% of the variance (multiple R = .60) in GPA. The standard error of estimate (*SEE*) for predicting GPA was 0.64. The strongest predictor of GPA was percent fat with a beta weight of -.46. The beta weights for minutes of MVPA and time in sedentary behavior were .13 and .25, respectively.

Physical Activity and PSDQ

Correlations among PSDQ subscale scores and time spent in various intensities of physical activity are presented in Table 6. Most of the correlations among the seven PSDQ subscale scores and time spent in different physical activity intensities were not statistically significant. Minutes spent in light physical activity was significantly correlated with three of the seven PSDQ subscale scores. Minutes per day spent in light physical activity was negatively correlated ($p < .01$) with the Self-Esteem ($r = -.51$), Body Fat ($r = -.52$), and Global Physical

Table 5.
Multiple Regression to Predict GPA from Measures of Body Composition, Sedentary Behavior, and Physical Activity

	Unstandardized	Standardized	
	b-weight Coefficient	βeta Coefficient	*p* value
Constant	2.586		.009
Sedentary Behavior	0.002	.25	.156
MVPA	0.014	.13	.481
Percent Fat	-0.047	-.46	.013
R	.60		
R^2	.36		
SEE	0.64		

Note: Dependent Variable = GPA; Independent Variables = Sedentary Behavior, MVPA, Percent Fat; *N* = 28; MVPA is moderate-to-vigorous physical activity; Percent fat is from Omron model HBF-306; Sedentary behavior and MVPA are expressed as minutes per day.

Self-Concept (r = -.48) subscales of the PSDQ. These correlations demonstrate that more time spent in light physical activity is associated with lower scores on the Body Fat, Self-Esteem, and Global Physical Self-Concept subscale scores. Minutes spent in moderate physical activity (r = .36) and MVPA (r = .36) were significantly correlated ($p < .05$) with the Physical Activity subscale.

Table 6.
Correlations among Time Spent in Physical Activity Intensities and PSDQ Subscale Scores

PSDQ Subscale	Physical Activity Intensity				
	Sedentary	Light	Moderate	Vigorous	MVPA
Appearance	-.23	-.23	-.20	-.15	-.20
Body Fat	.01	-.52**	-.10	-.18	-.12
Global Physical Self-Concept	-.08	-.48**	.04	.17	.05
Health	.01	-.03	-.27	-.09	-.26
Physical Activity	-.18	-.17	.36*	.24	.36*
Self-Esteem	-.11	-.51**	-.26	-.03	-.24
Sport Competence	-.18	-.23	.21	.20	.22

***p* at the .01 level, 2-tailed; **p* at the .05 level, 2-tailed

CHAPTER 5: DISCUSSION

The purpose of this study was to examine physical activity levels, body composition, and academic performance among adolescent females. A secondary purpose of the study was to examine how high school females perceive themselves physically. The sample consisted of a population of adolescent females residing in a rural county in eastern North Carolina. The findings of this study suggest that adolescent females in rural areas in the southeast do not meet recommended levels of physical activity. Among the final sample (n = 30) none of the high school females accumulated 60 minutes of MVPA per day. Not only did none of the girls meet the physical activity recommendations, but only one participant achieved 30 minutes of MVPA per day. This sample of adolescent females was highly inactive and had a high prevalence of overweight and obesity.

Overweight and Obesity

Thirty-six percent of participants were overweight, a BMI between the 85th and 94th percentiles. Thirty percent of females in this study were considered to be obese, with a BMI equal to or greater than the 95th percentile. The current sample had a higher prevalence of overweight and obesity than that found in North Carolina and in the U.S. The CDC (2008d) reported that in 2007, 15% of female adolescents were overweight. In North Carolina, approximately 17% of the female adolescent population is considered overweight. The current sample had over twice the prevalence rate of overweight as the rest of the state and of the U.S.

Nationally, 10% of adolescent females are considered obese. The same is true for the state of North Carolina (CDC, 2008d). Thirty percent of females in this study were considered to be obese, with a BMI equal to or greater than the 95th percentile; which is three times the national and state prevalence rates. Among the sample of 611 females between the ages of 12 and 19 years examined by Troiano et al. (2008), 19% were overweight and 17% were obese. In comparison, in a sample of adolescents from a rural area, 32% of adolescent males and females were overweight or obese (Treuth, Hou, Young, & Maynard, 2005), whereas 67% of the present sample of adolescents were overweight or obese. Females in the present study had a higher prevalence of overweight and obesity when compared to studies with similar samples. The present study, along with the study by Treuth et al., demonstrated that the prevalence of overweight and obese adolescents is high in rural areas.

The mean BMI among the current sample of adolescent females was 27.0 $kg{\cdot}m^2$ and the mean percent fat was 29.9%. The current sample of adolescent females is much fatter compared to other studies of similarly aged participants. In samples of adolescent females in which height and weight were measured, mean BMI results were between 22.8 $kg{\cdot}m^2$ and 24.2 $kg{\cdot}m^2$ (Pate et al., 2007; Sherar et al., 2009; Troiano et al., 2008; Treuth et al., 2005). Few studies have measured percent fat among high school adolescent females. The current sample's percent fat was similar to a sample of adolescents from a rural area measured by Treuth et al. (2005), also assessed with bioelectrical impedance analysis, which was 28.9%. Adolescent females in the current study had a higher BMI and greater prevalence of overweight and obesity than found in other studies of similarly aged participants.

Physical Activity

Few studies have used objective measures, such as accelerometers, to examine physical activity among adolescent females. Pate et al. (2009) monitored the change in physical activity of an ethnically diverse sample of middle school girls from six different states with accelerometers. Their sample consisted of 563 girls that were first monitored in the 6^{th} grade and again in the 8^{th} grade after a two year intervention. In the sixth grade, the girls averaged 24.0 (± 1.6) minutes per day of MVPA. Average MVPA was similar when the girls were in the eighth grade, 23.0 (± 1.6) minutes per day. Minutes per day of vigorous physical activity was low in both the sixth grade (6.0 ± 0.5 minutes per day) and in the eighth grade (5.5 ± 0.5 minutes per day).

In comparison to the adolescent girls in Pate et al.'s (2009) sample, physical activity levels of girls in the present study were lower. In the present study, adolescent girls from rural North Carolina averaged only 9.7 (± 7.1) minutes per day of MVPA and less than 1 minute per day of vigorous physical activity.

Troiano et al. (2008) reported on physical activity assessed via accelerometry of a nationally representative sample of 12-15 (n = 308) and 16-19 year old adolescents (n = 262). The present study utilized the same regression equation to calculate age specific cutpoints for moderate and vigorous intensity activity as Troiano et al. Participants in the Troiano et al. sample spent more time in MVPA and slightly more time in vigorous physical activity than the female adolescents in the present study. Mean MVPA for 12-15 year old and 16-19 year old females was 24.6 and 19.6 minutes per day, respectively.

Mean vigorous physical activity among 12-15 year old and 16-19 year old females was 2.9 and 1.1 minutes per day, respectively.

Treuth et al. (2005) also examined physical activity levels measured using accelerometers among adolescents from rural high schools. Adolescents were found to participate in a mean of 44.3 (± 30.3) minutes per day of MVPA and 3.8 (± 5.4) minutes per day of vigorous physical activity. The sample examined by Treuth et al. is somewhat similar to the sample in the present study; however, because the Treuth et al. results were not reported by gender and different cutpoints were used to categorize moderate intensity physical activity, no direct comparisons are possible. Treuth et al. used a lower cutpoint range to indicate moderate intensity physical activity (i.e., cutpoints associated with 3.4 to 4.0 METs), whereas in the present study moderate intensity activities were between 4.0 and 6.99 METs. Lower thresholds to indicate moderate intensity physical activity would result in higher estimates of MVPA. Regardless of differences between the two studies, it appears that few female adolescents meet the recommended level of physical activity of at least 60 minutes of moderate intensity activity per day (USDHHS, 2008).

Regression to Predict Academic Performance

The use of GPA as a measure of academic performance is a strength of this study because GPA represents a direct measure of overall academic performance in school. Regression analysis to predict GPA was performed with percent fat, MVPA, and sedentary behavior as independent variables. Regression results demonstrated that 36% of the variance in GPA could be explained by these predictors. This is a substantial finding considering that none of the predictor variables addressed study time, intelligence, or any other academic variable typically thought to influence academic performance. For the current sample of adolescent females, percent fat (β = -.46, *p* = .01) was the best predictor of GPA and minutes of sedentary behavior (β = .25, *p* = .12) was the next best predictor. Similar results were found when BMI z-score was used in place of percent fat (β = -.42, *p* = .02). When BMI z-score, MVPA, and sedentary behavior were used as the independent variables in the model, 34% of the variance in GPA was explained.

Previous studies that examined the relationship between physical activity and academic performance have demonstrated mixed results. Physical activity has been found to reduce fidgeting (Jarrett et al., 1998) and improve on-task behavior among children (Mahar et al., 2006), behaviors that are theoretically linked to academic performance. Melnick et al. (1992) examined the relationship between physical activity and academic performance, using self-reported participation in sports and self-reported GPA. GPA reported during the senior year served as the dependent variable and socioeconomic status, GPA during the sophomore year, and sport participation were the independent variables for the regression analysis. Data were analyzed by race/ethnicity, gender, and residential area (rural, suburban, or urban). Among most groups, participation in sports had no influence on GPA, except for Hispanic females residing in a rural area. The only significant correlation with senior year GPA was with sports participation among Hispanic females from a rural area, and this correlation was low (*r* = -.10). Sport participation among Hispanic females was associated with lower GPAs, but this relationship was low.

The findings of Melnick et al. (1992) suggested that physical activity was not significantly related to academic performance. Physical activity in the Melnick et al. study was measured by self-report for the three previous days. However, in the present study physical activity was measured by a more objective method. The findings of the present study may be more valid compared to previous studies which rely on both self-reported physical activity and academic performance. Results of the present study demonstrated that physical activity and academic performance were significantly related, $r = .34$. The positive relationship between MVPA and academic performance indicated that the more time participants spent in MVPA, the higher their GPA tended to be.

Results of the present study also demonstrated that body composition was a predictor of academic performance. A higher percent fat or BMI z-score predicted a lower GPA among adolescent females. Results from this study suggest that body composition, measured by BMI z-score or percent fat, is significantly related to academic performance.

Previous studies have demonstrated a positive relationship between physical activity and academic performance (Carlson et al., 2008; Coe, Pivarnik, Womack, Reeves, & Malina, 2006). Carlson et al. demonstrated a threshold effect of physical activity duration on academics. Among a group of elementary students, 36 minutes or more of physical education was related to higher mathematics and reading test scores compared to students with less physical education. Coe et al. also demonstrated a threshold effect of physical activity intensity on academic performance. Participants received a physical activity score, 1 (no activity), 2 (some activity), or 3 (meeting the

Healthy People 2010 guidelines). The highest physical activity score obtained was meeting *Healthy People 2010* recommendations of 30 minutes or more of moderate activity at least 5 days a week or 20 minutes or more of vigorous physical activity at least 3 days a week (CDC, 1996). Coe et al. found that academic performance of students who met or exceeded the recommended amount of vigorous physical activity was significantly better compared to students who did not achieve any vigorous physical activity. Participating in the recommended amount of vigorous physical activity was associated with better performance in school (Coe et al., 2006).

Physical Activity and Physical Self-Description

Dishman et al. (2006) examined the reliability of the PSDQ subscales among a sample of adolescent females and reported that all 11 subscales of the PSDQ had acceptable reliability coefficients ($R \geq .80$). The selected subscales used in the present study (Body Fat, Appearance, Sport Competence, Physical Activity, Self-Esteem, Health, and Global Physical Self-Concept) had reliability estimates above $R = .80$. The present study confirms the results reported by Dishman et al. by demonstrating that the PSDQ is a reliable measure for adolescent females.

In this study, each PSDQ subscale was treated as an individual score. High scores on the PSDQ subscales are associated with a more favorable self-concept, and low scores are associated with a less favorable self-concept. Overall, the sample of females in the present sample had similar self-perceptions compared to the Dishman et al. (2006) sample on most PSDQ subscales and slightly less favorable self-perceptions on the Body Fat subscale.

This study is the first known study to correlate PSDQ subscale scores with physical activity objectively measured by accelerometry. Previously, physical self-perception assessed with the PSDQ was correlated with physical activity measured by self-report measures among adolescents (Dishman et al., 2006; Schneider et al., 2008). In the present study, minutes of physical activity at some intensities were correlated with some PSDQ subscales, including Physical Activity, Body Fat, Global Physical Self-Concept, and Self-Esteem. The Physical Activity subscale was significantly correlated with moderate physical activity (r = .36) and with MVPA (r = .36). This finding is similar to the correlation reported by Dishman et al. (2006) that physical activity, measured by a 3-Day Physical Activity Recall, among black females correlated with the Physical Activity subscale score, r = .37. They found a higher correlation between the Physical Activity subscale score and self-reported physical activity for white girls, r = .50.

Light physical activity is considered to be above sedentary levels, but below a moderate intensity of 4.0 METs. Minutes spent in light intensity activity was significantly correlated with three subscales, Body Fat (r = -.52), Global Physical Self-Concept (r = -.48), and Self-Esteem (r = -.51). The negative correlations between the Body Fat, Global Physical Self-Concept, and Self-Esteem subscales and light physical activity demonstrate that as participants spent more time in activities of light intensity, scores on these three subscales tended to decrease. Examples of activities of light intensity, equivalent to 1.5-3 METs, are sitting, studying, dressing, eating, typing on the computer, and light household chores (Ainsworth et al., 2000). The more time participants spent in light activity, the lower their perceptions of self-esteem, global physical self-concept, and body fat tended to be. In the current sample, participants spent less than 10 minutes per day on average in MVPA, but spent an average of 3 hours and 16 minutes per day in light activities. If future research confirms that greater participation in light physical activity contributes to poorer self-concept and lower self-esteem, then the specific activities performed should be investigated. Light physical activity may not provide a challenge or the feeling of success which higher intensity activities provide.

MVPA was significantly correlated with the Physical Activity subscale, which measures the level of physical activity in which a person participates. For all other PSDQ subscales, MVPA was not related. Results from this study indicated that physical activity was not related to physical self-concept measured by all other subscales. A similar study by Dishman et al. (2006) found that physical activity was related to more PSDQ subscales than was found in the present study. Dishman et al. examined the relationship of physical activity and physical self-concept among black and white adolescent females. Physical activity was self-reported by completing the 3-Day Physical Activity Recall and physical self-concept was assessed using the PSDQ. Physical activity was positively and significantly related to scores on the Self-Esteem, Global Physical Self-Concept, Sport Competence, and Physical Activity subscales among adolescent females. The higher the amount of physical activity reported by the adolescent females, the higher perceived self-esteem, global physical self-concept, sport competence, and physical activity (Dishman et al., 2006). Schneider et al. (2008) also studied the relationship of physical activity and physical self-concept among adolescent females. The effect of a 9 month physical activity intervention on physical self-concept among adolescent females was examined. Physical activity was measured by the 3-Day Physical Activity Recall. Minutes of vigorous physical activity was correlated with PSDQ subscale scores. Schneider et al. found that the physical activity intervention had no significant effect on physical self-concept.

The findings from the present study support the conclusion that more time spent in light activity is associated with a lower perception of body fat, global physical self-concept, and self-esteem. This conclusion may allow for improved interventions among adolescent females. For example, in an effort to improve physical self-concept and physical activity levels, interventions could be targeted to decrease the percent of time spent in light intensity activities rather than focus on increasing MVPA. Replacing light intensity activities with alternative activities of choice may lead to increased physical activity of higher intensities.

Strengths, Limitations, and Future Research

This study of female adolescent physical activity had a few limitations. The adolescent females in the study were sampled on a voluntary basis. It is not confirmed that this sample of rural adolescent females is representative of eastern North Carolina. Based on the sample size and demographics of the present sample, care should be taken before generalizing the findings of this study to other populations. The compliance rate of participants wearing the accelerometers for 7 days was low. Upon the return of the accelerometers, 12 of the participants did not wear the monitor for a minimum of 3 days for 10 hours during the week days and 8 hours during the weekend days. Of the 42 participants given an accelerometer, only 30 had enough wear time to be included in the analysis. Future studies could focus on how to increase compliance to accelerometer wear among adolescents.

Strengths of the present study included use of an objective measure of physical activity by accelerometry and a direct measure of academic performance provided by the school (i.e., not self-reported). This study included an understudied population of adolescent females residing in a rural area in the southeast. Future research is needed on this population because, as can be seen from this study, this is a population at risk of developing diseases associated with obesity and inactivity. Physical activity needs to be increased among adolescent females to help prevent the onset of cardiovascular and other diseases. Future research may consider a comparison of physical activity of females residing in various residential areas. Females residing and attending school in rural areas may be compared to those living in suburban and urban areas to assess relationships among physical activity, residential area, and academic performance.

Conclusion

This study provides an important finding that adolescent females residing in the rural southeast are inactive and far less active than similarly aged females in the U.S. and in other areas of North Carolina. The females in this sample were also fatter compared to the national average. Increased fatness in adolescent females was associated with poorer academic performance. Increased physical activity in physically inactive adolescents is likely to improve academic performance. Improvements in body composition and physical activity appear to be beneficial for both health and academic performance.

Adolescence is an important transitional stage when individuals are developing into young adults with increasing independence. This may be an important time to assist them to make healthy lifestyle choices. Intervening during adolescence to improve body composition and physical activity may also help to improve academic performance, which will positively impact future academic and career choices.

REFERENCES

Aaron, D. J., Storti, K. L., Robertson, R. J., Kriska, A. M., & LaPorte, R. E. (2002). Longitudinal study of the number and choice of leisure time physical activities from mid to late adolescence. *Archives of Pediatrics and Adolescent Medicine, 156*, 1075-1080.

Adams, J. (2006, March). Trends in physical activity and inactivity amongst US 14-18 year olds by gender, school grade and race, 1993-2003: Evidence from the Youth Risk Behavior Survey. *BioMed Central Public Health, 6*, Article 57. Retrieved November 1, 2007, from http://www.biomedcentral.com/1471-2458/6/57

Ainsworth, B. E., Haskell, W. L., Whitt, M. C., Irwin, M. L., Swartz, A. M., Strath, S. J., et al. (2000). Compendium of physical activities: An update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise, 32*, 498-516.

American Association of University Women. (1994). *Shortchanging girls, shortchanging America: Executive summary*. Retrieved June 19, 2009, from American Association of University Women Web site: http://www.aauw.org/research/upload/SGSA-2.pdf

American College Health Association. (2002). *Healthy Campus 2010.* Retrieved August 20, 2008, from, California State Polytechnic University, Pomona Kinesiology and Health Promotion Department, http://www.csupomona.edu/~jvgrizzell/hc2010/hc2010cpp.pdf

American College Health Association. (2008). *Reference group executive summary spring 2007.* Retrieved August 20, 2008, from http://www.acha-ncha.org/ docs/ACHA-NCHA_Reference_Group_ExecutiveSummary_Spring2007.pdf

American College of Sports Medicine. (2006). *ACSM's guidelines for exercise testing and prescription* (7th ed.). Baltimore, MD: Lippincott Williams & Wilkins.

Anderson, L. H., Martinson, B. C., Crain, A. L., Pronk, N. P., Whitebird, R. R., Fine, L. J., et al. (2005, October). Health care charges associated with physical inactivity, overweight, and obesity. *Preventing Chronic Diseases*, *2*, Article 4. Retrieved August 28, 2008, from http://www.cdc.gov/pcd/issues/2005/ oct/04_0118.htm

Brener, N. D., McManus, T., Galuska, D. A., Lowry, R., & Wechsler, H. (2003). Reliability and validity of self-reported height and weight among high school students. *Journal of Adolescent Health, 32,* 281-287.

Brown, K. M., McMahon, R. P., Biro, F. M., Crawford, P., Schreiber, G. B., Similo, S. L., et al. (1998). Changes in self-esteem in black and white girls between the ages of 9 and 14 years. *Journal of Adolescent Health, 23,* 7-19.

Carlson, S. A., Fulton, J. E., Lee, S. M., Maynard, M., Brown D. R., Kohl, H. W., et al. (2008). Physical education and academic achievement in elementary school: Data from the Early Childhood Longitudinal Study. *American Journal of Public Health*, *98*, 721-727.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports, 100,* 126-131.

Centers for Disease Control and Prevention. (n.d.) *2003 National school-based Youth Risk Behavior Survey: Public-use data document*. Retrieved March 18, 2008, from ftp://ftp.cdc.gov/pub/data/yrbs/2003/ yrbs2003codebook.pdf

Centers for Disease Control and Prevention. (1996). Surgeon General's report of physical activity and health. *Journal of the American Medical Association, 276*, 522.

Centers for Disease Control and Prevention. (1997, November 14). CDC surveillance summaries, November 14, 1997. *MMWR 1997, 46*, Article SS-6. Retrieved December 23, 2008, from http://www.cdc.gov/ mmwr/preview/ind1997_ss.html

Centers for Disease Control and Prevention. (2004, May 21). CDC surveillance summaries, May 21, 2004. *MMWR 2004, 53*, Article SS-2. Retrieved February 15, 2008, from http://www.cdc.gov/mmwr/ preview/mmwrhtml/ss5302a1.htm

Centers for Disease Control and Prevention. (2006, June 9). CDC surveillance summaries, June 9, 2006. *MMWR 2006, 55*, Article SS-5. Retrieved March 18, 2008, from http://www.cdc.gov/mmwr/preview/ mmwrhtml/ss5505a1.htm

Centers for Disease Control and Prevention (2008a). *Diabetes public health resource*. Retrieved August 22, 2008, from http://www.cdc.gov/diabetes/projects/cda2.htm

Centers for Disease Control and Prevention. (2008b). *Overweight and obesity.* Retrieved August 22, 2008, from http://www.cdc.gov/obesity/index.html

Centers for Disease Control and Prevention. (2008c). *Physical activity statistics.* Retrieved August 18, 2008, from http://www.cdc.gov/nccdphp/dnpa/physical/stats/leisure_time.htm

Centers for Disease Control and Prevention. (2008d, June 6). CDC surveillance summaries, June 6, 2008. *MMWR 2008, 57*, Article SS-4. Retrieved March 5, 2008, from http://www.cdc.gov/HealthyYouth/yrbs/data/

Centers for Disease Control and Prevention. (2009). *Obesity: Halting the epidemic by making health easier*. Retrieved March 3, 2009, from http://www.cdc.gov/NCCdphp/ publications/AAG/obesity.htm

Center for Education Statistics. (1987, December). *High school and beyond: Third follow up (1986), sample design report*. Retrieved April 27, 2009, from http://nces.ed.gov/pubs88/88402.pdf

Coe, D. P., Pivarnik, J. M., Womack, C. J., Reeves, M. J., & Malina, R. M. (2006). Effect of physical education and activity levels on academic achievement in children. *Medicine and Science in Sports and Exercise, 38,* 1515-1519.

Colditz, G. A. (1999). Economic costs of obesity and inactivity. *Medicine and Science in Sports and Exercise, 31*(Suppl. 1), S663-S667.

Cooper, H., Valentine, J. C., Nye, B., & Lindsay, J. J. (1999). Relationships between five after-school activities and academic achievement. *Journal of Educational Psychology, 91*, 396-378.

Council on Sports Medicine and Fitness, & Council on School Health. (2006). Active healthy living: Prevention of childhood obesity through increased physical activity. *Pediatrics, 117*, 1834-1842.

Davison, K. K., & Schmalz, D. L. (2006, March 28). Youth at risk of physical inactivity may benefit more from activity-related support than youth not at risk.

International Journal of Behavioral Nutrition and Physical Activity, 3, Article 5. Retrieved July 5, 2009, from http://www.ijbnpa.org/content/3/1/5

Dietz, W. H. (1998). Health consequences of obesity in youth: Childhood predictors of adult disease. *Pediatrics, 101*, 518-525.

Dishman, R. K., Saunders, R. P., Felton, G., Ward, D. S., Dowda, M., & Pate, R. R. (2006). Goals and intentions mediate efficacy beliefs and declining physical activity in high school girls. *American Journal of Preventive Medicine, 31*, 475-483.

Eaton, D. K., Kann, L., Kinchen, S., Ross, J., Hawkins, J., Harris, W. A., et al. (2006). Youth Risk Behavior Surveillance - United States, 2005. *Journal of School Health*, *76*, 353-372.

Field, T., Diego, M., & Sanders, C. E. (2001). Exercise is positively related to adolescents' relationships and academics. *Adolescence, 36,* 105-110.

Finkelstein, E. A., Feibelkorn, I. C, & Wang, G. (2003, May 14). National medical spending attributable to overweight and obesity: How much, and who's paying? *Health Affairs, W3,* 219-226. Retrieved March 20, 2009, from http://content.healthaffairs.org/cgi/content/full/hlthaff.w3.219v1/DC1

Fox, K. R. (2000). Exercise and self-esteem. In Biddle S. J. H., Fox, K. R., & Boutcher, S. H (Eds.), *Physical activity and psychological well-being* (pp. 88-117). New York: Routledge.

Fredricks, J. A., & Eccles, J. S. (2006). Is extracurricular participation associated with beneficial outcomes? Concurrent and longitudinal relations. *Developmental Psychology, 42*, 698-713.

Freedman, D. S., Khan, L. K., Dietz, W. H., Srinivasan, S. R., & Berenson, G. S. (2001). Relationship of childhood obesity to coronary heart disease risk factors in adulthood: The Bogalusa Heart Study. *Pediatrics, 108*, 712-718.

Freedson, P. S., Melanson, E., & Sirard, J. (1998). Calibration of the Computer Science and Applications, Inc. accelerometer. *Medicine and Science in Sports and Exercise, 30*, 777-781.

Freedson, P. S., Sirard, J., Debold, N., Pate, R. R., Dowda, M., & Sallis, J. F. (1997). Validity of two physical activity monitors in children and adolescents. In N. Armstrong, B. J. Kirby, & J. R. Welsman (Eds.), *Children and Exercise XIX: Promoting health and well-being* (pp. 127-131). London: E & FN Spon.

Godin, G., & Shephard, R. J. (1985). A simple method to assess exercise behavior in the community. *Canadian Journal of Applied Sport Science, 10*, 141-146.

Harter, S. (1988). *Manual of Self-Perception Profile for Adolescents*. Denver, CO: University of Denver.

He, W., Sengupta, M., Velkoff, V. A., & DeBarros, K. A. (2005). *65+ in the United States: 2005*. (U. S. Census Bureau, Current Population Reports Publication No. P23-209). Washington, DC: U.S. Government Printing Office.

Hendelman, D., Miller, K., Baggett, C., Debold, E., & Freedson, P. (2000). Validity of accelerometry for the assessment of moderate intensity physical activity in the field. *Medicine and Science in Sports and Exercise, 32*(Suppl. 9), S442-S449.

Heron, M. P. (2007). Deaths: Leading causes for 2004. *National Vital Statistics Reports, 56*(5). Hyattsville, MD: National Center for Health Statistics.

Himes, J. H., Hannan, P., Wall, M., & Neumark-Sztainer, D. (2005). Factors associated with errors in self-reports of stature, weight, and body mass index in Minnesota adolescents. *Annals of Epidemiology, 15*, 272-278.

Horn, D. B., O'Neill, J. R., Pfeiffer, K. A., Dowda, M., & Pate, R. R. (2008). Predictors of physical activity in the transition after high school among young women. *Journal of Physical Activity and Health*, *5*, 275-285.

Howard, B., & Gillis, J. (2009). *High school sports participation increases for 20th consecutive year.* Retrieved October 8, 2009, from http://www.nfhs.org/content.aspx?id=3505&terms=participation+in+high+school+sports

Huang, T. T., Harris, K. J., Lee, R. E., Nazir, N., Born, W., & Kaur, H. (2003). Assessing overweight, obesity, diet, and physical activity in college students. *Journal of American College Health, 52*, 83-86.

Jaffee, L., & Manzer, R. (1992). Girls' perspectives: Physical activity and self-esteem. *Melpomene Journal, 11*, 14-23.

Jaffee, L., & Ricker, S. (1993). Physical activity and self-esteem in girls: The teen years. *Melpomene Journal, 12*, 19-26.

Jarrett, O. S., Maxwell, D. M., Dickerson, C., Hoge, P., Davies, G., & Yetley, A. (1998). Impact of recess on classroom behavior: Group effects and individual differences. *The Journal of Educational Research, 92,* 121-126.

Johnston, L. D., Delva, J., & O'Malley, P. M. (2007). Sports participation and physical education in American secondary schools: Current levels and racial/ethnic and socioeconomic disparities. *American Journal of Preventive Medicine, 33*(Suppl. 4), S195-S208.

Johnston, L. D., & O'Malley, P. M. (2003, May). Obesity among American adolescents: Tracking the problem and searching for causes. *Youth Education and Society*. Retrieved October 15, 2008 from http://www .rwjf.org/files/research/ YESOccPaper3.pdf

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2005, August). *Monitoring the Future national survey results on drug use, 1975-2004: Volume I, secondary school students* (NIH Publication No. 05-5727). Bethesda, MD: National Institute on Drug Abuse.

Jung, M. E., Bray, S. R., & Martin-Ginnis, K. A. (2008). Behavior change and the freshman 15: Tracking physical activity and dietary patterns in 1st-year university women. *Journal of American College Health, 56,* 523-530.

Keresztes, N., Piko, B. F., Pluhar, Z. F., Page, R. M. (2008). Social influences in sports activity among adolescents. *The Journal of the Royal Society for the Promotion of Health, 128,* 21-25.

Leenders, N. Y. J. M., Sherman, W. M., & Nagaraja, H. N. (2000). Comparisons of four methods of estimating physical activity in adult women. *Medicine and Science in Sports and Exercise, 32*, 1320-1326.

Li, Y., Dai, Q., Jackson, J .C., & Zhang, J. (2008). Overweight is associated with decreased cognitive functioning among school-age children and adolescents. *Obesity, 16,* 1809-1815.

Mahar, M. T., Murphy, S. K., Rowe, D. A., Golden, J., Shields, A. T., & Raedeke, T. D. (2006). Effects of a classroom-based program on physical activity and on-task behavior. *Medicine and Science in Sports and Exercise, 38*, 2086-2094.

Marsh, H. W. (1990). A multi-dimensional, hierarchical model of self-concept: Theoretical and empirical justification. *Educational Psychology Review*, *2*, 77-172.

Marsh, H. W. (1996). Physical Self Description Questionnaire: Stability and discriminant validity. *Research Quarterly for Exercise and Sport, 67*, 249-264.

Marsh, H. W., Richards, G. E., Johnson, S., Roche, L., & Tremayne, P. (1994). Physical Self-Description Questionnaire: Psychometric properties and a multitrait-multimethod analysis of relations to existing instruments. *Journal of Sport and Exercise Psychology, 16*, 270-305.

Marsh, H. W., & Shavelson, R. (1985). Self-concept: Its multifaceted, hierarchical structure. *Educational Psychologist, 20,* 107-123.

Matthews, C. E., Ainsworth, B. E., Thompson, R. W., & Bassett, D. R., Jr. (2002). Sources of variance in daily physical activity levels as measured by an accelerometer. *Medicine and Science in Sports and Exercise, 34*, 1376-1381.

McClain, J. J., Sisson, S. B., & Tudor-Locke, C. (2007). Actigraph accelerometer interinstrument reliability during free-living in adults. *Medicine and Science in Sports and Exercise, 39*, 1509-1514.

Melnick, M. J., Sabo, D. F., & Vanfossen, B. (1992). Educational effects of interscholastic athletic participation on African-American and Hispanic youth. *Adolescence, 27*, 295-308.

Must, A., & Anderson, S. E. (2003). Effects of obesity on morbidity in children and adolescents. *Nutrition in Clinical Care*, *6*, 4-12.

National Center for Education Statistics. (1996a). *National Educational Longitudinal Study: 1988-1994, Methodology Report* (NCES Publication No. 96-174). Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (1996b). *Who reports participation in varsity in intercollegiate sports at 4-year colleges?* (NCES Publication No. 97-911). Washington, DC: U.S. Government Printing Office.

National Center for Education Statistics. (2005). *What is the status of high school athletes 8 years after their senior year?* (NCES Publication No. 2005-303). Washington, DC: U.S. Department of Education.

National Collegiate Athletic Association. (2006). *2006-2007 guide for the college bound student-athlete.* Retrieved March, 16, 2007, from http://www.athletics.vt.edu/compliance/ eligibilitycenter/college-bound.pdf

National Collegiate Athletic Association. (2008, April). *Participation: 1981-82 - 2006-07 NCAA sports sponsorship and participation rates report*. Indianapolis, IN: Author

National Institutes of Health. (1995, December 18). Physical activity and cardiovascular health. *NIH consensus statement, 13,* Article 101. Retrieved January 16, 2008, from http://consensus.nih.gov/1995/ 1995ActivityCardivascularHealth101html.htm

Nelson, M. C., Gordon-Larsen, P., Adair, L. S., & Popkin, B. M. (2005). Adolescent physical activity and sedentary behavior: Patterning and long-term maintenance. *American Journal of Preventive Medicine, 28,* 259-266.

Pate, R. R., Dowda, M., O'Neill, J. R., & Ward, D. S. (2007). Change in physical activity participation among adolescent girls from 8th to 12th grade. *Journal of Physical Activity and Health, 4,* 3-16.

Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., et al. (1995). Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association, 273*, 402-407.

Pate, R. R., Stevens, J., Webber, L. S., Dowda, M., Murray, D. M., Young, D. R., et al. (2009). Age-related change in physical activity in adolescent girls. *Journal of Adolescent Health, 44*, 275-282.

Pfeiffer, K. A., Dowda, M., Dishman, R. K., McIver, K. L., Sirard, J. R., Ward, D. S., et al. (2006). Sport participation and physical activity in adolescent females across a four-year period. *Journal of Adolescent Health, 39*, 523-529.

Pronk, N. P., Goodman, M. J., O'Connor, P. J., & Martinson, B. C. (1999). Relationship between modifiable health risks and short-term health care charges. *Journal of the American Medical Association, 282*, 2235-2239.

Sallis, J. F., McKenzie, T. L., Kolody, B., Lewis, M., Marshall, S., & Rosengard, P. (1999). Effects of health-related physical education on academic achievement: Project SPARK. *Research Quarterly for Exercise and Sport, 70*, 127-134.

Schneider, M., Dunton, G. F., & Cooper, D. M. (2008). Physical activity and physical self-concept among sedentary adolescent females: An intervention study. *Psychology of Sport and Exercise, 9*, 1-14.

Serdula, M. K., Ivery, D., Coates, R. J., Freedman, D. S., Williamson, D. F., & Byers, T. (1993). Do obese children become obese adults? A review of the literature. *American Journal of Preventive Medicine, 22*, 167-177.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-concept: Validation of construct interpretations. *Review of Educational Research, 46*, 407-441.

Sherar, L. B., Gyurcsik, N. C., Humbert, M. L., Dyck, R. F., Fowler-Kerry, S., & Baxter-Jones, A. D. G. (2009). Activity and barriers in girls (8-16 yr) based on grade and maturity status. *Medicine and Science in Sports and Exercise, 41*, 87-95.

Sirard, J. R., Melanson, E. L., Li, L., & Freedson, P. S. (2000). Field evaluation of the Computer Science and Applications, Inc. physical activity monitor. *Medicine and Science in Sports and Exercise, 32*, 695-700.

Sirard, J. R., Pfeiffer, K. A., & Pate, R. R. (2006). Motivational factors associated with sports program participation in middle school students. *Journal of Adolescent Health*, *38*, 696-703.

Sonstroem, R. J. (1984). Exercise and self-esteem. *Exercise and Sport Sciences Reviews, 12*, 123-155.

Sørenson, T. I., & Sonne-Holm, S. (1988). Risk in childhood of development of severe adult obesity: Retrospective, population-based case-cohort study. *American Journal of Epidemiology*, *127*, 104-113.

Strum, R. (2002). The effects of obesity, smoking, and drinking on medical problems and costs. *Health Affairs, 21*, 245-253. Retrieved January 10, 2009, from http://content.healthaffairs.org/cgi/reprint/21/2/ 245.pdf

Suminski, R. R., Petosa, R., Utter, A. C., & Zhang, J. J. (2002). Physical activity among ethnically diverse college students. *Journal of American College Health, 51*, 75-80.

Telama, R., Yang, X., Viikari, J., Välimäki, I., Wanne, O., & Raitakari, O. (2005). Physical activity from childhood to adulthood: A 21-year tracking study. *American Journal of Preventive Medicine*, *28*, 267-273.

Treuth, M. S., Hou, N., Young, D. R., & Maynard, L. M. (2005). Accelerometry-measured activity or sedentary and overweight in rural boys and girls. *Obesity Research, 13*, 1606-1614.

Troiano, R. P., Berrigan, D., Dodd, K. W., Masse, L. C., Tilert, T., & McDowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine and Science in Sports and Exercise, 40*, 181-188.

Trost, S. G., Pate, R. R., Freedson, P. S., Sallis, J. F., & Taylor, W. C. (2000). Using objective physical activity measures with youth: How many days of monitoring are needed? *Medicine and Science in Sports and Exercise, 32*, 426-431.

Trost, S. G., Pate, R. R., Sallis, J. F., Freedson, P. S., Taylor, W. C., Dowda, M., et al. (2002). Age and gender differences in objectively measured physical activity in youth. *Medicine and Science in Sports and Exercise, 34*, 350-355.

U.S. Department of Health and Human Services. (1996). *Physical activity and health: A report of the Surgeon General.* Atlanta, GA: U.S. Department of Health and Human Services.

U.S. Department of Health and Human Services. (2008). *2008 Physical activity guidelines for Americans* (ODPHP Publication No. U0035). Washington, DC: U.S. Government Printing Office.

U.S. Department of Health and Human Services. (2000). *Healthy People 2010*: *Understanding and improving health* (2nd ed.). Washington, DC: U.S. Government Printing Office.

U.S. Department of Health and Human Services, & U.S. Department of Agriculture. (2005). *Dietary guidelines for Americans, 2005* (6th ed.) (HHS Publication No. HHS-ODPHP-2005-01-DGA-A). Washington, DC: U.S. Government Printing Office.

Wechsler, H., McKenna, M. L., Lee, S. M., & Dietz, W. H. (2004). The role of schools in preventing childhood obesity. *The Standard*, *5*, 4-11.

Welk, G. J., Blair, S. N., Wood, K., Jones, S., & Thompson, R. W. (2000). A comparative evaluation of three accelerometry-based physical activity monitors. *Medicine and Science in Sports and Exercise, 32*(Suppl. 9), S489-S497.

Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., & Dietz, W. H. (1997). Predicting adult obesity in young adult from childhood to parental obesity. *New England Journal of Medicine, 337*, 869-873.

World Health Organization. (2008). Global strategy on diet, physical activity and health: Physical activity and older adults. Geneva, Switzerland: Author.

APPENDIX A: DEMOGRAPHIC QUESTIONNAIRE

Name:___________________________________ Date:____________________

Address:____

Cell Phone Number:____________________ Home Phone Number:____________________

Email Address:____________________________

Age: _________ years Date of Birth:____________(Month/Day/Year)

Gender: ☐ Female ☐ Male

Do you think of yourself as Latino or Hispanic or Mexican American or of Spanish origin?

☐ Yes ☐ No

Do you think of yourself as … (check all that apply or leave blank if none apply):

☐ White

☐ Black or African American

☐ Asian

☐ Native Hawaiian or other Pacific Islander

☐ American Indian or Alaska Native

☐ Some other group (please specify):______________________________

☐ Don't Know

What is the highest level of school your guardian(s) has (have) completed?

☐ Not a high school graduate

☐ High school graduate

☐ Some college

☐ College graduate

☐ Graduate school

Do you plan to go to college after high school?

☐ Yes ☐ No

The following questions will ask about your participation in sports and physical activities.

1. Are you participating in a junior varsity or varsity sport this spring season?

☐ Yes ☐ No

If you selected yes, which sport? ____________________

2. Did you participate in a junior varsity or varsity sport in the winter season?

☐ Yes ☐ No

If you selected yes, which sport? ____________________

3. Did you participate in a junior varsity or varsity sport in the fall season?

☐ Yes ☐ No

If you selected yes, which sport? ____________________

4. Do you participate in an organized sport or physical activity outside of school (e.g., dance, martial arts, tennis, gymnastics, volleyball, baseball, lacrosse, cheer, etc.?

☐ Yes ☐ No

If you selected yes, which sports or physical activities? _________, _________, _________.

5. Did you participate in a sport or physical activity in middle school?

☐ Yes ☐ No

If you selected yes, which sport s or physical activities? _________, _________, _________.

6. Did you participate in a sport or physical activity when you were ten years old or younger?

☐ Yes ☐ No

If you selected yes, which sports or physical activities? _________, _________, _________.

7. Are you enrolled in physical education class this semester?

☐ Yes ☐ No

8. Would you be willing to allow us to contact you in the future with another opportunity to participate in a research study?

☐ Yes ☐ No

APPENDIX B: PSDQ

(Marsh et al., 1994)

All information supplied will be kept strictly confidential.

NAME: ____ DATE: ___/___/_____
BIRTH DATE: ___/___/____ AGE: _____ years MALE / FEMALE (circle one)

PLEASE READ THESE INSTRUCTIONS FIRST
This is not a test – there are no right or wrong answers.

This is a chance to look at yourself. **It is not a test.** There are no right answers and everyone will have different answers. Be sure that your answers show how you feel about yourself. **PLEASE DO NOT TALK ABOUT YOUR ANSWERS WITH ANYONE ELSE.** We will keep your answers private and not show them to anyone.

There are six possible answers for each question – "True", "False", and four answers in between. There are six boxes next to each sentence, one for each of the answers. The answers are written at the top of the boxes. Before you start there are three examples below.

1	2	3	4	5	6
False	Mostly False	More false than true	More true than false	Mostly true	True

SOME EXAMPLES

A. *I am a creative person.* 1 2 3 4 5 (6)
(The 5 has been circles because the person answering believes the statement "I am a creative person" is mostly true. That is, the statement is mostly like him/her.)

B. *I am good at writing poetry.* 1 2 3 (4) 5 6
(The 2 has been circled because the person answering believes the statement is mostly false as far as he/she is concerned. That is, he/she feels he/she does not write good poetry.)

C. *I enjoy playing with pets.* 1 2 (3) (~~4~~) 5 6
(The 5 has been circled because at first the person thought that the statement was mostly true but then the person corrected it to 6 to show the statement was very true about him/her.)

Please do not leave any statements blank. If unsure, please ASK FOR HELP.
Please **circle the number** which is the **most correct** statement about you.

	Statement	False	Mostly False	More false than true	More true than false	Mostly True	True
1	When I get sick I feel so bad that I cannot even get out of bed	1	2	3	4	5	6
2	Several times a week I exercise or play hard enough to breathe hard (to huff and puff)	1	2	3	4	5	6
3	I am too fat	1	2	3	4	5	6
4	Other people think I am good at sports	1	2	3	4	5	6
5	I am satisfied with the kind of person I am physically	1	2	3	4	5	6
6	I am attractive for my age	1	2	3	4	5	6
7	Overall, most things I do turn out well	1	2	3	4	5	6
8	I usually catch whatever illness (flu, virus, cold, etc.) is going around	1	2	3	4	5	6
9	I often do exercise or activities that make me breathe hard	1	2	3	4	5	6
10	My waist is too large	1	2	3	4	5	6
11	I am good at sports	1	2	3	4	5	6
12	Physically, I am happy with myself	1	2	3	4	5	6
13	I have a nice looking face	1	2	3	4	5	6
14	I don’t have much to be proud of	1	2	3	4	5	6
15	I am sick so often that I cannot do all the things I want to do	1	2	3	4	5	6
16	I get exercise or activity three or four times a week that makes me huff and puff and lasts at least 30 minutes	1	2	3	4	5	6
17	I have too much fat on my body	1	2	3	4	5	6
18	Most sports are easy for me	1	2	3	4	5	6
19	I feel good about the way I look and what I can do physically	1	2	3	4	5	6
20	I am better looking than most of my friends	1	2	3	4	5	6

	Statement	False	Mostly False	More false than true	More true than false	Mostly True	True
21	I feel that my life is not very useful	1	2	3	4	5	6
22	I hardly ever get sick or ill	1	2	3	4	5	6
23	I do physically active things (like jogging, dance, bicycling, aerobics, gym, or swimming) at least three times a week	1	2	3	4	5	6
24	I am overweight	1	2	3	4	5	6
25	I have good sport skills	1	2	3	4	5	6
26	Physically, I feel good about myself	1	2	3	4	5	6
27	I am ugly	1	2	3	4	5	6
28	Overall, I am not good	1	2	3	4	5	6
29	I get sick a lot	1	2	3	4	5	6
30	I do lots of sports, dance, gym, or other physical activities	1	2	3	4	5	6
31	My stomach is too big	1	2	3	4	5	6
32	I am better at most sports than most of my friends	1	2	3	4	5	6
33	I feel good about who I am and what I can do physically	1	2	3	4	5	6
34	I am good looking	1	2	3	4	5	6
35	Most things I do, I do well	1	2	3	4	5	6
36	When I get sick it takes me a long time to get better	1	2	3	4	5	6
37	I do sports, exercise, dance, or other physical activities almost every day	1	2	3	4	5	6
38	Other people think I am fat	1	2	3	4	5	6
39	I play sports well	1	2	3	4	5	6
40	I feel good about who I am physically	1	2	3	4	5	6
41	Nobody thinks that I am good looking	1	2	3	4	5	6
42	Overall, I have a lot to be proud of	1	2	3	4	5	6

	Statement	False	Mostly False	More false than true	More true than false	Mostly True	True
43	I have to go to the doctors because of illness more than most people my age	1	2	3	4	5	6
44	Overall, I am a failure	1	2	3	4	5	6
45	I usually stay healthy even when my friends are sick	1	2	3	4	5	6
46	Nothing I do ever seems to turn out right	1	2	3	4	5	6

APPENDIX C: PSDQ FACTORS

Physical Activity: “Levels of physical activity in which one has engaged” (Marsh, et al, 1994).

Appearance: “Perceptions of own physical appearance” (Marsh, et al, 1994).

Body Fat: “Perceived body fat” (Marsh et al., 1994).

General Physical Self-Concept: “Global physical self-concept” (Marsh et al., 1994); “feeling positive about one’s physical self” (Marsh, 1996, p. 253).

Health: “Perceptions of one’s own physical health” (Marsh et al., 1994).

Self Esteem: “Overall positive feelings about oneself” (Marsh, 1996, p. 253).

Sport Competence: “Perceptions of one’s own sporting ability” (Marsh et al., 1994).

APPENDIX D: IRB APPROVAL LETTER

EAST CAROLINA UNIVERSITY

University and Medical Center Institutional Review Board
East Carolina University • Brody School of Medicine
600 Moye Boulevard • Old Health Sciences Library, Room 1L-09 • Greenville, NC 27834
Office **252-744-2914** • Fax **252-744-2284** • **www.ecu.edu/irb**
Chair and Director of Biomedical IRB: L. Wiley Nifong, MD
Chair and Director of Behavioral and Social Science IRB: Susan L. McCammon, PhD

TO: Mathew Mahar, EdD, Dept of Exercise & Sports Science, ECU—101 Minges Coliseum

FROM: UMCIRB

DATE: March 16, 2009

RE: Expedited Category Research Study

TITLE: "Physical Activity, Physical-Self Description, and Academic Performance in High School Females"

UMCIRB #09-0240

This research study has undergone review and approval using expedited review on 3.6.09. This research study is eligible for review under an expedited category because of the following reasons:

- Collection of data through noninvasive procedures (not involving general anesthesia or sedation) routinely employed in clinical practice, excluding procedures involving x-rays or microwaves. Where medical devices are employed, they must be cleared/approved for marketing. (Studies intended to evaluate the safety and effectiveness of the medical device are not generally eligible for expedited review, including studies of cleared medical devices for new indications.) Examples: (a) physical sensors that are applied either to the surface of the body or at a distance and do not involve input of significant amounts of energy into the subject or an invasion of the subject's privacy; (b) weighing or testing sensory acuity; (c) magnetic resonance imaging; (d) electrocardiography, electroencephalography, thermography, detection of naturally occurring radioactivity, electroretinography, ultrasound, diagnostic infrared imaging, doppler blood flow, and echocardiography; (e) moderate exercise, muscular strength testing, body composition assessment, and flexibility testing where appropriate given the age, weight, and health of the individual.

- Research involving materials (data, documents, records, or specimens) that have been collected, or will be collected solely for nonresearch purposes (such as medical treatment or diagnosis). (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(4). This listing refers only to research that is not exempt.)

- Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies. (NOTE: Some research in this category may be exempt from the HHS regulations for the protection of human subjects. 45 CFR 46.101(b)(2) and (b)(3). This listing refers only to research that is not exempt.)

The Chairperson (or designee) deemed this **unfunded** study **no more than minimal risk** requiring a continuing review in **12 months.** Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.

The above referenced research study has been given approval for the period of **3.6.09** to **3.5.10**. The approval includes the following items:

- Internal Processing Form (dated 2.25.09)
- Informed Consent (dated 2.19.09)
- Minor Assent
- Letter of Support (dated 2.19.09)
- Questionnaire
- Flyer

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

The UMCIRB applies 45 CFR 46, Subparts A-D, to all research reviewed by the UMCIRB regardless of the funding source. 21 CFR 50 and 21 CFR 56 are applied to all research studies under the Food and Drug Administration regulation. The UMCIRB follows applicable International Conference on Harmonisation Good Clinical Practice guidelines.