A STUDY OF PHYSICAL FITNESS AND ACADEMIC PERFORMANCE LEVELS OF SIXTH AND SEVENTH GRADE STUDENTS

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James B. Woodward Jr.

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A STUDY OF PHYSICAL FITNESS AND ACADEMIC PERFORMANCE LEVELS

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ABSTRACT

JAMES WOODWARD. A STUDY OF PHYSICAL FITNESS AND ACADEMIC PERFORMANCE LEVELS OF SIXTH AND SEVENTH GRADE STUDENTS. (Under the direction of Dr. Vicky Martin) School of Education, November 2009. The purpose of this study was to examine the difference in academic performance levels between physically fit and physically unfit sixth and seventh grade students. Fitness levels were determined by assessing participants on the Fitnessgram® battery of physical fitness tests, which measures body composition, aerobic capacity, muscular strength, muscular endurance, and flexibility. Academic levels were assessed using the school district's academic benchmark tests as well as Grade Point Average (GPA). The researcher used a series of nine independent *t*-tests to determine if there was a significant difference between the academic performance levels of physically fit and physically unfit students according to the Fitnessgram® assessments. The null hypothesis was rejected and a significant statistical difference was discovered when comparing Language Arts/Reading Benchmark Test scores, Math Benchmark Test scores, as well as the Grade Point Average of participants that achieved the Healthy Fitness Zone (HFZ) for all six tests in the Fitnessgram® battery of assessments, and those that did not achieve the HFZ. The null hypothesis was also rejected and a significant statistical difference was discovered when comparing Language Arts/Reading Benchmark and Math Benchmark Test scores of the participants that achieved the HFZ on the aerobic capacity test, to those that did not achieve the HFZ.

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DEDICATION

I dedicate this dissertation to my family whose support has never wavered. To my children Grace, Griffin, and Brady, I pray that my model of hard work and determination will be a Godly example for you to follow as you grow older, and as you begin your own journey and discovery of God's will for your life. I thought of you often during the times I was working or away from you, and kept you in mind when I felt discouraged. The thoughts of each of you encouraged me to continue down a difficult road.

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CHAPTER 1: INTRODUCTION TO THE STUDY

A new generation of increased academic accountability has taken hold in American schools as a result of the No Child Left Behind Act (U.S. Department, 2001). With the growing focus on academic achievement, increased educational accountability, and federally mandated academic assessments, students' opportunities for physical activity, including recess and organized physical education classes, have been reduced or eliminated from the daily school schedule. These mandates come at a time when many states are requiring fitness testing and data reporting, even with less time allotted for physical education. The researcher used the Fitnessgram® battery of physical fitness tests to evaluate the physical fitness levels of middle school students, and the school district's academic benchmark tests and grade point average to evaluate academic performance levels. This study examined the differences in academic performance levels between physically fit and unfit sixth and seventh grade students. The first chapter of this dissertation presents the background of the study, states the problem, lists the research questions and hypotheses, describes the professional significance, gives an overview of the methodology, and defines key terms.

Background of the Study

Opportunities for physical activity, including recess and organized physical education classes, have been reduced or eliminated from the daily school schedule in many school districts. Growing academic accountability standards resulting from the No Child Left Behind Act, have caused a reduction of time spent in physical education classes, to allow more time spent in academic classes (Coe, Pivarnik, Womack, &

Malina, 2006). These cuts come at an inopportune time as obesity levels of all Americans, especially among children and adolescents, have risen over several decades. It is common knowledge that inactivity and poor nutrition influence a person's amount of body fat (Corbin & Pangrazi, 2008; U.S. Department, 2007). The prevalence of obesity and overweight increases as physical activity levels decrease. Self-esteem and motivation is typically lower in obese and overweight individuals, and incidents of depression are increased.

Data from a 2003-2004 report from the National Health and Nutritional Examination (NHANES) estimates that 17% of children and adolescents are obese, or are in the 95th percentile for weight (Centers for Disease, 2003). Between 1980 and 2002, the obesity rate among adults doubled and the rate among children tripled. The prevalence of obesity and overweight in almost all subgroups is at unprecedented levels, and continues to increase in the United States (U.S. Department, 2007). An inactive lifestyle during childhood and adolescence can lead to unhealthy habits and sedentary related diseases in adulthood such as diabetes, heart disease, and musculoskeletal maladies. In fact, many sedentary related diseases are occurring at earlier ages among children and adolescents. The number of adolescents categorized as at risk for obesity and overweight are at unprecedented levels. Unhealthy children miss more school than healthy children, and standardized test scores and course grades are correlated to attendance. As young people become more sedentary, their level of physical fitness also declines. The impact of a non-active lifestyle not only affects the physical domain of young people, but also the cognitive realm as well.

Obesity and the prevalence of overweight of children, adolescents, and adults is reaching epidemic proportions and affects the human body and spirit in a multitude of negative ways. Though the prevalence of obesity is higher, this problem is not just limited to minorities or lower socio-economic groups. Obesity is a national health concern touching individuals from all lifestyles, and it is becoming a global issue, not just limited to the United States. The mind and body are negatively affected by obesity, which is reflected in academic scores of children and adolescents. Over the last fifty years, the obesity issue has been studied briefly. However, a renewed interest in the topic is a result of more accountability on academic performance evidenced by standardized tests from local, state, and national government agencies.

A portion of the research over the last fifty years concerning the relationship between physical fitness and academic performance centers on the physiological changes during exercise, and how those changes aid memory and learning. All of the body's systems change dramatically when a person transitions from resting state to exercise. Increased blood flow, because of cardiorespiratory response to exercise, includes an increase of blood flow to the skin and active skeletal muscles (U.S. Surgeon General, 1996). As this happens, oxygen extraction and pulmonary ventilation occurs instantaneously (U.S. Surgeon General). Short term and long-term effects of improved cardiorespiratory fitness may include a reduction of depression and anxiety, and an increase in self-esteem. These effects may lead to a positive relationship with academic performance (Sigman, 2008).

Increased brain-based research has complimented research in the areas of student physical fitness and academic performance levels. However, relatively few studies explore the relationship between the two topics, as it has proven difficult to establish randomized studies in schools. Another difficulty is selecting an adequate sample with complete physical fitness scores and academic scores while using reliable and valid instruments. According to studies by The Philanthropic Collaborative for Healthy Georgia (2007), fitness surveys of children are not common. Therefore, there is a need for more research on the topic, especially for practicing physical education professionals.

Advocates for physical education and personal health classes are reluctant to make the assertion that physical fitness and physical activity lead to improved academic performance. Many physical education proponents believe that improved fitness levels and increased time for physical activity have health benefits separate from, and that outweigh, the relationship to academics (Vail, 2008). However, today's physical education teacher and school administrators must account not only for the increased emphasis on academic testing and accountability, but also lean on past research to determine how physical education classes can aid academic performance.

Research over the last fifty years has discovered little to no relationship between physical performance and academic performance, or the data has been based on shallow evidence (Martin & Chalmers, 2007; Taras, 2005; Sallis et al., 1999). Several of these studies show minimal statistical significance as a result of the studies' designs, as they measured differences in individual subjects' pre and post academic test scores before and after physical exercise. These test results are brief snapshots of time in a student's life and do not give an accurate picture of overall physical fitness level or academic performance level. Other anomalies arise, as it is difficult to show improvement in physical fitness or academic scores in the short amount of time as in a six or nine week physical education class. The results of this study will add to the existing professional literature, and shed more light on the importance of students' existing fitness levels and the connection to academic performance.

Problem Statement

The research problem was to examine the difference in academic performance levels between physically fit and physically unfit sixth and seventh grade students. Fitness levels were determined by assessing participants on the Fitnessgram® battery of physical fitness tests. To assess academic performance, the researcher used the school district's academic benchmark tests and the students' grade point average. The Fitnessgram battery of fitness tests measures body composition, aerobic capacity, muscular strength, muscular endurance, and flexibility. The academic benchmark tests evaluate a student's math, reading, and language arts skills. The difference between physical fitness and academic performance levels, or cognition levels, is related to the theories surrounding the framework of psychological health.

Theoretical Framework

The theoretical framework for this study revolves around the rationale that a person's fitness level is not only a determinant of physiological health, but psychological health as well. This idea can include employees in a business setting, as better overall health leads to less stress and absenteeism, along with higher productivity. This same concept is accepted on the school level as healthier children are in a better mood, have a higher self-esteem, and miss less school than their unhealthy counterparts, thus leading to better academic performance and overall psychological health. Exercise can affect four areas of psychological health including well being and mood, personality and self-concept, physiological stress responsiveness, and cognition (Plante & Rodin, 1990).

More research is needed in this area of study as the empirical data and results are mixed concerning the connection between exercise and psychological health as described by Plante and Rodin. Based on this theoretical framework, the researcher will investigate the differences in academic performance levels of physically fit and physically unfit sixth and seventh grade students.

Research Questions

1. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the Healthy Fitness Zone (HFZ) for all six areas of the Fitnessgram®, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

   Null Hypothesis: There will be no significant difference in the Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

2. Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

   Null Hypothesis: There will be no significant difference in the Math Benchmark Test scores for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

3. Will the grade point average (GPA) be significantly different for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the GPA of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

   Null Hypothesis: There will be no significant difference in the GPA for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the GPA of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

4. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the HFZ for body mass index (BMI), compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for BMI?

   Null Hypothesis: There will be no significant difference in Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for BMI, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for BMI.

5. Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for BMI, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for BMI?

   Null Hypothesis: There will be no significant difference in Math Benchmark Test scores for students achieving the HFZ for BMI, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for BMI.

6. Will the GPA be significantly different for students achieving the HFZ for BMI, compared to the GPA of students that did not achieve the HFZ for BMI?

   Null Hypothesis: There will be no significant difference in GPA for students achieving the HFZ for BMI, compared to the GPA of students that did not achieve the HFZ for BMI.

7. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the HFZ for aerobic capacity evidenced by the Progressive Aerobic Capacity Endurance Run (PACER), compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity?

   Null Hypothesis: There will be no significant difference in Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for aerobic capacity, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity.

8. Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for aerobic capacity evidenced by the PACER, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity?

   Null Hypothesis: There will be no significant difference in Math Benchmark Test scores for students achieving the HFZ for aerobic capacity, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity.

9. Will the GPA be significantly different for students achieving the HFZ for aerobic capacity evidenced by the PACER, compared to the GPA of students that did not achieve the HFZ for aerobic capacity?

   Null Hypothesis: There will be no significant difference in the GPA for students achieving the HFZ for aerobic capacity, compared to the GPA of students that did not achieve the HFZ for aerobic capacity.

Professional Significance

The methods and results of this study will contribute to the research base for areas in education including physical education curriculum, school scheduling, and extra curriculum options. The research will also encourage the promotion of exercise, recess, and fitness in schools, and continued fitness testing. The general problem statement and need for this study affects students in all grades, in public and private schools, as well as parents, teachers, and school administrators. All educational stakeholders are impacted by increased academic accountability coupled with a growing overweight and obese society, and sedentary lifestyles.

Chapter Two will reveal that the results of previous studies are mixed, and that researchers call for extended research, especially for pre-high school students. Parents, students, and school personnel can use the knowledge gained from the research in this study, and previous studies to make informed decisions concerning health and fitness promotion, extracurricular activities such as team and individual sports, and physical education elective courses. The connection between physical fitness and academic performance is not fully understood as many of the studies relating to fitness and cognition have taken place with older adults, and very few experimental studies have used children or adolescents.

Studies that have researched the connection between physical fitness and academic performance using school age children, especially middle school students are rare. True experimental studies are difficult because of the barriers involved in randomly assigning students to control groups, especially in schools where every student is required to participate in physical education. Another hindrance to experimental studies is that the physical education curriculum cannot be altered. Though not an experimental study, this study examines the differences in academic performance levels of physically fit and physically unfit students. The fitness tests and academic tests for all students involved in this study are a part of the regular physical education and academic curriculum. The method used in this study has not been widely used on the middle school level. The results will contribute to the professional literature and knowledge base of academic and physical education teachers, parents, school administrators, and students.

Overview of Methodology

The purpose of this quantitative study was to examine the differences in academic performance levels between physically fit and physically unfit sixth and seventh grade students. The researcher used the Fitnessgram® battery of physical fitness tests to evaluate the physical fitness levels of the participants, and the school district's academic benchmark tests along with grade point average to evaluate the level of academic performance.

The researcher chose to use a sample consisting of sixth and seventh grade students in a middle school located in the Southeastern United States. This middle school is part of a school district that is in one of the fastest growing counties in the country, and the students historically perform above the state and national average on standardized tests. Physical education classes are offered every day and are 55 minutes in length. Each student is enrolled in physical education for at least one, 9-week grading period. Intramural sports and interscholastic sports are available through the school, and recreational sports are accessible in the community. The testing site uses Fitnessgram® as the fitness assessment program, and is the only middle school in the school district using a criterion referenced testing instrument for physical fitness. Fitnessgram® is a battery of physical fitness tests as well as a reporting and tracking software. All students in sixth, seventh, and eighth grades are administered the Fitnessgram® assessment at least once per year at the testing site. The school has a climate controlled gym and weight room, as well as an athletic field for physical education classes and fitness testing.

Participants in this study ranged in age from 11 to 14. Males made up 56% of the sample while females made up 44% of the sample. Compared to the rest of the school district, the Asian and Black population was slightly lower. The middle school, like other schools in the district and region, is predominately White. The participants had a school attendance rate of 96%. Ten percent of the sample was served in English as a Second Language (ESOL) or English Language Learners (ELL) programs. Many of the students are considered economically disadvantaged evidenced by 25% receiving free or reduced lunch.

Various fitness tests such as the Back-Saver Sit and Reach Test, measuring of body mass index (BMI), the Curl-Up Test, PACER, Push-Up Test, and Trunk Lift Test were used to evaluate participants' levels of personal fitness. The fitness instruments are part of the Fitnessgram® battery of fitness tests. The researcher selected the six fitness tests that Fitnessgram® recommends.

First, the Back-Saver Sit and Reach Test is the recommended test by Fitnessgram® for lower body flexibility, as it places less strain on the lower back, and vertebral disc compression is reduced compared to the traditional Sit and Reach Test.

The Back-Saver Sit and Reach Test is a reliable instrument when tested consistently as a measure of hamstring flexibility.

Secondly, body composition is determined by calculating body mass index (BMI). BMI is a value calculated by measuring a person's weight (kilograms) and dividing it by their height squared (meters). The Fitnessgram® software can convert English measurements to the metric system. The software also calculates the BMI and determines if a person's body composition is in the Healthy Fitness Zone (HFZ), or "Needs Improvement."

Thirdly, the Curl-Up Test measures abdominal strength and endurance. Fitnessgram® recommends this test over the traditional sit up as there is less ballistic type movements that may cause spinal injuries. The Curl-Up Test is also suggested over the sit-up test to decrease movement and pressure on the spine, and to incorporate multiple abdominal muscles and oblique muscles when compared to traditional sit-ups.

The fourth test used in the Fitnessgram® battery of tests is the Progressive Aerobic Cardiovascular Endurance Run (PACER). The PACER is a multistage 20-meter shuttle run developed by Leger and Lambert (1982). The PACER measures aerobic capacity and is measured in terms of VO_2 max, which is the maximum rate of oxygen that the body can use during exercise (Cureton & Plowman, 2008). The researcher chose the PACER over the mile run, as the PACER can be performed indoors in a gym where weather conditions are not a factor. Fitnessgram® recommends the PACER because participants typically have a positive experience, and they can learn the importance and techniques of pacing when taking part in aerobic exercise.

The fifth fitness assessment, the Push-Up Test, measures upper body strength and endurance. The test requires no additional equipment as do other tests for upper body strength and endurance, such as modified pull-ups, chin-ups, and the flexed arm hang. This test was selected over the alternative tests for upper body strength, as no additional equipment was needed. Anatomical logic leads to the validity of the Push-Up Test, as the assessment requires the participant to use the pectoralis major as the dominant muscle. The triceps and anterior deltoid serve as contributing muscles during the Push-Up Test.

Finally, the Trunk Lift Test's objective is to measure trunk strength and extension. The test is considered a minimum assessment of the components that make up trunk strength and flexibility such as torso length, body weight, passive trunk extension and endurance (Meredith & Welk, 2007). Gym mats and at least a 12-inch ruler, or preferably a yardstick, are the only items needed to perform the Trunk Lift Test.

After fitness testing, the participants' data was organized into groups depending on if they achieved the Healthy Fitness Zone (HFZ), or did not achieve the HFZ on the fitness tests. Each participant had one or two academic tests scores, including one for the Language Arts/Reading Benchmark Test and one for the Math Benchmark Test. Grade point average (GPA) will also be used as an academic variable for comparison. The benchmark tests were developed for each grade level and are administered at approximately week eight of each nine-week grading period. Every student in grades six, seven, and eight in the school district is administered the Language Arts/Reading Benchmark and the Math Benchmark Tests four times a year. During the second grading period, the exams were administered in the academic classes at the same time as the Fitnessgram® assessments were administered in physical education classes.

The researcher matched the participants that achieved the Healthy Fitness Zone

(HFZ) for all six fitness tests with their Language Arts/Reading Benchmark Test score, Math Benchmark Test score, and their grade point average (GPA). The scores of the participants that did not achieve the HFZ for all six fitness tests were matched with their respective benchmark tests and GPA. The same procedure was replicated with the groups meeting or not meeting the HFZ for body mass index (BMI), as well as meeting or not meeting the HFZ for aerobic capacity. The researcher was then able to begin statistical testing between fitness levels and academic performance scores by comparing the benchmark data and GPA of the various groups that met or did not meet the HFZ for all six fitness tests and individual tests.

Descriptive statistics were used to determine measures of central tendency according to age and gender for the Back-Saver Sit and Reach, body mass index, Curl-Up, the Progressive Aerobic Capacity Endurance Run, Push-Up, and the Trunk Lift Tests. Descriptive statistics were also calculated for the Language Arts/Reading Benchmark and Math Benchmark Tests as well as GPA.

Independent *t*-tests were calculated to determine the difference in the means of the academic scores of the healthy and unhealthy fitness groups for each of the academic indicators. The healthy groups met the Healthy Fitness Zone (HFZ) on fitness tests and the unhealthy groups did not meet the HFZ. Independent *t*-tests were used to determine if there was a statistically significant difference at the $p < .05$ level in academic scores between the two fitness level groups.

Summary

Chapter One was designed to give the reader a sense of the purpose and background information surrounding this study, as well as identify the research questions and an overview of the methodology. Chapter Two will describe the theoretical and practical research and literature related to this study. Details concerning the methodology including procedures, validity, and reliability information will be discussed in Chapter Three. The results of the statistical analysis will be described in Chapter Four, while the summary and discussion by the researcher will be delivered in Chapter Five.

Definition of Key Terms

Body Mass Index (BMI) is defined by the Centers for Disease Control as reliable indicator of body fat as a value calculated from a person's weight and height.

Fitnessgram® is a battery of fitness tests that assesses health-related fitness components such as cardiovascular fitness, muscular strength, muscular endurance, flexibility, and body composition. Scores are evaluated against objective criterion-based standards, called Healthy Fitness Zones that indicate the level of fitness necessary for optimal health. Fitnessgram® is also a software program for storing and calculating fitness data.

Healthy Fitness Zones (HFZ) are zones of fitness levels based on criterion-referenced standards established by The Cooper Institute, that represent minimum levels of fitness that offer protection against the diseases that result from sedentary living

No Child Left Behind Act (NCLB) is the federal program and legislation affecting kindergarten through high school. NCLB is built on four principles such as accountability, choices for parents, greater local control and flexibility, and an emphasis on scientific research when making education policy.

Obesity is defined by the Centers for Disease Control as an adult having a body mass index (BMI) greater than or equal to 30.

Overweight is defined by the Centers for Disease Control as an adult having a body mass index (BMI) from 25 to 29.9.

Progressive Aerobic Capacity Endurance Run (PACER) is a 20 meter multistage fitness run used to measure aerobic capacity.

The Cooper Institute is an organization that conducts research in epidemiology, exercise physiology, behavior change, hypertension, children's health issues, obesity, nutrition, aging, and other health issues related to fitness. The Cooper Institute also developed the Fitnessgram® battery of fitness tests and software.

CHAPTER 2: REVIEW OF THE LITERATURE

During the process of this literature review, the researcher chose topics that contribute to the theoretical framework and background of the study such as obesity and physical activity levels of young people, school fitness testing, the physiology of physical activity, and the literature opposing and supporting the relationships between physical fitness and academic performance. To collect information on each of these topics, the researcher used educational research databases and journal databases with key word searches including "academic achievement and adolescent obesity," "physical fitness and adolescents," "physical activity and adolescents," "physical fitness and cognition," and "school fitness testing."

With the growing focus on academic achievement, increased educational accountability, and federally mandated academic assessment through the No Child Left Behind Act (U.S. Department, 2001), students' opportunities for physical activity, including recess and organized physical education classes have been reduced, or eliminated from the daily school schedule. More time is devoted to academic classes, resulting in less time for physical education classes (Coe, Pivarnik, Womack, & Malina, 2006; Daley & Ryan, 2000; Shephard, 1996). The lack of physical activity during childhood and adolescence can lead to unhealthy habits and sedentary related diseases in youth and in adulthood, and the number of adolescents categorized as at risk for obesity and being overweight is at an all time high. Unhealthy children are also absent from school more than healthy children, and coupled with low physical activity, the average percent of body fat in students has increased. With this reduction of physical activity, the level of physical fitness among children and adolescents has also declined.

Fitness testing is on the rise as programs like Fitnessgram® are becoming popular at a time when there is an increased emphasis on maximizing the time spent in physical education to be meaningful and effective. This program, developed by The Cooper Institute, contains criterion-referenced health standards, as opposed to the norm-referenced standards found in the widely used Presidential Fitness assessment. Fitnessgram® has emerged over the last decade as a driving force for physical fitness testing in over 11,000 schools in the United States (Corbin & Pangrazi, 2008). California, Missouri, and Texas use Fitnessgram® to test all or most students' fitness levels on a periodic basis. The battery of fitness tests for Fitnessgram® can be used for personal fitness self-testing, personal best testing, institutional testing, parental reporting, and personal tracking. The mission of Fitnessgram® is to promote lifelong physical fitness, physical activity, and other health-related behaviors (Corbin & Pangrazi, 2008).

One goal of Fitnessgram® is to not only aid parents and students with knowledge concerning the student's body composition, but also their fitness levels which is based on age and gender. The Healthy Fitness Zone (HFZ) is the optimal score area that students should achieve based on a healthy lifestyle. The HFZ is available for body composition, as well as tests for flexibility, upper body strength, abdominal strength, and aerobic capacity. Fitness assessments like the tests from Fitnessgram® have been used to measure relationships between physical fitness and academic performance.

Research on the relationship between physical fitness and academic achievement has emerged from studies that show a neutral relationship or positive relationship between time spent in physical education class and academic performance scores.

Several researchers state that there is no evidence that increasing time in physical education class negatively affects academic scores (Bailey, 2006; Carlson et al., 2008). As standardized test scores remain the highest indicator for school and individual student success, it is important to note that increased time in physical education does not have an adverse effect on standardized test scores (Sallis et al., 1999). On the contrary, studies by Bailey (2006) and Carlson et al. (2008) have demonstrated a relationship between an increase in physical activity and its positive effect on classroom behavior, attention span, and self-esteem, which can improve academic performance. The relationship between increased time in daily physical activity correlating to improved physical fitness is well documented, and will be discussed later in this chapter.

Prevalence of Obesity and Being Overweight

Obesity levels of all Americans, especially among children and adolescents have risen over several decades (Ogden, Flegal, Carroll, & Johnson, 2002; Ogden et al., 2006). Studies have revealed that inactivity and poor nutrition influence a person's amount of body fat (Corbin & Pangrazi, 2008; U.S. Department, 2007). As physical activity decreases, health maladies such as obesity and being overweight are increased. Self-esteem and motivation are typically lower in obese and overweight individuals and incidents of depression are increased. These factors often negatively affect academic performance of children and adolescents.

There are differing descriptions of the term "obesity" since the Centers for Disease Control (2003) does not use the term directly. However, the agency defines overweight as a body mass index (BMI) at or above the 95^{th} percentile (Centers for Disease). The leading organization on obesity, The American Obesity Association, defines overweight as a BMI of 25 or greater, and obesity as BMI over 30, which is in the 95th percentile (Taras & Potts-Datema, 2005). Obesity in children is often accompanied by Type 2 diabetes, hypertension, asthma, musculoskeletal injuries, cancer, liver disease, and cardiovascular diseases (Datar & Strum, 2004; Ogden et al., 2006; Taras & Potts-Datema, 2005; Suskind et al., 2000; & Vail, 2008). Obese children often struggle in school because of lower self-esteem, depression, and truancy, which may be a contributing factor to poor academic performance (Taras & Potts-Datema, 2005). Though the relationship is not fully understood, Taras and Potts-Datema stated that poor school performance might increase the risk of obesity.

Data from a 2003-2004 report from the National Health and Nutritional Examination (NHANES) estimates that 17% of children and adolescents are obese, or are in the 95th percentile for weight (Centers for Disease, 2003). This phenomenon has increased from 4% to 17% reported in the 1970 survey (U.S. Department, 2007). In addition, data from a survey found that 32% of adults over the age of 20 were considered obese (Centers for Disease, 2003). The NHANES report and the organization Active Living Research (2007) stated that there are about 25 million adolescents that are considered obese or overweight. Between 1980 and 2002, the obesity rate among adults doubled and the rate among children tripled. The prevalence of being overweight in almost all subgroups is at an all time high and continues to increase in the United States (U.S. Department, 2007).

Mexican-American and African-American children ages 6 to 19 are 40% more likely to be at risk for being overweight, or are already overweight (National Association [NASPE], 2006). The United States is not alone in that children in countries around the world including Britain and China have seen the prevalence of obesity and overweight rise dramatically (Ogden et al., 2006). NASPE (2006) stated in their Shape of the Nation Report that overweight children ages eight and below are 80% more likely to be overweight or obese as adults.

Obese and overweight adults rarely lose weight or keep the weight under control because their dieting is not related to a healthy lifestyle change, and exercise is not implemented into their daily or weekly schedule (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997). As the risk of sedentary-related diseases in adulthood rises over time, it is highly important to prevent obesity during childhood. Whitaker's study examined 854 subjects and determined that both obese and non-obese children under the age of 10 are high risk for obesity as an adult when their parents are obese. Lack of physical activity and fitness is a major factor in becoming obese as a child, and obese children typically mature into obese adults (Christodoulos, Flouris, & Tokmakidis, 2006; Togashi et al., 2002).

A 36-week study by Suskind et al. (2000) reports limited success with traditional obesity treatments for adolescents including increased exercise, nutrition education, and lifestyle modification. The researchers suggest that simultaneous clinical treatment for obese parents and children is essential for successful treatment. Children under the age of 10 experienced the greatest risk of the effect of parental obesity. After the age of 10 and during middle school years, the role of health and physical education teachers is critical in promoting proper nutrition and lifelong participation in physical activity (Christodoulos et al., 2006; Whitaker et al., 1997). Public schools are entering the discussion, as fitness testing is becoming a part of the general physical education curriculum.

The Centers for Disease Control (2003) reports a four-fold increase in obesity rates over the last 20 years, and many schools are requiring students to be measured for body composition. Calculating body mass index (BMI) is the most common measurement for body composition in schools. Agencies such as the International Task Force on Obesity agree that measuring BMI can be an incorrect prediction of body fatness, and BMI does not account for increased muscle mass (Taras & Potts-Datema, 2005). However, calculating BMI is a readily available predictor for public school teachers to use since there is very little cost involved. Calculating BMI is also less invasive for students than using skin-fold calipers or hydrostatic weighing procedures.

Obesity and overweight of adults, children, and adolescents is reaching epidemic proportions and both affect the human body and spirit in a multitude of negative ways. This problem is not just limited to minorities or lower socio-economic groups, though the prevalence is higher. This national health issue affects individuals from all lifestyles and it is also becoming a global issue and not just limited to the United States. As the research has shown, the mind and body are negatively affected by obesity, which can reduce academic scores of children and adolescents.

Physical Activity among Children and Adolescents

Decrease in Physical Activity

Children and adolescents' activity levels have a direct correlation with obesity, higher body mass index, and a strong correlation to health risks in adult life such as heart disease, Type II diabetes, musculoskeletal difficulties, high blood pressure, and cancer (Corbin & Pangrazi, 2008; U.S. Surgeon General, 1996; Philanthropic, 2007). Research has shown that high-density lipoprotein (HDL) cholesterol can be lowered in children with sports participation, training, and regular physical activity, which can lead to health benefits as adults (Hager, Tucker, & Seljaas, 1995). A high percentage of body fat can contribute to psychosocial risks, cardiovascular risks, liver disease, asthma, sleep apnea, and Type II diabetes among children and adolescents (Datar & Strum, 2004; Dietz, 1998; Luder, Melnik, & Dimaio, 1998; Mallory, Fiser, & Jackson, 1989; Swartz & Puhl, 2003; U.S. Department, 2007). Once a person is overweight or obese, physical activity is less enjoyable and it is more difficult. Physical inactivity is a well-known cause for overweight and obesity in children, adolescents, and adults (Welk & Blair, 2008).

Contributing to the rise of obesity rates in the United States among youth and adults is a general decrease in physical activity at all levels. Former Surgeon General David Satcher (U.S. Department, 1999) reported that about 25% of adults, and 13% of youth demonstrated no physical activity during their leisure time according to survey results collected in 1992. The percentage of high school students not engaging in physical activity has increased to nearly 33%, and this percentage increases as students age (National Association [NASPE], 2006). Geographic location, race, socio-economic level, and lower levels of education have also been shown to contribute to the lack of physical activity among groups such as Hispanics, African-Americans, and women (NASPE, 2006; U.S. Surgeon General, 1996). In 2007, the state of Georgia reported that 44% of students do not meet the recommended 60 minutes of daily physical activity (Philanthropic, 2007).

Daily Physical Activity Recommendations

Highly respected organizations and individuals agree that children and adolescents need at least 60 minutes of moderate to vigorous physical activity (MVPA) per day to maintain a healthy lifestyle (American Heart, 2005; National Association, 2004; Strong et al., 2005; U.S. Surgeon General, 1996). The National Association for Sport and Physical Education, NASPE, (2006), recommends that school age children should be allowed to participate in vigorous activities that are varied, developmentally appropriate, and enjoyable. According to Satcher (2005), nearly one third of high school students and almost half of young people, aged 12 to 21 do not participate in regular vigorous activity.

Children and adolescents become less active as they grow older, and girls are generally less active compared to boys (Prochaska, Pate, & Sallis, 2008; U.S. Surgeon General, 1996). Studies have shown that obese adults were overweight as children (Pangrazi, Beighle, Vehige, & Vack, 2003; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997), which places importance on children remaining physically active through adolescence, and from adolescence to adulthood. Satcher (2005), reports that 70% to 80% of overweight children will become obese adults. Overweight adults have a shorter life expectancy than their healthy weight counterparts (Satcher). The Healthy 2010 initiative, sponsored by the Centers for Disease Control and the President's Council on Physical Fitness and Sports (2000), confirms a lower life expectancy for inactive adults compared to their physically active counterparts. The Healthy 2010 report also stated that regular physical activity helps maintain cognitive functioning and independence in older adults.

Daily physical activity is imperative as the benefits of exercise greatly diminish within two weeks if physical activity is reduced or stopped. The effects of physical training disappear within two to eight months if physical activity is not continued (U.S Department, 1999). The implications for physical education teachers include stressing time-on-task in the physical education classroom, and encouraging adolescents to increase their daily physical activity, especially vigorous physical activity. An increase in physical activity is beneficial to children, adolescents, and adults both physically, emotionally, and mentally.

Physical Activity and Physical Education Class

Daily physical activity in general has been declining over the last few decades. Children and adults alike are spending less time outdoors working and playing, and more time indoors viewing television and playing video games. The movement to a more sedentary life is the result of business and industry's progression away from agriculture, advancements in technology, and urban sprawl. This progression to a more sedentary lifestyle is no exception in public schools as physical education and recess have been cut to just a few days a week, or is even non-existent in many schools. Budget cuts and increased academic accountability have been the demise of physical education programs, as well as extracurricular sport offerings in the public schools. Many students once received much of their physical activity in conjunction with their school. Currently, many of those opportunities are unavailable, and many students do not take the initiative to participate in physical activity on their own.

In 1989, 90% of elementary schools allowed organized recess for at least one class period each day. This percentage has decreased due to safety and liability concerns (Jarrett, 2002). Former U.S. Surgeon General David Satcher (2005) cites that many schools now sell candy, chips, and soft drinks, and that only 2% of students reach the recommended daily number of servings of the five food groups. Many schools have reduced or abolished recess in lieu of more academic time. As a result, less than 25% of students get at least 30 minutes of physical activity per day (Satcher).

Only 3.8% of elementary schools, 7.9% of middle schools, and 2.1% of high schools provide daily physical education class at a time when there are approximately 25 million students that are overweight or obese (Active Living, 2007). The agency also stated that replacing physical education time with more academic time does not necessarily improve academic performance, and children that are more active perform better academically. Coupled with reduced time in physical education, the quality and quantity of elementary school physical education programs have decreased over the last several decades, as pressures to meet increasing academic standards have risen (Hall, 2007). Hall noted that certified physical educators are only required in 28 states, and 75% of parents do not want physical education removed from the school curriculum (Hall).

Recently, more research has indicated the benefits of youth resistance training, which is often achieved in before and after-school programs along with physical education classes. “Resistance training refers to a specialized method of conditioning that involves a progressive use of a wide range of resistive loads and a variety of training techniques. These methods are designed to enhance muscle function, increase muscle size, improve body compositions, boosts sports performance, and reduce athletic injuries” (Faigenbaum, 2003, p.1).

Along with Faigenbaum, organizations such as the American Academy of Pediatrics (2001), the American College of Sports Medicine (2000), and the American

Orthopedic Society of Sports Medicine (1988), support properly supervised and well designed youth training programs. Benefits of youth resistance training include increased muscular strength, muscle power, muscular endurance, bone mineral density, motor performance skills, cardiorespiratory fitness, , sports performance, improved body composition, enhanced mental health and well-being (Faigenbaum, 2003). Resistance training can also stimulate a more positive attitude towards lifetime physical activity (Faigenbaum).

Physical education and Sport (PES), is believed to enhance self-esteem, self-confidence, cognitive and social development, academic achievement, and PES helps develop self-respect and respect for others (Bailey, 2006). Bailey uses the framework of a 50-nation study titled, *Project Report to the 4th International Conference of Ministers and Senior Official Responsible for Physical Education and Sport* (MINSEPS IV), which described PES outcomes as pertaining to five domains: Physical, Lifestyle, Affective, Social, and Cognitive. Educational budgetary constraints and more accountability to raise academic test scores have resulted in many physical education classes being reduced or even cut from many schools and school systems, thus students are not able to explore the five domains of PES. Coupled with a loss of recess or breaks for exercise, students are not engaging in the recommended amount of physical activity at school, and many parents and school administrators are concerned that an increase in PES time detracts from academic class time and performance on examinations (Sallis et al., 1999; Shephard, 1997).

However, Bailey (2006) notes that physical activity increases blood flow to the brain, which can increase alertness, change in mood, and improved self-esteem. Bailey cites a landmark French study by Vanves (1952, as cited in Bailey) where academic time was reduced by 26%, and replaced with Physical education and Sport (PES) to determine the effects of increased PES. Vanves' study reported fewer discipline problems, reduced absenteeism, and more attentiveness. Recent studies from Australia, Canada, and the United States have revealed comparable sets of standardized test scores when at-school physical activity increased by 50 minutes a day and time spent in academic classes was reduced by 50 minutes per day (Ahamed et al., 2007, Coe et al., 2006; Sallis et al., 1999).

In conclusion, physical levels of youth have been on the decline due in part to the reduction of time spent in physical education class, recess, and extracurricular opportunities. Many of these programs have succumbed to budgetary constraints, while others were dismissed or changed by educational administrators, in the name of academic accountability. The research does not support decreased time for physical activity in lieu of more time for academics.

Fitness Testing

Fitness testing of students gained considerable interest beginning in 1954 as American children were demonstrating lower scores on fitness tests when compared to European children, especially those in Germany and the former Soviet Union (Mood, Jackson, & Morrow, 2007; Plowman et al., 2006). During the Cold War of the 1950's, President Dwight D. Eisenhower established the President's Council on Physical Youth to emphasize the importance of physical activity and fitness among America's youth (Mood et. al., 2007; Plowman et. al., 2006). Organizations such as the American Alliance for Health, Physical Education, Recreation, and Dance (AAHPERD) were quickly established to promote physical activity and fitness (Mood et al., 2007).

According to Mood, Jackson, and Morrow (2007), there are five important events that have influenced the measurement of physical fitness and fitness testing in schools. These events included (a) initial nationwide interest in physical activity the 1950's; (b) the development of a health related fitness construct; (c) nationwide youth fitness studies such as the National Children and Youth Fitness Studies in 1985 and 1987, and the National School Population Fitness Survey in 1986; (d) evaluation - moving to criterion referenced testing as opposed to norm referenced testing; (e) measuring activity as opposed to measuring fitness. School fitness testing has been a part of physical education classes for 50 years (Martin & Chalmers, 2007; Mood et al., 2007). Teachers must choose to use or not use fitness testing in the curriculum when it is not mandated by the state or school district.

Over a 2-year period, Martin and Chalmers (2007) found that 83% of physical education teachers implemented fitness testing, and 61% used nationally recognized programs such as the President's Challenge or Fitnessgram®. The President's Challenge is a norm- referenced test. Only 19% of surveyed teachers used Fitnessgram®, which is a nationally known criterion-referenced battery of tests created by The Cooper Institute. Researchers and organizations have recommended the use of criterion-referenced standards, like the set provided in Fitnessgram®, when administering student fitness testing (Xiaofen & Silverman, 2004). Seventy-nine percent of physical education teachers stated that their classroom instruction was related to the fitness testing (Xiaofen & Silverman), which is important for optimal performance on the fitness tests. Preparing for fitness tests in physical education is very different from preparing students for a test in academic classes, as adequate practice is considered necessary to learn the movements of the fitness test, and to maintain proper form for optimal fitness test performance.

Fitnessgram® was established in 1977 by Charles L. Sterling and the program joined with The Cooper Institute for Aerobics Research in 1981 (Plowman et al., 2006). Fitnessgram® is innovative in the field of fitness testing and is dedicated to providing the best resource for fitness testing, reporting, and promotion of physical activity (Corbin & Pangrazi, 2008; Mood, Jackson, & Morrow, 2007; Plowman et. al. 2006). Currently, Fitnessgram® is used in over 11,000 schools worldwide as the mission of Fitnessgram® is to promote lifelong physical fitness, physical activity, and other health-related behaviors (Corbin & Pangrazi, 2008).

The Fitnessgram® program tests abdominal strength and endurance, aerobic capacity, body composition, flexibility, trunk extensor strength, and upper body strength and endurance. Several tests can be performed in each category to meet the needs of different populations of students. Fitnessgram® uses criterion-referenced standards and student performance is scored in the Healthy Fitness Zone (HFZ), or "Needs Improvement." The zones are aligned to criterion-referenced health standards as the standards are based on how much fitness a child needs for optimal health. The Cooper Institute and other experts in the physical education domain determine the basis for these standards. The standards are unique based on age and gender. The mission of Fitnessgram® is described with the H.E.L.P. acronym: H- Health and health related-fitness; E- Everyone; L-Lifetime; P-Personal (Corbin & Pangrazi, 2008).

The Fitnessgram® program and battery of tests was designed to be used for personal fitness testing, personal best testing, institutional testing, parental reporting, and personal goal tracking (Appendixes A & B). Fitnessgram® is not recommended for students until they reach the fourth grade as the tests are not considered reliable at this age, and the students may not quite understand the meaning of their results (Corbin & Pangrazi, 2008). The Fitnessgram® Scientific Advisory Board establishes appropriate and inappropriate uses for Fitnessgram®. The Scientific Advisory Board also established the Healthy Fitness Zone (HFZ) for each test according to age and gender. Other benefits and uses for Fitnessgram® include planning curriculum, conducting research, centralized record keeping, and demonstrating evidence of fitness education in schools.

Inappropriate uses of Fitnessgram® are those that contradict the mission of Fitnessgram® evidenced in the H.E.L.P. philosophy, and that are contradictory to the National Association for Sports and Physical Education's (NASPE) standards and objectives. Using fitness tests as the primary method of grading students and assessing students in physical education is discouraged. The Cooper Institute does not condone using fitness scores as the primary method for grading, nor do they condone determining teacher success based on fitness scores. Exempting students from physical education based on fitness scores is also considered an inappropriate practice (Corbin & Pangrazi, 2008). The Cooper Institute inanimately expresses the importance of confidentiality when conducting fitness testing and score reporting.

Only a few states mandate physical fitness testing of all public school students. The state of California tests more students than any other state. California law requires the California Department of Education to collect and report physical fitness data for the state's students every two years. Physical fitness testing is conducted in California for grades five, seven, and nine. In 2007, more than 1.3 million California students (90% of students in grades five, seven, and nine) participated in the Fitnessgram® battery of physical fitness tests measuring aerobic capacity, body composition, flexibility, and muscular strength and endurance (California, 2007).

The latest data collected by the National Health and Nutrition Examination Survey (NHANES), reported that one third of students do not meet cardiorespiratory fitness standards (Pate, Wang, Dowda, Farrell, & O'Neill, 2006). Studies report a relationship between cardiorespiratory fitness and body composition among adolescents that are overweight (Drinkard et al., 2001; Lazzer, 2005; Nassis, Psarra, & Sidossis, 2005). The California Physical Fitness Test- Report to the Governor and Legislature (2007), states that only 27% of fifth grade students tested in the Healthy Fitness Zone (HFZ) on six out of six fitness tests. The report also states that 36% of fifth graders, 36% of seventh graders, and 44% of ninth graders did not meet the HFZ for aerobic capacity (California, 2007).

Fitness testing is a largely debated topic among parents, school administrators, students, and state legislatures. In 2008, the state of Georgia proposed body composition testing and data reporting for all students. The initiative failed, but in 2009 the Georgia General Assembly passed legislation that requires state wide fitness testing and data reporting beginning in 2011 (Georgia General, 2009). Many decision makers and stake holders feel that confidentiality in fitness testing is an issue and that the results, especially for obese, overweight, and not-fit children, may do more harm than good. Therefore, fitness testing is not mandated in most states as too many individuals ignore the problem of inactivity and obesity of America’s youth. Often the opinions of health and physical education teachers are disregarded even when they understand the importance of physical fitness and fitness testing, as well as the physiological benefits of regular physical activity and exercise.

Physiology of Physical Activity and Fitness

When the body experiences increases in physical activity and exercise, especially increased aerobic demands, changes occur instantaneously. These changes occur for males and females, and for children and adults alike. All of the body's systems change dramatically when a person transitions from resting state to exercise. Increased blood flow because of cardiorespiratory response to exercise includes an increase of blood flow to the skin and active skeletal muscles (U.S. Surgeon General, 1996). Short-term and long-term effects of improved cardiorespiratory fitness may include a reduction of depression and anxiety, and an increase in self-esteem. These effects can lead to a positive relationship with academic performance (Sigman, 2008). Blood pressure increases with dynamic exercise, and oxygen extraction and pulmonary ventilation occurs instantaneously. More blood flow to the brain helps the brain function at a more efficient level (U.S. Surgeon General, 1996).

Increased blood flow to the brain helps neurons communicate with each other (Hall, 2007). Hall states, "A greater amount of neurons are able to exchange and retain information, enabling individuals to understand, comprehend, remember, and retrieve more information and at a quicker rate" (p.124). Increased blood flow to the brain also provides more nutrients such as glucose and oxygen as the brain consumes 20% of the body's energy (Hall). Physical activity also reduces the levels of cortisol while stress triggers an increase of cortisol. Excess cortisol renders the brain less capable of completing complex skills, as well as basic planning, judgment, and problem solving which can negatively affect academic performance in children and adolescents (Hall).

Since 1975, researchers have studied reaction times with older athletes compared to non-athletes (Lambourne, 2006). These studies have proved that exercise can increase cerebral blood flow or can change the structure of the hippocampus and cerebral cortex (Hall, 2007; Lambourne, 2006). Research by Lambourne dealing with cognitive functioning and exercise among older adults tested working memory capacity based on exercise rates. His research revealed a positive relationship between these two variables. Studies involving humans and animals reveal complex neural connections between areas of the brain that control learning and movement (Jensen, 1998; Shephard, 1997). Magnetic Resonance Imaging (MRI) has revealed increased blood flow to the frontal lobe of the brain during exercise. The results of these brain scans also correspond to increased academic performance on math and standardized tests with an emphasis on decision-making skills (Sigman, 2008).

Studies on brain research that concentrate on the relationship between physical activity and cognition usually focus on the hippocampus, which controls memory and learning. Exercise has been shown to increase more synaptic connections, which can be an indicator for improved academic achievement (Trudeau & Shephard, 2008). According to Taras (2005), physical activity also improves overall circulation and blood flow to the brain, along with higher levels of endorphins and nor-epinephrine. Shephard (1996) concluded that exercise and physical activity helps reduce boredom, thus increasing attention span, and increases self-esteem and concentration. Physiologic differences between boys and girls have been noted, as boys may need a greater level of activity stimulus to achieve the same effects as girls (Carlson et al., 2008; Pate et al., 2006; Sigman, 2008).

The positive relationship between exercise and physical activity is a precursor to the discussion concerning the connection between physical fitness and academic performance. Technology such as magnetic resonance and brain scan equipment allows physicians and exercise scientists to determine the effects of exercise on the body's systems, especially the brain. Increased blood flow benefits the body in many ways. Perhaps the greatest benefit is the efficiency of the brain to use the increased amounts of oxygen and nutrients for cognitive reasoning and functioning. The increase in brain activity helps individuals reduce stress and depression levels, increase cognition and memory, and aids academic performance in students.

Physical Fitness and Academic Performance

There are multitudes of studies that have been completed on the individual topics of physical fitness levels of children and adolescents, as well as academic performance levels of students. However, relatively few studies explore the relationships or connections between the two topics. It has proven difficult to establish randomized studies in schools. Selecting a sample with both complete physical fitness scores and academic scores, while using reliable and valid instruments, is no easy task. According to The Philanthropic Collaborative for Healthy Georgia (2007), fitness surveys of children are not common. This section dissects the limited current research on the connection between physical fitness and academic performance for children and adolescents, including research that supports a neutral relationship, as well as a positive relationship between the two variables.

In 2006, The Philanthropic Collaborative for Healthy Georgia (PCHG) examined fifth and seventh grade Georgia public and private school students' level of physical fitness. The organization reported findings in alignment with previous research that students with unhealthy levels of body mass index (BMI) also perform poorly on physical fitness tests in the areas of muscular strength and endurance, cardiorespiratory capacity, and flexibility. The PCHG also reported that 30% of Georgia's youth failed to meet the Healthy Fitness Zone (HFZ) for BMI, and 52% failed to reach the HFZ for cardiorespiratory fitness. The same study also showed the overall fitness level of Georgia's youth to be very discouraging as 57% did not meet the HFZ for at least two out of four tests for flexibility, muscular strength and endurance, and more surprisingly only 3% met the HFZ for all of the fitness tests including BMI and cardiorespiratory capacity (PCHG). Childhood obesity has increased in the last 25 years, as well as an increase of adult diseases among children such as hypertension and Type 2 diabetes (PCHG).

One of the most widely referenced agencies conducting research in the field of youth fitness levels and the relationship to academic performance is the California Department of Education (CDE). The CDE produced reports on the topics in 2002, 2005, and 2007. These reports are considered landmark studies by many current researchers and physical education advocates and agencies. The CDE (2005) states there is little research examining the relationship between physical fitness and academic achievement, and their reports do not infer causality.

In 2005, the California Department of Education tested fifth, seventh, and ninth grade students by implementing the Fitnessgram® battery of physical fitness tests, and the California Standards Test (CST), which measures academic performance. Student performance on the Physical Fitness Test (PFT) was scored in two levels: (a) in the Healthy Fitness Zone (HFZ); and (b) needs improvement. Needs improvement means the student did not score in the HFZ. As the PFT score improved, the mean score on CST language arts test also improved for all three-grade levels. The same is true for the math CST for all three grade levels. After subgroup analyses, females had a higher rate change compared to males (CDE, 2005).

The California (2005) findings concerning the differences between female and male students are consistent with the findings concerning the physiologic differences taking place during exercise between females and males (Carlson et al., 2008; Pate et al., 2006; Sigman, 2008). Socio-economic status of students was also analyzed and the rate of change was greater for non-National School Lunch Program students (California Department, 2005). The agency also reported a significant positive relationship between physical fitness and academic performance. However, the agency did not publish the correlation coefficient in their report. The agency implied that physical activity, physical fitness, and physical education promote improved general health; and a healthy body improves intellectual capacity.

Grissom (2005) evaluated the California Department of Education's 2001 study where average achievement scores on the SAT/9 test were compared with physical fitness tests using the Fitnessgram® program. Grissom (2005) reported that the California findings are preliminary, and more research needs to be conducted concerning the relationship between physical fitness and academic performance. Arrington (2007) supports the claim that research on the relationship between physical fitness and academic achievement is in its early stages.

Concerning the 2001 California study, Grissom (2005) noted validity concerns with the academic variable as it was based on a subjective, non-standardized rating scale.

Achievement also varied from different testing sites, and there were inconsistencies with the results. The concern with most correlation studies deals with methodology, especially with small sample sizes, and the problem with experimental type designs on this topic is that it is very difficult to raise academic achievement scores Grissom (2005). Grissom also noted that many of the studies involving physical fitness and the relationship to academic performance contain invalid and unreliable instruments for fitness testing.

Direct measures of academic achievement include standardized test scores, course grades, and grade point average (GPA). Standardized tests have been validated and reliability information is readily available on standardized tests (Coe, 2006; Sallis et al., 1999; Strong et al., 2005). These tests are preferred over course averages as teacher bias and validity and reliability factors are an issue (Sallis et al., 1999). Indirect tests include measurements of concentration, memory, and behavior observations (Coe, 2006; Keays & Allison, 1995; Strong et al., 2005). Another noted concern in researching fitness levels of children and adolescents and their academic performance, is the difficulty in obtaining a large sample of students with both complete fitness and academic scores. Trudeau and Shephard (2008) reiterate this idea in that the school setting is not conducive to randomized controlled studies.

Research over the last 50 years has determined little to no relationship between physical performance and academic performance, or the data has been based on shallow evidence (Martin & Chalmers, 2007; Taras, 2005; Sallis et al., 1999). Cook (2005) cites reports from Virginia and Illinois that physical education and physical fitness have little impact on academic achievement. Evidence from numerous studies report mixed results including no association, or a small association between physical fitness and academic achievement (Ahamed et al., 2007; Carlson, 2008; Coe et al., 2006; Daley & Ryan, 2000; Dwyer, Coonan, Leitch, Hetzel, & Baghurst, 1983; Fisher, Juszczak, & Friedman, 1996 Raviv & Low, 1990; Tremblay, Inman, & Willms, 2000).

Advocates for physical education and personal health classes are careful to make the assertion that physical fitness and physical activity lead to improved academic performance. The advocates believe that improving fitness levels and increasing time for physical activity have health benefits separate from, and that outweigh the relationship to academics (Vail, 2008). Even the California Department of Education (2005) admits in their report that better living conditions and a higher level of overall health may contribute to higher physical fitness and academic performance scores.

Martin and Chalmers (2007) conducted a study measuring academic performance by using the Iowa Test of Basic Skills (ITBS), and physical performance by using the President's Challenge, in order to add to the existing literature. The subjects in Martin and Chalmers' study included students in grades three, five, six, and eight and they participated voluntarily. The authors stated that the resulting correlation of $p = .19$ and its significance is up to the reader, as $p = .19$ is typically considered to be on the low end of significance. The researcher also stated that only 3.7% of the variability in academic performance could be attributed to physical performance based on their findings. Martin and Chalmers question the California Department of Education's (2005) position that healthy children are better learners, as the California study only reported mean scores and the results are left to interpretation.

Taras (2005) examined 14 published studies that focused on physical activity and academic performance. Most of the studies examined by Taras resulted in a weak or zero correlation at all between physical activity and academic performance. A few of the studies (Caterino & Polak, 1999; Raviv & Low, 1990) found that concentration levels improved immediately after activity, but were not sustained. Taras (2005) mentions that studies using adults showed little cognitive improvement with small changes, but there were gains over longer periods. Taras also stated in several instances that more research is needed on the benefits of physical activity for school-aged children. The researcher felt that academic improvements based on physical activity might be more noticeable in subgroups or with extremely large populations. She also stated that physical activity might indirectly affect academic performance by reducing stress, inducing a calming effect, and changing one's mood.

As mentioned in earlier sections, being overweight or obese can lead to increased anxiety, diabetes, high blood pressure, asthma, and depression. Satcher (2005) reported that overweight children are subject to anxiety disorders, isolation from peers, and depression. These students also miss four times as much school as healthy weight children. Schools can offer sound nutrition and physical activity for all students. Properly nourished children perform at higher academic levels. Satcher agrees with the National Association for Sport and Physical Education (NASPE, 2008) in that math scores can increase as physical activity increases, and students have better attendance and a positive attitude. NASPE also encourages young adults to exercise more to promote a healthy lifestyle that will follow them into adulthood. The suggestion by NASPE is that students should raise their active heart rate between 135 to 175 beats per minutes, five days a week, for 20 minutes (Vail, 2008).

A positive relationship between physical activity and short-term concentration has been demonstrated (Coe et al., 2006; Sallis et al., 1999; Shephard, 1996), and long-term exercise and fitness gains have improved cognitive performance (Etnier et al., 1999). Other researchers have shown that exercise and stretching helps students relieve anxiety and relax (Etnier et al., 1999; Vail, 2008). Higher academic scores may be a result of improved mood, self-esteem, attention span, and reduced stress (Bailey, 2006; Coe et al., 2006; Hills, 1998; Sallis et al., 1999; Shephard, 1996; Taras, 2005; Vail, 2008). In schools, physical activity can be implemented in physical education class as well as organized recess.

Recess promotes physical health and social development, which creates an optimal learning environment. Jarrett (2002) cites the National Association for Sport and Physical Education (NASPE) in that students need physical education in a structured environment. Students also need recess to allow choices for physical activity. Increased physical activity on all levels helps contribute to an individual's level of physical fitness. Recess, extracurricular sports, and physical education classes are a few ways that children and adolescents can become more physically fit. Many states have reduced the required time spent in these activities during the school day, while California requires ninth grade students to take four years of physical education if they do not pass required fitness tests (Cook, 2005).

BrainGym™ (2003) and SPARK™ (1989) are widely used physical activity and fitness programs that encourage increased physical activity and positive socialization, while improving cognition (Sallis et al., 1999; Vail, 2008). These programs can be implemented in physical education classes as well as academic classes. With cross lateral movements found in activities such as Tai Chi, students are encouraging both sides of the brain to work together, which helps curb negative classroom behavior issues (Sallis et al., 1999; Vail, 2008).

The association between physical fitness and academic performance is most notable in studies where subjects participate in regular vigorous activity (Coe et al., 2006). Satcher (2005) offers suggestions to schools to help students become healthier by maintaining a healthy lifestyle, and participating in moderate to vigorous activity. His suggestions include forming an advisory council, developing a wellness policy, allowing physical activity and nutrition education during the school day, and encouraging faculty and staff to be healthy exemplars. Students that attend schools that follow these recommendations have shown improved test scores in math (Sallis et al., 1999; Shephard, 1997). As stated previously, experimental studies have shown an increase in math scores with increased physical activity. Similar results have been discovered in correlation studies considering math scores and physical fitness levels (Sallis et al, 1999).

The California Department of Education's (CDE, 2005) study is at the forefront of the discussion. This is perhaps the largest study of its kind in the United States, however smaller studies (Castelli, Hillman, Buck, & Erwin, 2007; Knight & Rizzuto, 1993) yielded similar results, even though they were fourteen years apart. The smaller studies are in agreement with the CDE study (2005) showing a significant positive relationship between fitness levels and academic performance. The CDE used the Physical Fitness Test (PFT), which incorporated Fitnessgram® as their battery of physical fitness tests, and the California Standards Tests (CST) as their academic marker. The tests were administered to fifth, seventh, and ninth grade public school students. Results from the study revealed an increase in mean PFT scores and CST scores for all grade levels in Math and English, and for both male and female students (CDE, 2005). The CDE study is also significant as the agency was able to obtain fitness and academic scores for over 1.3 million students.

Summary

The professional literature and reports from government agencies have demonstrated an interest in physical activity, consequences of obesity, and trends in fitness testing in regards to children and adolescents. The relationship between body composition, especially body fat percentage, and physical fitness levels of adolescents has not been examined in detail. Studies concerning the relationship between physical fitness and academic performance are few; therefore, more research is needed.

Current research on the relationship between physical fitness and academic performance is in its infancy. On the surface, the relationship seems to be one of common sense. However, many factors contribute to both physical fitness and academic performance including but not limited to genetics, motivation, nutrition, and environment. Understandably, there are very few randomized studies using elementary or middle grades students. Difficulties arise because of class scheduling and class size restrictions, thus hindering experimental and quasi-experimental designs. Studies have shown that positive changes in classroom behavior, self-esteem, and improved school satisfaction are a result of physical activity, and these areas are positively linked to school performance.

Anthropometric testing of students is controversial as many parents and students are opposed to school-wide or even state-wide testing for height, weight, and body composition. The concerns of anthropometric testing include invasion of privacy or embarrassment of students, and revealing the obvious fact that the students are obese or overweight. The possibility exists that testing body composition can perpetuate eating disorders, depression, and taunting by other students. These fears are understandable if the evaluator in untrained, or if there are no steps in place to ensure confidentiality or to encourage students to be physically active, rather than to lose excess weight.

Measuring student fitness levels on various components such as aerobic capacity, body composition, flexibility, and muscular strength and endurance is valuable, as fitness testing helps students and parents understand the benefits of maintaining a healthy and active lifestyle. The measurement data is also important as one considers the negative effects of excess weight and body fat that can occur in early adulthood. Fitness report cards can serve as an informational tool for students, parents, and physical educators to discuss how to incorporate physical activity into everyday life. As students accept responsibility for personal health and become intrinsically motivated to be physically active, the impact can be transferred to parents and siblings to adopt a healthy family lifestyle.

Examining the relationship between physical fitness and academic performance among sixth and seventh graders, especially those that participate in a physical education program, can positively influence physical education curriculum planning, teaching, and mastery of standards. Physical education professionals can implement fitness lessons to help make up for the lack of student physical activity outside of school. Fitness focused lessons go beyond traditional team sports activities that are often not inclusive; while fitness based lessons ensure physical activity and success for everyone. Students can take part in games and exercises that will not only prepare them for the fitness assessments, but also allow them to raise their heart rate to increase cardiorespiratory health and cognitive functioning during physical education classes. Improved cognitive capacity can also help students achieve a higher level of academic performance.

CHAPTER 3: METHODOLOGY

General Context

Chapter Three describes the participants and procedures used in this study, as well as a discussion on the validity and reliability data for the instruments. The purpose of this study was to examine the differences in academic performance levels between physically fit and physically unfit sixth and seventh grade students. The researcher used the Fitnessgram® battery of physical fitness tests to evaluate the physical fitness levels of the participants, and the school district's academic Math and Reading/Language Arts Benchmark Tests, as well as grade point average to evaluate the level of academic performance.

Research Design

The researcher conducted a quantitative study with a descriptive design. The variables used for comparison were the participants' fitness levels assessed by the Fitnessgram® battery of physical fitness tests, and academic performance scores on standardized tests along with grade point average. The descriptive study was conducted to determine an association between the variables, and not causality. The researcher chose a descriptive design rather than an experimental design as a random sample was not feasible, and the variables were not administered a research treatment.

Research Context

The researcher chose to use a sample consisting of sixth and seventh grade students in a middle school located in the Southeastern United States. The sixth and seventh grades were selected, and the eighth grade omitted, based on personal and nonformal observations of motivation levels towards personal fitness, along with willingness to participate in physical activity during physical education class. This school district is part of one of the fastest growing counties in the country, and historically performs above its state and the national average on standardized tests. The district consists of approximately 32,000 students in 30 schools, including eight middle schools. The district estimates that 15 new schools will be needed before 2013 as the enrollment is expected to reach 50,000 students.

At the research site, all students take an organized physical education class for at least one 9-week grading period each year. Physical education classes are conducted every day and are 55 minutes in length. Intramural sports and interscholastic sports are offered via the school. Traditional team sports and recreational sports are available in the community. These offerings allow opportunities for students to be physically active in and outside of the school setting. The testing site uses Fitnessgram® as the fitness assessment curriculum and is the only middle school in the school district using a criterion referenced testing instrument for physical fitness. All students in sixth, seventh, and eighth grades are administered the Fitnessgram® assessment at least once per year at the testing site. Some students may be administered the fitness assessment up to four times a year depending on their class schedule. The school has a climate controlled gym and weight room, as well as an athletic field for fitness testing and physical education.

Research Participants

The target population for this study was sixth and seventh grade students in an organized physical education class. The population contained 259 sixth grade students and 245 seventh grade students. The sample pool was 155 sixth grade students and 152 seventh grade students from eight, pre-existing physical education classes during the second grading period of the year. These students completed the Fitnessgram® assessment as well as the academic benchmark tests. A randomized sample was not feasible as students were scheduled into physical education classes by the school's administration. The sample is believed to be representative of the sixth and seventh grade population of the school district as the middle schools all have similar demographics.

Participants in this study ranged from 11 to 14 years of age. Males made up 53% of the sample while females made up 47% of the sample. The Asian (.72%) and Black populations (1.01%) were slightly lower compared to the rest of the district, but the Hispanic population (9.34%) was higher.

Table 1

School District Demographic Information

Ethnicity	Percentage
Asian	4.59
Black	2.20
Hispanic	8.95
Native Alaskan/ American Indian	0.14
Multiracial	2.03
White	82.09

The middle school, like other schools in the district and region, is predominately White. The participants have a school attendance rate of 96%. Ten percent of the sample was served in English as a Second Language (ESOL) programs or are considered English Language Learners (ELL). Many of the students are categorized as economically disadvantaged evidenced by 25% receiving free or reduced lunch. The researcher did not have access to individual participant's status concerning free and reduced lunch, as this is private data. Approximately 15% of the sample was served in gifted education programs, while 12% was served in special education programs for intellectual or physical disabilities (Georgia Department, 2007).

Table 2

Testing Site Demographic Information

Ethnicity	Percentage
Asian	0.72
Black	1.01
Hispanic	9.34
Native Alaskan/ American Indian	0.14
Multiracial	1.72
White	87.07

Instruments Used in Data Collection

Back-Saver Sit and Reach Test

The Back-Saver Sit and Reach Test is the recommended assessment for lower body flexibility by Fitnessgram®. The test places less strain on the lower back and lessens vertebral disc compression as compared to the traditional Sit and Reach Test. The Back-Saver Sit and Reach Test is a reliable instrument when tested consistently as a measure of hamstring flexibility. Research over 50 years has discovered correlations of .93 to .99 with a 95% confidence interval of .89 to .99 (Plowman, 2008). These correlations were between the Back-Saver Sit and Reach compared to the traditional Sit and Reach Test. However, this test cannot be considered a valid measure of lower back flexibility. To test hamstring flexibility, the researcher will use Classic Sit and Reach box from GOPHER Sports, which is recommended for the President's Council on Fitness and Fitnessgram® tests. Graphical representations of the Back-Saver Sit and Reach Test are located in Appendix C. The Healthy Fitness Zones (HFZ) for the Back-Saver Sit and Reach for males age 10 to 14 is 8 inches, and the HFZ for girls age 10 to 14 is 10 inches.

The following procedures for the Back-Saver Sit and Reach Test are referenced from the *FITNESSGRAM®/ACTIVITYGRAM® Test Administration Manual*:

> The student removes his or her shoes and sits down at the test apparatus. One leg is fully extended with the foot flat against the face of the box. The other knee is bent with the sole of the foot flat on the floor. The instep is placed in line with, and 2 to 3 inches to the side of, the straight knee. The arms are extended forward over the measuring scale with hands placed one on top of the other. With palms down, the student reaches directly forward (keeping back straight and the head up) with both hands along the scale four times and holds the position of the fourth reach for at least 1 second. After one side has been measured, the student switches the position of the legs and reaches again. The student may allow the bent knee to move to the side as the body moves forward if necessary, but the sole of the foot must remain on the floor. Record the number of inches on each side to the nearest ½ inch reached, to the maximum score of 12 inches. (Meredith &

Welk, 2007, p.54)

Body Mass Index (BMI)

There are numerous tests for body composition including bioelectrical impedance, hydrostatic weighing, skin-fold measurements, and calculating body mass index (BMI). The researcher chose to calculate BMI as opposed to the other methods because limited equipment is needed, and the test is less invasive to middle school students. Each of the body composition testing methods has a measurement error of 2% to 3% when estimating body fat (Meredith and Welk, 2007). BMI is calculated by measuring a person's weight (kilograms) and dividing it by their height squared (meters). The Fitnessgram® software can convert English measurements to the metric system. The software also calculates BMI and determines if the value is in the Healthy Fitness Zone (HFZ), "Needs Improvement". Graphical representations of the test for BMI is located in Appendix C, and Table 3 lists the HFZ for BMI.

Table 3

Body Mass Index (BMI) Healthy Fitness Zones

Age	Male HFZ	Female HFZ
10	14.0–21.0	13.7–23.5
11	14.3–21.0	14.0–24
12	14.6–22.0	14.5–24.5
13	15.1–23	14.9–24.5
14	15.6–24.5	15.4–25.0

Note. The HFZ is the BMI value.

After the measurements for height and weight are collected, they were entered in the Fitnessgram® database, and the software computed BMI for the researcher. The following procedures for determining BMI are referenced from the *FITNESSGRAM/ ACTIVITYGRAM® Test Administration Manual*:

> Have people remove their shoes when you are measuring height and weight. You are encouraged to drop fractions of an inch or a pound and use the last whole number. (Meredith & Welk, 2007, p.38)

Curl-Up Test

The Curl-Up Test measures abdominal strength and endurance. This assessment is recommended by Fitnessgram® over the traditional sit up test because there are less ballistic movements. The Curl-Up Test is selected over the sit-up test to:

> a) decrease movement of the fifth lumbar vertebrae over the sacral vertebrae, b) and to minimize the activation of the hip flexors, c) increase the activation of the external and internal oblique and transverse abdominals, and d) maximize abdominal muscle activation of the lower and upper rectus abdominals relative to disc compression (load) when compared with a variety of sit-ups. (Meredith & Welk, 2007, p.42)

Plowman (2008) recognizes that there are few results concerning the consistency of the Curl-Up Test, and validity is decreased due to the lack of a criterion measure. Higher reliability data is available for high school and college students (R = .97) as compared to younger children (R = .70). Plowman suggests the need for further research on the reliability of the Curl-Up Test with younger children. The most significant reason to use the Curl-Up Test is logical validity based on analysis of biomechanical and anatomical observations, and for reducing injuries to the lower back and spine. More research is needed to determine the validity of the Curl-Up Test as compared to other abdominal strength and endurance tests. Graphical representations of the Curl-Up Test can be found in Appendix C, and Table 4 lists the HFZ for Curl-Ups.

Table 4

Curl-Up Test Healthy Fitness Zones (HFZ)

Age	Male HFZ	Female HFZ
10	12–24	12–26
11	15–28	15–29
12	18–36	18–32
13	21–40	18–32
14	24–45	18 – 32

Note. The HFZ is the number of Curl-Ups.

The following procedures for the Curl-up Test are referenced from the *FITNESSGRAM®/ ACTIVITYGRAM® Test Administration Manual*:

> Partner A lies in a supine position on the mat, knees bent at an angle of approximately 140°, feet flat on the floor, legs slightly apart, arms straight and parallel to the trunk with palms of hands resting on the mat. The fingers are stretched out and the head is in contact with the mat. Partner B places a measuring strip on the mat under Partner A's legs so that partner A's fingertips are just resting on the nearest edge of the measuring strip. Keeping heels in contact with the mat, Partner A curls up slowly, sliding fingertips across the strip until fingertips reach the other side. Partner A curls back down until his or her head touches the mat. Movement should be slowed and gauged to the specified

cadence of about 20 curl-ups per minute. The teacher should call the cadence or use a prerecorded cadence. Partner A continues until he or she can no longer continue or has completed 75 curl-ups. Students are stopped when the second form correction is made, or when they can no longer continue. (Meredith & Welk, 2007, p.42)

Progressive Aerobic Capacity Endurance Run (PACER)

The Progressive Aerobic Cardiovascular Endurance Run (PACER) is a multistage 20-meter shuttle run developed by Leger & Lambert (1982). The PACER measures aerobic capacity. Terms such as cardiovascular fitness, cardiorespiratory endurance, and aerobic capacity are often uses interchangeably. However, cardiovascular fitness and cardiorespiratory endurance are measures of performance ability. Aerobic capacity refers to functional or physiological capacity, of the cardiovascular and respiratory system and is measured in terms of VO_2 max (Cureton & Plowman, 2008). VO_2 max is "the maximum rate that oxygen can be taken up and utilized by the body during exercise" (p.9.3). VO_2 max has been validated against the PACER and mile run, as both criterion tests have yielded similar results (Beets and Pitetti, 2006; Plowman and Liu, 1999). The researcher chose the PACER over the mile run because the PACER can be performed indoors in a gym, and weather conditions are not a factor. Fitnessgram® recommends the PACER for the following reasons:

1. All students are more likely to have a positive experience in performing the PACER, 2) the PACER helps students learn the skill of pacing, 3) students who have a poorer performance will finish first and not have the embarrassment of being the last person to complete the test.

2. Participants practice the PACER a week in advance during their physical education class. Cones are set up 20 meters apart running down each sideline of the basketball court. After students complete the test, they should continue to walk and stretch in the designated cool down area. (Meredith & Welk, 2007, p.28)

The following procedures for the PACER are referenced from the *FITNESSGRAM®/ACTIVITYGRAM® Test Administration* Manual:

> Mark the 20-meter (21 yards, 32 inches) course with marker cones to divide lanes and a tape or chalk line at each end. Before test day, allow students to listen to several minutes of the tape so that they know what to expect. Students should then be allowed at least two practice sessions. Each version of the test will give a 5-second countdown and tell the students when to start. Students should run across the 20-meter distance and touch the line with their foot by the time the beep sounds. At the sound of the beep, they turn around and run back to the other end. If some students get to the line before the beep, they must wait for the beep before running the other direction. Students continue in this manner until they fail to reach the line before the beep for the second time. A single beep will sound at the end of the time for each lap. A triple beep sounds at the end of each minute. The triple beep serves the same function as the single beep and alerts the runners that the pace will get faster. The first time a student does not reach the line by the beep, the student stops where he or she is and reverses direction immediately, attempting to get back on pace. The test is completed for a student the next time (second time) he or

she fails to reach the line by the beep. (Meredith & Welk, 2007, pp.28-29)

Further discussion of the Progressive Aerobic Capacity Endurance Run (PACER) is located in Appendix C, and Table 5 lists the HFZ for the PACER.

Table 5

PACER Healthy Fitness Zones (HFZ)

Age	Male HFZ	Female HFZ
10	23–61	7–41
11	23–72	15–41
12	32–72	15–41
13	41–83	23–51
14	41–83	23–51

Note. The HFZ is the number of 20-meter laps.

Push-Up Test

The Push-Up Test measures upper body strength and endurance. The procedure requires no additional equipment as do other tests for upper body strength and endurance such as modified pull-ups, chin-ups, and the flexed arm hang. This test was selected over the alternative tests, as no additional equipment was needed. The Push-Up Test is considered reliable from elementary age students to college age students. Reliability increases when the teacher objectively counts the repetitions and assesses accuracy, as opposed to students counting a partner. Studies involving elementary and high school students have revealed correlation coefficients ranging from .50 to .86 (Plowman, 2008). Anatomical logic leads to the validity of the Push-Up Test, as the test requires the participant to use the pectoralis major as the dominant muscle. The triceps and anterior deltoid act as contributing muscles during the Push-Ups Test. Graphical representations of the Push-Up Test are located in Appendix C and Table 6 lists the HFZ for Push-Ups.

Table 6

Push-Up Test Healthy Fitness Zones (HFZ)

Age	Male HFZ	Female HFZ
10	7–20	7–15
11	8–20	7–15
12	10–20	7–15
13	12–25	7–15
14	14–30	7–15

Note. The HFZ is the number of 90 degree Push-Ups.

The following procedures for the Push-Up Test are referenced from the *FITNESSGRAM®/ ACTIVITYGRAM® Test Administration Manual*:

> The student being tested assumes a prone position on the mat with hands placed under or slightly wider than the shoulders, fingers stretched out, legs straight and slightly apart, and toes tucked under. The student pushes off the mat with the arms until arms are straight, keeping the legs and back straight. The back should be kept at a straight line from head to toes throughout the test. The student then lowers the body using the arms until the elbows bend at a 90° angle and the upper arms are parallel to the floor. This movement is repeated as many times as possible. The rhythm should be approximately 20, 90° push-ups per minute or 1, 90° push-up every 3 seconds. Students are stopped when the second form correction is made. The score is the number of 90° push-ups performed.

(Meredith & Welk, 2007, p.48)

Trunk Lift Test

The objective of the Trunk Lift Test is to measure trunk strength and extension. The test is considered a minimum assessment of the components that make up trunk strength and flexibility such as torso length, body weight, passive trunk extension and endurance (Meredith & Welk, 2007). Plowman (2007) states there is little reliability information concerning the Trunk Lift Test with younger children, however a single trial of test-retest reliability was found to be .85 to .99 (Plowman). More research is needed to develop validity on the Trunk Lift Test.

Gym mats and at least a 12-inch ruler, but preferably a yardstick, are the only pieces equipment needed to perform the Trunk Lift Test. Graphical representations of the Trunk Lift Test are located in Appendix C. The Healthy Fitness Zone (HFZ) for the Trunk Lift Test for males and females age 10 to 14 is 9 to 12 inches. The following procedures for the Trunk Lift Test are referenced from the *FITNESSGRAM®/ ACTIVITYGRAM® Test Administration Manual*:

> The student being tested lies on the mat in a prone position. Toes are pointed and hands are placed under the thighs. Place a coin or other marker on the floor in line with the student's eyes. The student lifts the upper body off the floor, in a very slow and controlled manner, to a maximum height of 12 inches. The head should be maintained in a neutral alignment with the spine. The position is held long enough to allow the tester to place a ruler on the floor in front of the student and determine the distance from the floor to the student's chin. The ruler should be placed at least an inch to the front of the student's chin and not directly under

> the chin. Once the measurement has been made, the student returns to the starting position in a controlled manner. Allow two trials, recording the highest score. (Meredith & Welk, 2007, pp.45-47)

Language Arts/Reading Benchmark Test

The school district involved in this study works in conjunction with Edusoft, a subsidiary of Riverside Publishing, to develop the Language Arts/Reading Benchmark Test. The questions chosen for the test are aligned with the district and state curriculum standards by Edusoft personnel and school district representatives. The benchmark test is developed for each grade level and is administered at approximately week eight of each grading period. Every student in grades six, seven, and eight in the school district is administered the Language Arts/Reading Benchmark Test four times a year. During the second nine week grading period, this test was administered at the same time as the Fitnessgram® assessments at the testing site.

The school district reports reliability information for the sixth grade Language Arts/Reading Benchmark Test with a Kuder-Richardson Reliability Value (KR-20) of .88, while the seventh grade Reading/Language Arts Benchmark test has a KR-20 Value of .86. Edusoft uses the KR-20 reliability formula as it measures internal consistency of test items. The school district states

> A high value indicates that test items tend to measure the same skills, because students who get one answer correct are likely to get another correct as well. On a test that covers a single, focused topic area; many experts look for a reliability value of 0.6 to consider the exam reliable. An exam with reliability in excess of 0.8 is considered very reliable. (Forsyth County, 2008)

Math Benchmark Test

The school district involved in this study works with Edusoft to develop the Math Benchmark tests. Edusoft personnel and school district representatives align the questions on the Math Benchmark Test with the district and state curriculum standards. The benchmark test is developed for each grading quarter and is administered at approximately week eight of each grading period. Every student in grades six, seven, and eight in the school district is administered the Math Benchmark test four times a year. During the second nine week grading period, this test was administered at the same time as the Fitnessgram® tests at the testing site.

The school district reports reliability information for the sixth grade Math Benchmark Test with a Kuder-Richardson Reliability Value (KR-20) of .88, while the seventh grade Math Benchmark Test has a KR-20 Value of .86. Edusoft uses the KR-20 reliability formula as it measures internal consistency of test items. The school district states, “An exam with reliability in excess of 0.8 is considered very reliable” (Forsyth County, 2008).

Grade Point Average (GPA)

Many schools on the elementary, middle, high school, and college levels assign letter grades such as A, B, C, D, and F as final course grades. Standard practice is to assign a numerical value such as 4 (A); 3 (B); 2 (C); 1 (D); 0 (F), in order to determine a grade point average (GPA). The total number of points are added and divided by the number of letter grades, which correspond to the number of classes, or the number of credit hours. In the case of credit hours, the numerical point per grade would be multiplied by the number of credit hours to determine quality points or also called honor points. Though GPA is not a testing instrument, it has traditionally been shown to be a consistent predictor of academic performance. Studies have shown that college performance as a freshman correlates to a high school student's GPA (Lounsbury, Fisher, Levy, & Welsh, 2002; Nichols & Levy, 2009).

Procedures Used

Upon approval by the Institutional Review Board of Liberty University and the local school principal, the researcher administered fitness testing according to the guidelines developed by The Cooper Institute referenced in the *FITNESSGRAM®/ ACTIVITYGRAM® Test Administration Manual* (Meredith & Welk, 2007). The researcher collected fitness data, as well as academic performance data. Two other certified physical education teachers also administered fitness tests and collected fitness data. Fitness testing and the benchmark tests are pre-existing components of the participants' physical education and academic curriculum.

The researcher collected and analyzed data for each of the following physical fitness tests: Back-Saver Sit and Reach, body mass index (BMI), Curl-Ups, Progressive Aerobic Capacity Endurance Run (PACER), Push-Ups, and the Trunk Lift. After fitness testing, the researcher recorded and entered the fitness scores in the Fitnessgram® database. Only the researcher and three other certified physical education professionals had access to the Fitnessgram® scores after the data was collected. One fitness test was administered per day for a total of six days. Make up testing was conducted for any participant that missed one or more of the six Fitnessgram® tests.

Benchmark tests for Reading/Language Arts and Math were administered district wide by homeroom teachers during the same period of time fitness testing was conducted. The benchmark tests were administered over a two-day period. Make up testing was also administered for any participant that missed any of the benchmark tests.

Fitness Testing

The six Fitnessgram® tests were administered over a six-day period. After the completion of fitness testing and data input using the Fitnessgram® database, each participant's score on the fitness tests determined the participant's category of being in the Healthy Fitness Zone (HFZ), or "Needs Improvement" for each test. Participants can be categorized as meeting the HFZ, or Needs Improvement for individual fitness tests, or for meeting or not meeting the HFZ for any combination of tests from zero to all six tests.

The Healthy Fitness Zone (HFZ) is determined by Fitnessgram® according to criterion-referenced standards and it is based on the participants' age and gender. The Fitnessgram® software package determines if subjects meet the HFZ, or do not meet the HFZ for BMI based on height and weight. The software will also determine the achievement or non-achievement of the HFZ for each of the individual physical fitness tests. Certified physical education teachers conduct the fitness tests and they enter the scores in the Fitnessgram® database. If the software had not been available to the researcher, Fitnessgram® provides charts listing the HFZ by age and gender for each fitness test. The HFZ for all fitness tests is located are Appendices D & E.

After fitness testing, the researcher categorized the participants as healthy or not healthy, based on their achievement or non-achievement of the Healthy Fitness Zone (HFZ). The first grouping for comparison was participants (n = 71) that achieved the HFZ for all six of the fitness tests, which left a comparison group of participants (n = 206) that did not achieve the HFZ for all six of the fitness tests. Further grouping included participants (*n* = 205) that achieved the HFZ for body mass index (BMI), compared to participants (*n* = 72) that did not achieve the HFZ for BMI. Another category included participants (*n* = 193) that met the HFZ for aerobic capacity evidenced by the Progressive Aerobic Capacity Endurance Run (PACER), and participants that did not achieve (*n* = 87) the HFZ for aerobic capacity. The researcher chose meeting or not meeting the HFZ for BMI and aerobic capacity as sub groups to analyze further, based on the review of the literature found in Chapter Two.

Language Arts/Reading and Math Benchmark Testing With GPA

Benchmark tests were developed by the school district in conjunction with Edusoft, a division of Riverside Publishing, which provides reliability and validity data previously mentioned earlier in this chapter. During the same time as fitness testing, participants were administered the Language Arts/Reading and Math Benchmark Tests over a two day period in their respective homeroom class. With the assistance of the school's data clerk, the researcher collected benchmark data and grade point average (GPA) for all sixth and seventh grade students. The researcher then deleted the students' benchmark scores and GPA's from the spreadsheet if they did not participate in fitness testing.

Data Analysis

Data Organization

Before any academic performance indicators were organized, the researcher used the Fitnessgram® software to build reports displaying groups of students that met the Healthy Fitness Zone (HFZ) for all six fitness tests, the HFZ for BMI, and the HFZ for aerobic capacity. The remaining students did not meet the HFZ for these areas. The researcher used the Fitnessgram® reports to verify that each participant that took part in fitness testing also completed the academic benchmark tests in Language Arts/ Reading and Math. The data was also matched with a current GPA for each student.

Next, the researcher matched the participants that achieved the Healthy Fitness Zone (HFZ) for all six fitness tests with their Language Arts/ Reading and Math Benchmark Test scores and GPA. The researcher then matched the participants that did not achieve the HFZ for all six fitness tests with their benchmark tests and GPA. The researcher used Microsoft Excel to match and sort the data. This procedure was replicated with the groups meeting or not meeting the HFZ for body mass index (BMI), and for the groups meeting or not meeting the HFZ for aerobic capacity, to their respective benchmark scores and GPA. The researcher was then able to begin statistical testing between fitness levels and academic performance levels by comparing the benchmark data and GPA of the various fitness groups that met or did not meet the HFZ.

Statistical Procedures

The researcher used Microsoft Excel and the statistics software program StatCrunch to analyze the data in this quantitative study. Descriptive statistics were used to determine measures of central tendency including mean, minimum and maximum scores, standard deviation, and the percent achieving the Healthy Fitness Zone (HFZ) according to age and gender for each fitness test. Other calculations included measures of central tendency for the Language Arts/Reading and Math Benchmark Tests as well as GPA.

Independent *t*-tests were performed to determine the difference in the means of the academic scores of the healthy and unhealthy fitness groups. The healthy groups met the Healthy Fitness Zone (HFZ) in fitness testing and the unhealthy groups did not. The academic indicators consisted of Language Arts/Reading and Math Benchmark scores as well as grade point average (GPA). Independent *t*-tests were calculated to determine if there was a statistically significant difference at the $p < .05$ level in academic scores between the two fitness level groups.

Research Questions and Hypotheses

Specifically, nine t-tests were calculated and the null hypotheses were tested for the following research questions:

1. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the Healthy Fitness Zone (HFZ) for all six areas of the Fitnessgram®, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

   Null Hypothesis: There will be no significant difference in the Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

2. Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

   Null Hypothesis: There will be no significant difference in the Math Benchmark Test scores for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

3. Will the grade point average (GPA) be significantly different for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the GPA of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

   Null Hypothesis: There will be no significant difference in the GPA for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the GPA of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

4. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the HFZ for body mass index (BMI), compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for BMI?

   Null Hypothesis: There will be no significant difference in Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for BMI, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for BMI.

5. Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for BMI, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for BMI?

   Null Hypothesis: There will be no significant difference in Math Benchmark Test scores for students achieving the HFZ for BMI, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for BMI.

6. Will the GPA be significantly different for students achieving the HFZ for BMI,

compared to the GPA of students that did not achieve the HFZ for BMI?

Null Hypothesis: There will be no significant difference in GPA for students achieving the HFZ for BMI, compared to the GPA of students that did not achieve the HFZ for BMI.

7. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the HFZ for aerobic capacity evidenced by the Progressive Aerobic Capacity Endurance Run (PACER), compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity?

   Null Hypothesis: There will be no significant difference in Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for aerobic capacity, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity.

8. Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for aerobic capacity evidenced by the PACER, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity?

   Null Hypothesis: There will be no significant difference in Math Benchmark Test scores for students achieving the HFZ for aerobic capacity, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity.

9. Will the GPA be significantly different for students achieving the HFZ for aerobic capacity evidenced by the PACER, compared to the GPA of students that did not

achieve the HFZ for aerobic capacity?

Null Hypothesis: There will be no significant difference in the GPA for students achieving the HFZ for aerobic capacity, compared to the GPA of students that did not achieve the HFZ for aerobic capacity.

Summary

Chapter Three outlined the methodology used to perform this quantitative study including detailed descriptions of the participants, instruments, and procedures used. Demographic data for the participants, validity and reliability data for the instruments, as well as procedures for administering the instruments were also explained. Finally, the procedures for conducting the study were detailed. This study examined the differences in academic performance levels between physically fit and physically unfit sixth and seventh grade students. The researcher used the Fitnessgram® battery of physical fitness tests to evaluate the physical fitness levels of the participants, as well as the participants' academic performance. Academic performance was evaluated by using the school district's academic benchmark tests and students' grade point average to address the research questions presented in Chapter One. The next chapter will detail the results of the study based on statistical analysis.

CHAPTER 4: RESEARCH FINDINGS

As stated in the introductory chapter, the purpose of this study was to examine the differences in academic performance levels of physically fit, and physically unfit sixth and seventh grade students. The researcher used the Fitnessgram® battery of physical fitness tests to evaluate the physical fitness levels of the participants, and the school district's academic Reading/Language Arts and Math Benchmark Tests to evaluate the levels of academic performance. The researcher also evaluated grade point average as an academic indicator.

The population for this study was sixth and seventh grade students, while the sample pool was selected from students enrolled in organized physical education classes. The sample pool consisted of 155 sixth grade students and 152 seventh grade students from eight, pre-existing physical education classes. The study occurred during the second grading period of the school year. The participants completed the Fitnessgram® battery of tests, and they completed the district wide academic benchmark tests. The sample is believed to be representative of the sixth and seventh grade population of the school district. The research questions investigated in this study were:

1. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the Healthy Fitness Zone (HFZ) for all six areas of the Fitnessgram®, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®?
   Null Hypothesis: There will be no significant difference in the Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for all six areas

of the Fitnessgram®, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

2. Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

   Null Hypothesis: There will be no significant difference in the Math Benchmark Test scores for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

3. Will the grade point average (GPA) be significantly different for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the GPA of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

   Null Hypothesis: There will be no significant difference in the GPA for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the GPA of students that did not achieve the HFZ for all six areas of the Fitnessgram®.

4. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the HFZ for body mass index (BMI), compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for BMI?

   Null Hypothesis: There will be no significant difference in Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for BMI, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for BMI.

5. Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for BMI, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for BMI?

   Null Hypothesis: There will be no significant difference in Math Benchmark Test scores for students achieving the HFZ for BMI, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for BMI.

6. Will the GPA be significantly different for students achieving the HFZ for BMI, compared to the GPA of students that did not achieve the HFZ for BMI?

   Null Hypothesis: There will be no significant difference in GPA for students achieving the HFZ for BMI, compared to the GPA of students that did not achieve the HFZ for BMI.

7. Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the HFZ for aerobic capacity evidenced by the Progressive Aerobic Capacity Endurance Run (PACER), compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity?

   Null Hypothesis: There will be no significant difference in Language Arts/ Reading Benchmark Test scores for students achieving the HFZ for aerobic capacity, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity.

8. Will the Math Benchmark Test scores be significantly different for students

achieving the HFZ for aerobic capacity evidenced by the PACER, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity?

Null Hypothesis: There will be no significant difference in Math Benchmark Test scores for students achieving the HFZ for aerobic capacity, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity.

9. Will the GPA be significantly different for students achieving the HFZ for aerobic capacity evidenced by the PACER, compared to the GPA of students that did not achieve the HFZ for aerobic capacity?

   Null Hypothesis: There will be no significant difference in the GPA for students achieving the HFZ for aerobic capacity, compared to the GPA of students that did not achieve the HFZ for aerobic capacity.

Descriptive Information

For this study, the population at the testing site consisted of 259 sixth graders and 245 seventh graders, while the sample pool consisted of 155 sixth grade students and 152 seventh students. The researcher compared the Language Arts/Reading and Math Benchmark Tests scores, as well as grade point average (GPA), for students that reached the Healthy Fitness Zone (HFZ) for all six Fitnessgram® tests, and those that did not. The six Fitnessgram® tests include assessments for upper body strength, abdominal strength, flexibility, aerobic capacity, and body composition. Based on the previous research discussed in Chapter Two, the researcher also compared the same academic benchmark test scores for participants that reached the HFZ, to the scores of those that did not reach the HFZ, for aerobic capacity and body composition.

Concerning the sixth grade participants, 142 completed all six of the Fitnessgram® tests, and 23% (*n* = 32) reached the Healthy Fitness Zone for all six tests. There were 149 sixth grade students that were measured for body composition, while 150 students completed the Progressive Aerobic Capacity Endurance Run (PACER). Of the sixth grade participants, 75% (*n* = 112) reached the HFZ for body mass index (BMI), and 79% (*n* = 119) reached the HFZ for the PACER (Table 7).

Table 7

Sixth Grade Fitnessgram Data

Grade	Test	# Completed	% Reached HFZ	# Reached HFZ
6	All six tests	142	23	32
6	BMI	149	75	112
6	PACER	150	79	119

Table 8

Seventh Grade Fitnessgram Data

Grade	Test	# Completed	% Reached HFZ	# Reached HFZ
7	All six tests	136	34	46
7	BMI	142	80	114
7	PACER	142	65	92

For the seventh grade participants, 136 completed all six of the Fitnessgram® tests, and 34% (*n* = 46) reached the Healthy Fitness Zone for all six tests. There were

142 seventh grade students that were measured for body composition, while 142 completed the PACER test. Of the seventh grade participants, 80% (*n* = 114) reached the HFZ for BMI, and 65% (*n* = 92) reached the HFZ for the PACER (Table 8).

Results

The following tables display the summary data including measures of central tendency, and the *t*-tests results based on the research questions listed earlier in this chapter. Each research question pertains to the academic comparison groups of those that passed (achieved the HFZ), or did not pass (did not achieve the HFZ) each fitness test. Each research question is addressed as follows:

Research Question #1: Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the Healthy Fitness Zone (HFZ) for all six areas of the Fitnessgram®, compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

A total of 278 students completed all six of the Fitnessgram® tests, which includes 142 sixth grade students and 136 seventh grade students. There were 269 students that also had a matching Language Arts/Reading Benchmark Test score. The Language Arts/Reading Benchmark Test results for the groups that met the HFZ for all six Fitnessgram® tests, and those that did not meet the HFZ for all six tests are listed in Table 9. Table 10 lists the results of the *t*-test for the same comparison groups.

At the probability level of $p < .05$, $df = 139.15$, the t-stat value of 2.59 is larger than the table value of 1.98. This indicates that the difference in Language Arts/Reading Benchmark performance between the two groups is statistically significant, resulting in the rejection of the null hypothesis. The participants that met the HFZ for all six

Table 9

Language Arts/Reading Benchmark Test and All Six Fitnessgram Test Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	69	75.60	291.77	17.08	2.06
Did Not Meet HFZ	200	69.21	412.20	20.30	1.44

Table 10

Language Arts/Reading Benchmark and All Six Fitnessgram t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	6.49	2.51	139.15	2.59	0.01

Note. μ_1 = Met HFZ; μ_2 = Did not meet the HFZ.

Fitnessgram® tests had statistically significant higher scores on the Language Arts/Reading Benchmark Test, compared to the participants that did not meet the HFZ on all six Fitnessgram® tests.

Research Question #2: Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

A total of 278 students completed all six of the Fitnessgram® tests, which includes 142 sixth grade students and 136 seventh grade students. There were 271 students that also had a matching Math Benchmark Test score. The Math Benchmark Test results for the groups that met the HFZ for all six Fitnessgram® tests, and those that did not meet the HFZ for all six tests are listed in Table 11. Table 12 lists the results of the *t*-test for the same comparison groups.

Table 11

Math Benchmark Test and All Six Fitnessgram Tests Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	71	78.75	185.16	13.61	1.61
Did not meet HFZ	200	71.22	345.57	18.59	1.31

Table 12

Math Benchmark Test and All Six Fitnessgram t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	7.52	2.08	167.60	3.61	0.0004

Note. μ_1 = Met HFZ, μ_2 = Did not meet the HFZ.

At the probability level of $p < .05$, $df = 167.60$, the t-stat value of 3.61 is larger than the table value of 1.96. This indicates that the difference in Math Benchmark performance between the two groups is statistically significant, resulting in the rejection of the null hypothesis. The participants that met the HFZ for all six Fitnessgram® tests had statistically significant higher scores on the Math Benchmark Test, compared to the participants that did not meet the HFZ on all six Fitnessgram® tests.

Research Question #3: Will the grade point average (GPA) be significantly different for students achieving the HFZ for all six areas of the Fitnessgram®, compared to the GPA of students that did not achieve the HFZ for all six areas of the Fitnessgram®?

A total of 278 students completed all six of the Fitnessgram® tests, which includes 142 sixth grade students and 136 seventh grade students. There were 275 students that also had a matching grade point average (GPA). The GPA results for the groups that met the HFZ for all six Fitnessgram® tests, and those that did not meet the HFZ for all six tests are listed in Table 13. The results of the *t*-test for the same comparison groups are located in Table 14.

At the probability level of $p < .05$, $df = 150.62$, the *t*-stat value of 2.44 is larger than the table value of 1.96. This indicates that the difference in GPA between the two groups is statistically significant, resulting in the rejection of the null hypothesis. The participants that met the HFZ for all six Fitnessgram® tests had statistically significant higher GPA's, compared to the participants that did not meet the HFZ on all six Fitnessgram® tests.

Table 13

Grade Point Average and All Six Fitnessgram Tests Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	71	3.46	0.23	0.48	0.06
Did not meet HFZ	204	3.29	0.36	0.60	0.04

Table 14

Grade Point Average All Six Fitnessgram t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	0.17	0.07	150.62	2.44	0.02

Note. μ_1 = Met HFZ, μ_2 = Did not meet the HFZ.

Research Question #4: Will the Language Arts/ Reading Benchmark Test scores be significantly different for students achieving the HFZ for body mass index (BMI), compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for BMI?

A total of 291 students completed the test for body composition, which determines Body Mass Index (BMI), including 149 sixth grade students and 142 seventh grade students. There were 267 students that also had a matching Language Arts/ Reading Benchmark Test score. The Language Arts/ Reading Benchmark Test results for the groups that met the HFZ for BMI and those that did not meet the HFZ for BMI tests are listed in Table 15. The results of the *t*-test for the same comparison groups are located in Table 16.

Table 15

Language Arts/Reading Benchmark Test and BMI Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	197	71.69	378.22	19.45	1.39
Did not meet HFZ	70	68.21	416.34	20.41	2.44

Table 16

Language Arts/Reading Benchmark Test and All Six Fitnessgram t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	3.47	2.80	116.46	1.24	0.22

Note. μ_1 = Met HFZ, μ_2 = Did not meet the HFZ.

At the probability level of $p < .05$, $df = 116.46$, the *t*-stat value of 1.24 is smaller than the table value of 1.98. This indicates that the difference in Language Arts/Reading Benchmark performance between the two groups is not statistically significant, resulting in the retention of the null hypothesis. Even though the participants that met the HFZ for BMI had a higher mean score on the Language Arts/Reading Benchmark Test compared to the mean score of those that did not meet the HFZ, the mean difference was not statistically significant.

Research Question #5: Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for BMI, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for BMI?

A total of 291 students completed the test for body composition, which determines body mass index (BMI), including 149 sixth grade students and 142 seventh grade students. There were 269 students that also had a matching Math Benchmark Test score. The Math Benchmark Test results for the groups that met the HFZ for BMI and those that did not meet the HFZ for BMI are listed in Table 17. The results of the *t*-test for the same comparison groups are located in Table 18.

At the probability level of $p < .05$, $df = 116.62$, the *t*-stat value of 1.46 is smaller than the table value of 1.98. This indicates that the difference in Math Benchmark performance between the two groups is not statistically significant, resulting in the retention of the null hypothesis. Even though the participants that met the HFZ for BMI had a higher mean score on the Math Benchmark Test compared to the mean score of those that did not meet the HFZ, the mean difference was not statistically significant.

Research Question #6: Will the GPA be significantly different for students achieving the HFZ for BMI, compared to the GPA of students that did not achieve the HFZ for BMI?

A total of 291 students completed the test for body composition, which

Table 17

Math Benchmark Test and BMI Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	200	74.07	310.40	17.61	1.25
Did not meet HFZ	69	70.43	320.31	17.90	2.15

Table 18

Math Benchmark Test and BMI t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	3.63	2.49	116.62	1.45	0.15

Note. μ_1 = Met HFZ, μ_2 = Did not meet the HFZ.

determines body mass index (BMI), including 149 sixth grade students and 142 seventh grade students. There were 273 students that also had a matching GPA. The GPA results for the groups that met the HFZ for BMI and those that did not meet the HFZ for BMI, are listed in Table 19. The results of the *t*-test for the same comparison groups are located in Table 20.

At the probability level of $p < .05$, $df = 120.10$, the *t*-stat value of 1.38 is smaller than the table value of 1.98. This indicates that the difference in GPA between the two groups is not statistically significant, resulting in the retention of the null hypothesis. Even though the participants that met the HFZ for BMI had a higher mean GPA compared to the mean GPA of those that did not meet the HFZ, the mean difference was not statistically significant.

Research Question #7: Will the Language Arts/ Reading Benchmark Test scores

Table 19

Grade Point Average and BMI Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	202	3.36	0.33	0.57	0.04
Did not meet HFZ	71	3.25	0.34	0.59	0.07

Table 20

Grade Point Average and BMI t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	0.11	0.08	120.02	1.38	0.17

Note. μ_1 = Met HFZ, μ_2 = Did not meet the HFZ.

be significantly different for students achieving the HFZ for aerobic capacity evidenced by the Progressive Aerobic Capacity Endurance Run, (PACER), compared to the Language Arts/ Reading Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity?

A total of 292 students completed the PACER test, which measures aerobic capacity, including 150 sixth grade students and 142 seventh grade students. There were 270 students that also had a matching Language Arts/ Reading Benchmark Test score. The Language Arts/ Reading Benchmark Test results for the groups that met the HFZ for the PACER, and those that did not meet the HFZ for the PACER are listed in Table 21. The results of the *t*-test for the same comparison groups are located in Table 22.

At the probability level of $p < .05$, $df = 146.99$, the *t*-stat value of 3.88 is larger than the table value of 1.96. This indicates that the difference in Language Arts/Reading

Table 21

Language Arts/Reading Benchmark Test and the PACER Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	186	74.10	344.25	18.55	1.36
Did not meet HFZ	84	63.95	418.72	20.46	2.32

Table 22

Language Arts/Reading and the PACER t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	10.15	2.61	146.99	3.88	0.0002

Note. μ_1 = Met HFZ, μ_2 = Did not meet the HFZ.

Benchmark performance between the two groups is statistically significant, resulting in the rejection of the null hypothesis. The participants that met the HFZ for aerobic capacity on the PACER test had statistically significant higher scores on the Language Arts/Reading Test, compared to the participants that did not meet the HFZ on the PACER test.

Research Question #8: Will the Math Benchmark Test scores be significantly different for students achieving the HFZ for aerobic capacity evidenced by the PACER, compared to the Math Benchmark Test scores of students that did not achieve the HFZ for aerobic capacity?

A total of 292 students completed the PACER, which measures aerobic capacity, including 150 sixth grade students and 142 seventh grade students. There were 272 students that also had a matching Math Benchmark Test score. The Math Benchmark

Test results for the groups that met the HFZ for the PACER and those that did not meet the HFZ for the PACER are listed in Table 23. The results of the *t*-test for the same comparison groups are located in Table 24.

At the probability level of $p < .05$, $df = 133.08$, the *t*-stat value of 4.19 is larger than the table value of 1.96. This indicates that the difference in Math Benchmark performance between the two groups is statistically significant, resulting in the rejection of the null hypothesis. The participants that met the HFZ for BMI had statistically significant higher scores on the Math Benchmark Test, compared to the participants that did not meet the HFZ for BMI.

Research Question #9: Will the GPA be significantly different for students achieving the HFZ for aerobic capacity evidenced by the PACER, compared to the GPA of students that did not achieve the HFZ for aerobic capacity?

Table 23

Math Benchmark Test and the PACER Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	191	76.16	266.28	16.31	1.18
Did not meet HFZ	81	66.09	356.53	18.88	2.10

Table 24

Math Benchmark Test and the PACER t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	10.08	2.41	133.08	4.18	< 0.0001

Note. μ_1 = Met HFZ, μ_2 = Did not meet the HFZ.

A total of 292 students completed the PACER test, which measures aerobic capacity, including 150 sixth grade students and 142 seventh grade students. There were 276 students also had a matching GPA. The GPA results for the groups that met the HFZ for the PACER test, and those that did not meet the HFZ for the PACER test are listed in Table 25. The results of the *t*-test for the same comparison groups are located in Table 26.

At the probability level of $p < .05$, $df = 172.66$, the *t*-stat value of 1.89 is smaller than the table value of 1.96. This indicates that the difference in GPA between the two groups is not statistically significant, resulting in the retention of the null hypothesis. Even though the participants that met the HFZ on the PACER test had higher GPA's compared to the GPA's of participants that did not meet the HFZ on the PACER test, the difference was not statistically significant.

Table 25

Grade Point Average and the PACER Results

Group	*n*	Mean	Variance	*SD*	*SE*
Met HFZ	189	3.38	0.34	0.58	0.04
Did not meet HFZ	87	3.24	0.31	0.56	0.06

Table 26

Grade Point Average and the PACER t-Test Results

Difference	Mean	*SE*	*df*	*t*-stat	*p* value
$\mu_1 - \mu_2$	0.14	0.07	172.66	1.89	0.06

Note: μ_1 = Met HFZ, μ_2 = Did not meet the HFZ.

Summary

The statistical analysis of the nine research questions has resulted in the rejection of the null hypothesis in five areas. The null hypothesis was rejected and a statistical difference was discovered when comparing Language Arts/Reading Benchmark Test scores, Math Benchmark Test scores, as well as the Grade Point Average (GPA) of participants that achieved the Healthy Fitness Zone (HFZ) for all six tests in the Fitnessgram® battery of assessments, and those that did not achieve the HFZ. The null hypothesis was also rejected and a statistical difference was discovered when comparing Language Arts/Reading Benchmark Test scores and Math Benchmark Test scores of the participants that achieved the HFZ on the PACER, and those that did not achieve the HFZ.

The null hypothesis was retained when comparing Language Arts/Reading Benchmark Test scores, Math Benchmark Test scores, as well as GPA for participants that achieved the HFZ for body mass index (BMI), and those that did not achieve the HFZ. Moreover, the null hypothesis was retained when comparing GPA of participants that achieved the HFZ on the PACER, and those that did not achieve the HFZ. A thorough discussion of the preceding results is located in the next chapter.

CHAPTER 5: SUMMARY AND DISCUSSION

This chapter provides a summary of the study including the problem statement, a review of the methodology, and a summary of the results. There will also be a discussion on the implications of the study, limitations of the study, and recommendations for future research.

Problem Statement

The research problem was to examine the difference in academic performance levels between physically fit and unfit sixth and seventh grade students. Fitness levels were determined by assessing participants on the Fitnessgram® battery of physical fitness tests. Academic performance was assessed by administering the school district's academic benchmark tests. Grade point average was also used as an academic indicator. The difference between physical fitness and academic performance levels, or cognition levels, is related to the theories surrounding the framework of psychological health. The researcher used the theoretical framework that healthy children are superior learners as a basis for this study.

Review of the Methodology

The researcher chose to use a sample consisting of sixth and seventh grade students in a middle school located in the Southeastern United States. All students in this school are administered the Fitnessgram® assessment at least once per year. Some students participate in fitness testing up to four times a year if they are enrolled in physical education class during all four grading periods. The participants ranged in age from 10 to 14 years old, and they completed at least a portion of the Fitnessgram® battery of tests. They also completed academic benchmark tests. A randomized sample was not feasible as students were scheduled into physical education classes by the school's administration. This scheduling issue also did not lend the research to be a true experimental study.

The participants completed a variety of physical fitness tests for the Fitnessgram® program. The fitness tests included the Back-Saver Sit and Reach Test, Curl-Up Test, Push-Up Test, Trunk Lift Test, and the Progressive Aerobic Capacity Endurance Run. The participants were also evaluated for body composition by determining their body mass index. To measure academic performance, the participants were assessed on the Language Arts/Reading Benchmark Test and the Math Benchmark Test. Grade point average was also used to assess academic performance. Reliability and validity information for all of these instruments are discussed in Chapter Three.

The researcher administered fitness tests according to the guidelines developed by The Cooper Institute, referenced in the *FITNESSGRAM®/ ACTIVITYGRAM® Test Administration Manual* (Meredith & Welk, 2007). With the assistance of two certified physical education teachers, the researcher collected fitness data and academic performance data. Fitness testing and the benchmark tests are pre-existing components of the participants' physical education and academic curriculum. The researcher collected and analyzed data for each of the following physical fitness tests: Back-Saver Sit and Reach, body mass index (BMI), Curl-Ups, Push-Ups Trunk Lift, and the Progressive Aerobic Capacity Endurance Run (PACER). After fitness testing, the researcher entered the fitness scores in the Fitnessgram® database. One fitness test was administered per day for six days, and make-up testing was conducted. Benchmark tests for Language Arts/Reading and Math and were administered district wide by homeroom teachers during this same time.

After fitness testing and data entry of the fitness scores, the participants were categorized as meeting the Healthy Fitness Zone (HFZ), or not meeting the HFZ, for each individual fitness test, and other combination of tests. The Cooper Institute establishes the HFZ according to research and criterion-referenced standards. The standards are described as optimal health standards based on the participants' age and gender. The researcher chose "Meets" or "Did Not Meet the HFZ" for body mass index and aerobic capacity as sub-groups for further analysis. The researcher chose these sub-groups as the groups are mentioned routinely in the professional literature detailed in Chapter Two. After fitness testing data was collected, the researcher collected academic data.

With the assistance of the school's data clerk, the researcher collected benchmark data and grade point averages for all sixth and seventh grade students that participated in fitness testing. Before any academic performance indicators were organized, the researcher used the Fitnessgram® software to build reports displaying groups of students that met the Healthy Fitness Zone (HFZ) for all six fitness tests, for body mass index, and for aerobic capacity. The researcher then matched the participants' fitness scores that achieved the HFZ for all six fitness tests, body composition, and aerobic capacity with their Language Arts /Reading Benchmark Test and Math Benchmark Test scores, as well as their GPA.

Descriptive statistics and independent *t*-tests were performed to determine the difference in the means of the academic scores of the healthy and unhealthy fitness groups. The healthy group met the Healthy Fitness Zone (HFZ) in fitness testing whereas the unhealthy groups did not. The academic indicators consisted of Language Arts/Reading Benchmark and Math Benchmark Tests scores as well as GPA. Independent *t*-tests were used to determine if there was a statistically significant difference at the $p < .05$ level in academic scores between the two fitness level groups.

The researcher designed the study by measuring the fitness levels of students at a fixed point in time and comparing physically fit and unfit students' academic scores, as opposed to a more linear approach. Research up to this point has focused on the improvement or decline of academic scores over a period of time in relation to physical fitness increases or decreases. This seems plausible, however in a school setting, the school schedule and physical education curriculum do not make correlation research reasonable. It is extremely difficult to raise fitness levels or academic performance levels in a grading period of four to nine weeks. Therefore it is difficult to determine if there is a relationship under these conditions.

Review of the Results

The statistical analysis of the nine research questions resulted in the rejection of the null hypothesis in five areas. The null hypothesis was rejected and a significant statistical difference was discovered when comparing Language Arts/Reading Benchmark Test scores, Math Benchmark Test scores, and grade point average (GPA) of participants that achieved the Healthy Fitness Zone (HFZ) for all six tests of the Fitnessgram®, and those that did not achieve the HFZ for all six tests. The middle school students that met the HFZ on all six fitness tests outperformed the participants that did not meet the HFZ on all six tests in the areas of language arts and reading skills. The healthier students also had higher classroom grades as evidenced by their GPA.

The null hypothesis was also rejected and a significant statistical difference was discovered when comparing Language Arts/Reading Benchmark Test scores and Math Benchmark Test scores of the participants that achieved the HFZ on the Progressive Aerobic Capacity Endurance Run (PACER), and those that did not achieve the HFZ on the PACER. The results further suggest that sixth and seventh grade students considered to be healthy for aerobic capacity evidenced by the PACER also perform at high academic levels compared to students that are not aerobically healthy. A high level of aerobic capacity is a strong indicator of overall physical fitness. Aerobic activity increases aerobic capacity, and has shown to increase blood flow and oxygen to the brain, resulting in increased brain activity. The results of this study are in line with research (Hall, 2007; Jensen, 1998; Lambourne, 2006; Shephard, 1997; Sigman, 2008; & Taras, 2005), when discussing cardiovascular fitness and academic performance.

There was no significant statistical difference discovered when comparing Language Arts/Reading Benchmark Test scores, Math Benchmark Test scores, or grade point average for the participants that achieved the Healthy Fitness Zone (HFZ) for body mass index (BMI), and those that did not achieve the HFZ for BMI. The discussion of the validity of BMI is common as the BMI value only takes into account one's height and weight. The BMI value does not reflect one's body fat percentage or the percentage of muscle within a subject. A muscular subject may weigh more than a subject with a higher body fat percentage; therefore, they will also have a higher BMI. However, the subject with the higher muscle percentage is considered to be in an improved state of physical health. Generally, middle school students are not overly muscular; therefore the BMI value is considered an accurate indicator for body composition. The relationship between body composition, especially body fat percentage, and physical fitness levels of adolescents has not been examined in detail. A more accurate picture of body composition can be achieved through skin-fold tests or hydrostatic weighing; however these methods are either invasive or expensive and not conducive to the school setting.

Moreover, the null hypothesis was retained when comparing grade point average of participants that achieved the Healthy Fitness Zone (HFZ) on the aerobic test, and those that did not achieve the HFZ on the aerobic test. This result is contradictory to the rejection of the null hypothesis concerning the comparison of means between Language Arts/Reading and Math Benchmark Tests results. A plausible reason can be attributed to students taking varying levels of Language Arts, Reading, and Math courses, while everyone took the same benchmark test. Since the Fitnessgram® program takes into account an individual's age and gender when determining the HFZ for each fitness test, the researcher chose not to further delineate the groups for statistical analysis based on age or gender.

Overall, the participants in this study were shown to be healthy in the areas of body composition and aerobic capacity as 78% achieved the Healthy Fitness Zone (HFZ) for body mass index (BMI), and 72% achieved the HFZ on the aerobic test. These results are similar to a study in the testing site's same state that resulted in 70% of students achieving the HFZ for BMI. However, on the state level, only 48% of students achieved the HFZ for aerobic capacity (PCHG, 2007). A similar study by the California Department of Education (2007), reported that 64% of seventh graders achieved the HFZ for aerobic capacity.

Discussion

Implications of the Study

The results of this study and the results from previous research have demonstrated a connection between physical fitness and academic performance. The implications seem logical in that physically fit students should perform at high academic levels under the pretense that healthy children are better learners. Overall health is not just a result of one's physical fitness level. Health status is also result of genetic construct, nutrition, demographics, lifestyle, and socio-economic status. There is a direct correlation between physical fitness and the type and amount one spends doing physical activity (American Heart, 2005; Faigenbaum, 2005; Satcher, 2005; Strong et al., 2005; NASPE, 2006;U.S. Surgeon General, 1996). Physical fitness and overall health status play an important role in a child's academic state and performance in school. The implications for educators include a consideration of all aspects of a child's life including their physical, mental, and spiritual well being.

Physically fit children tend to receive proper nutrition and parental support, and they are involved in a wide array of extracurricular activities including, but not limited to team and individual sports. With the understanding that physical activity and physical fitness contribute to learning, the attitude of school personnel should be one of support for physical education classes and recess. Educators should also encourage students to participate in school and community sport offerings. A well-rounded child is one that is balanced in academic areas, but also in their mental and physical health. Optimal health is characterized by mental, physical, and spiritual well being. Physically fit children tend to enjoy physical activity and participate in fitness testing with a personal challenge to perform their best. This attitude is also extended to their academic pursuits, which is reflected in standardized test scores, as well as course grades.

This study has revealed an association between physical fitness and academic performance when one is considered healthy in multiple areas including flexibility, muscular strength, muscular endurance, body composition, and especially aerobic capacity. A secular perspective on the subject of physical fitness focuses on increased time spent in physical education, recess, individual exercise, or scholastic sports. Coaches and physical education instructors increase the amount of physical demands on athletes to overload the muscles and cardiovascular system, with the purpose of increasing muscular strength, endurance, and aerobic capacity. However, even though increased intellectual capacity is not the goal of most coaches or physical education instructors, a side benefit of these physical training principles may be an increase of academic scores.

This increase in physical activity concentrates on two aspects of the human character including the mind and body. It is logical to presume that increasing time for physical activity also increases the level of personal fitness as the body becomes stronger and healthier. However, the spiritual aspect is not addressed from a secular perspective. The spiritual aspect completes the human character and is found when one teaches, and has an understanding of physical fitness based on a Biblical worldview. It is important to consider levels of physical fitness and academic performance from a physiological perspective and the changes that occur in the body from safe and proper training principles. When one can integrate physical training principles with a Biblical perspective, the opportunities to mold and mentor the complete person comes forth.

The Bible states, "Do you not know that your body is a temple of the Holy Spirit, who is in you, whom you have received from God?" (1 Corinthians 6:19, New International Version). Teachers and coaches can implement aspects of science and spirituality in one model rather than separating the two domains. We are to be good stewards of our bodies as they are gifts from God. This includes taking care to exercise regularly, eat properly, and continue to gain academic knowledge throughout one's lifetime. Transferring this information and understanding to students is a challenge, especially in the public school setting. However, this challenge is one that should be accepted and taken seriously. My goals as a teacher with a Biblical worldview are to link the aspects of the physical, mental, and spiritual domains. This includes being a positive male role model with high moral character and ethical values. This also includes being an exemplar for physical fitness, and modeling compassion and concern for students and athletes in all areas of their lives, not just their level of physical performance. The aspects surrounding physical performance will fade at life's end; however, the spiritual implications will live through all eternity.

Implications for Practice

School administrators, parents, students, general education teachers, and physical education teachers can benefit greatly when they understand the value of physical fitness as it relates to academic performance. This study has shown and is supported by previous research that physically fit children out perform less fit children on standardized tests. This level of performance has been demonstrated when testing for overall fitness, as in achieving the Healthy Fitness Zone (HFZ) for all of the Fitnessgram® tests, and for individual assessments such as tests for aerobic capacity. Previous research has focused on aerobic exercise and its immediate effects on learning and cognition. The researcher believes that the knowledge gained in this study and from previous research supports the theory that aerobic capacity is one of the most reliable predictors of overall physical fitness.

Aerobic exercise must be regularly practiced for improvements to be seen in cardiorespiratory endurance and capacity. Special activities can be planned to promote aerobic exercise such as fun runs and running clubs. Some students may choose to participate in aerobic focused school sponsored sports such as track and field or cross-country. However, physical education teachers have the task of providing meaningful and appropriate activities in physical education classes for the majority of the students in a school. Cardiorespiratory endurance and capacity can be achieved through traditional activities such as jogging laps, one-half mile and mile runs, and organized sprints. Traditional aerobic exercise are physiological sound, however to keep student interest and motivations high, activities must be varied and enjoyable. Students can achieve an aerobic workout through relay races, the Progressive Aerobic Capacity endurance Run (PACER), timed run/walks (jog one minute/walk one minute), fitness focus games involving forms of tag, and modified traditional team sports. These types of activities will help students enjoy and appreciate strenuous exercise.

The results of this study have led the researcher to implement a more varied approach in his own physical education classes to achieve aerobic fitness and to promote overall physical fitness. The focus has shifted away from traditional team sports to an increased focus aerobic fitness and grade appropriate strength training. One day a week, the physical education lesson is devoted solely to aerobic fitness, with planned activities such as a mile run, timed run/walks, or the Progressive Aerobic Capacity Endurance Run (PACER). Two days a week, students participate in an activity called Fitness Fair. The Fitness Fair activity starts with a warm up period, and then students begin walking around the gym for one to two minutes. The teacher plays music and the students begin jogging at a steady pace of their own comfort level. The jog lasts between one and two minutes. When the music stops, the students will participate in an exercise for 30 seconds. There are signs designating various exercises stationed around the gym for students to do, depending on which sign they are in front of when the music stops. As an alternative, teachers will allow one student to select a card designating an exercise for everyone in the class to do at the same time.

Typically, Fitness Fair lasts for approximately 15 to 20 minutes. During this time, students are jogging for approximately 10 to 15 minutes, and doing exercises the remainder of the time. Exercises include items from the Fitnessgram® assessment such as various types of push-ups, curl-ups, and other age appropriate exercises. This varied activity allows students to participate in aerobic and strength training exercises in a non-traditional format. Appropriate music and exercising with fellow classmates makes the activity more enjoyable for the students.

Enjoyable activities in physical education are beneficial to students. However, because of the limited time in physical education classes, students cannot achieve the Surgeon General's recommended 60 minutes of daily moderate to vigorous physical activity in physical education class alone. Student support is needed from parents, school administrators, and general education teachers as more offerings for physical activity are needed on a daily basis. These offerings are beneficial even if they are only in 10 or 15-

minute intervals.

Action should be taken to ensure that every student from kindergarten through high school receives sixty minutes of physical activity per day. For this to happen, curriculum mandates and educational policies must adapt to our changing and increasing sedentary society. High school curricula should include four years of physical education and physical education should be a graduation requirement. Education budgets must be adjusted to increase certified physical education instructors and to improve and add facilities conducive to physical activity. More physical activity choices need to be implemented to include students that do not play for a school sponsored athletic team, and physical fitness should be on the same level academics. Physical fitness assessments should be administered regularly to reflect the high importance of physical fitness and activity. Even with more activity choices, students must take the initiative to participate in activities at an intense enough level to receive cardiorespiratory benefits. Even more importantly, students should develop intrinsic motivation to participate in physical activity after their adolescence years and their transition into young adulthood.

Students need various levels of support from school personnel, peers, and parents to develop an appreciation for moderate and vigorous exercise. Former Surgeon General Satcher (2005) offers suggestions for schools to encourage healthier lifestyles. The suggestions include forming a health advisory council, a school wellness policy, physical activity at school, nutrition education, and teacher and staff exercise opportunities. These suggestions can be implemented in all classes outside of physical education and the efforts have shown to increase math scores and physical fitness levels (Sallis et al., 1999; Shephard, 1997). The recommendations from Satcher (2005) take place outside of physical education classes and sports. These suggestions allow school personnel to become involved with students in a different role other than the relationship of teacher and student. Positive relationships aid trust, and trust in an adult that genuinely cares for a student's well being, helps students and athletes understand and reach their full potential on the field and in the classroom.

Limitations

This study was conducted to determine if there is a significant statistical difference in the academic performance levels of physically fit and unfit students. To obtain scores on academic tests and fitness tests, the researcher was dependent on sixth and seventh students giving their best effort, especially on the physical fitness tests. With this knowledge in mind, the researcher chose not to include eighth grade students, as informal observations in the past have concluded that eighth grade students do not consistently give their best effort on fitness tests. The researcher controlled for biased results as he conducted fitness testing and collected fitness scores based on the specific instructions found in the *FITNESSGRAM / ACTIVITYGRAM Reference Guide* (Meredith & Welk, 2008.) The researcher collected fitness data for approximately one fourth of the participants, and two other physical education professionals collected fitness data for the remaining students. Since the Healthy Fitness Zone (HFZ) for each fitness test is based on age and gender, the researcher did not review the ages of the participants as he administered the fitness tests. This step assured that the researcher did not have any bias as he did not encourage students to reach a certain level on each fitness test. The researcher did not administer the tests used to assess academic performance.

Informal observations during fitness testing concluded that the sixth and seventh grade students were giving their best effort. Many students will stop the physical fitness test at the point of a passing score rather than the point of physical exhaustion. This knowledge led the researcher to use groupings of achieving the Healthy Fitness Zone (HFZ), or not achieving the HFZ, as opposed to raw scores. For example, the HFZ for a 13-year-old male on the Progressive Aerobic Capacity Endurance Run (PACER) is 41 to 83 laps. This is a wide range with 41 laps being the minimum amount to achieve the HFZ for aerobic capacity, while 83 laps is the upper limit of the HFZ. Students can score above the HFZ. When comparing two different 13-year-old male's scores, a student with a 45 on the PACER and one with a 75 both considered healthy. Any score below a 41 needs improvement in the area of aerobic capacity. The student that scored a 45 on the PACER very well could have completed more laps, but chose not to because the student scored in the HFZ. This example must be kept in mind with the other five fitness tests as well.

The researcher chose to compare the academic sores of the two fitness groups based on if they reached the Healthy Fitness Zone (HFZ) or not on all six fitness tests. Further statistical analysis was conducted for body mass index and aerobic capacity. Moreover, the researcher consciously chose not to conduct individual statistical testing on achieving the HFZ or not for the Push-up Test, Curl-up Test, or the Trunk Lift Test. Previous research detailed in Chapter Two, did not support further examination of these fitness tests. However, this may be an area for further investigation considering the connections between the amount of muscle mass and physical fitness level, compared with academic levels. The research also supports further investigation of the connection between body composition and aerobic capacity compared to academic performance.

The sample used in this study is similar to the population of students in the school district where the research was conducted. Access to middle school students' scores is limited; therefore the researcher used subjects that that took part in fitness testing and academic testing during the same period. The results can be generalized in this school district, and to some extent to a larger region. However, the demographics of the country vary considerably when considering race, ethnicity, and socio-economic status. This is also true for gender as there are considerably less female students enrolled in physical education classes at the testing site. However, data from previous studies in California (2005, 2007) and the same state as the testing site, revealed similar results when discussing the physical fitness status of 10 to 14 year olds. For a truer picture of the connection between the differences in academic levels of physically fit and physically unfit children, studies including subjects from each state and demographic should be considered.

Recommendations for Further Research

The research in this study is meaningful and applicable to students, parents, and school personnel as it examined sixth and seventh grade students' fitness levels and academic performance. However, the researcher suggests further studies involving older high school students, especially those that do not participate in school sports or regular physical activity. As students get older, the percentage of older students that take part in any physical activity dwindles dramatically. Research could determine further connections between academic performance and fitness levels of older students, as well as the types and amounts of physical activity in which they are involved. The results could further promote the continuation of physical activity, especially as students age.

Other beneficial research may include true experimental studies concerning the benefits of aerobic exercise and the relationship to standardized test scores. However, in an experimental design, it would be difficult test a student on a maximum-effort physical fitness test, and then have them perform a standardized academic assessment. Studies have also discovered that concentration levels improved immediately after exercise but were not sustained (Caterino & Polak, 1999; Raviv & Low, 1990). Future studies involving an experimental group that takes part in aerobic exercise three to four times a week compared a control group that does not receive aerobic exercise, could be conducted to determine differences in academic performance levels over time.

These possible studies can benefit all educational stakeholders as growing academic accountability standards require all parties involved to identify new avenues for raising academic performance. This area of research will also benefit the physical education profession as more credence is given to the need for quality physical education instructors and instruction, as the connection to academic performance is made clearer. Physical education professionals must use the knowledge gained in studies surrounding physical fitness and academic performance as evidence that they can make a difference not only in one's physical health, but also one's mental well being.

REFERENCES

Active Living Research. (2007). *Active education: Physical education, physical activity, and academic achievement*. San Diego, CA: Author.

Ahamed, Y., Macdonald, H., Reed, K., Naylor, P. J., Liu-Ambrose, T., & McKay, H. (2007). School-based physical activity does not compromise children's academic performance. *Medicine & Science in Sports & Exercise, 39*, 371-376.

American Academy of Pediatrics. (2001). Strength training by children and adolescents. *Pediatrics, 107*(6), 1470-1472.

American College of Sports Medicine. (2000). *ACSM's guidelines for exercise testing and prescription* (6th ed.). Baltimore: Lippincott, Williams & Wilkins.

American Heart Association. (2005). *Exercise and children*. Retrieved December 1, 2008 from American Heart Association Web site: http://www.americanheart.org/ presenter.jhtml=4596

American Orthopedic Society for Sports Medicine. (1988). No Title. *Proceedings of the conference on strength training and the prepubescent*. Retrieved November 12, 2008 from the Centers for Disease Control and Prevention web site: http:// www.cdc.gov/nccdphp/dnpa/obesity/childhood/contributing_factors.htm

Arrington, S. L. (2007). The relationship between physical fitness and academic achievement. *Dissertation Abstracts International*. (UMI No. 3271261)

Bailey, R. (2006). Physical education and sport in schools: A review of benefits and outcomes. *Journal of School Health, 76*(8), 397-401.

BrainGym International. (2003). *A chronology of annotated research study summaries in the field of educational kinesiology*. Retrieved December 12, 2008 from The Educational Kinesiology Foundation Web site: http://www.braingym.org

California Department of Education. (2002). *Standardized testing and reporting program*. Retrieved November 1, 2008 from California Department of Education Web site: http://www.star.cde.ca.gov/star2000f/index.html

California Department of Education. (2005). *California physical fitness test: A study of the relationship between physical fitness and academic achievement in California using 2004 test results*. Retrieved November 1, 2008 from California Department of Education Web site: http://www.cde.ca.gov/ta/tg/pf/

California Department of Education. (2007). *2007 California physical fitness test: Report to the Governor and the Legislature*. Retrieved November 1, 2008 from California Department of Education Web site: http://www.cda.ca.gov//ta/tg/pf

Carlson, S. A., Fulton, J. E., Lee, S. M., Maynard, M., Brown, D. R., Kohl III, 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*(4), 721-727.

Castelli, D. M., Hillman, C. H., Buck, S. M., & Erwin, H. E. (2007). Physical fitness and academic achievement in third-and-fifth grade students. *Journal of Sport and Exercise Psychology*, *29*, 239-252.

Caterino, M. C., & Polak, E. D. (1999). Effects of 2 types of activity on the performance of 2nd-, 3rd-, and 4th-grade students on a test of concentration. *Perceptual Motor Skills*, *89*, 245-248.

Centers for Disease Control, & Prevention & President's Council on Physical Fitness and Sports. (2000). Physical activity and fitness. In *Healthy People 2010*. Washington, DC: U.S. Government Printing Office.

Centers for Disease Control, & Prevention: National Center for Health Statistics. (2003). *Percentages of children ages 6 to 18 who are overweight by gender, race, and Hispanic origin, 1976-1980, 1988-1994, and 1999-2002*. Atlanta, GA: Author.

Christodoulos, A. D., Flouris, A. D., & Tokmakidis, S. P. (2006). Obesity and physical fitness of pre-adolescent children during the academic year and the summer period: Effects of organized physical activity. *Journal of Child Health Care, 10*(3), 199-212.

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 & Science in Sports & Exercise, 38,* 1515-1519.

Cook, G. (2005). Cut to fit. *American School Board Journal*, 16-19.

Corbin, C. B., & Pangrazi, R. P. (2008). Appropriate uses of FITNESSGRAM. In G.J. Welk & M.D. Meredith (Eds.), *FITNESSGRAM/ACTIVITYGRAM Reference Guide* (3rd ed., pp. 2.1-2.15). Dallas, TX: The Cooper Institute.

Corbin, C. B., & Pangrazi, R. P. (2008). FITNESSGRAM and ACTIVITYGRAM: An introduction. In G.J. Welk & M.D. Meredith (Eds.), *FITNESSGRAM/ ACTIVITYGRAM Reference Guide* (3rd ed., pp. 1.1-1.6). Dallas, TX: The Cooper Institute.

Cureton, K.J. & Plowman, S.A. (2008). Aerobic capacity assessments. In G.J., Welk,

& M.D.Meredith (Eds.), *FITNESSGRAM/ACTIVITYGRAM Reference Guide* (3rd ed.). Dallas, TX: The Cooper Institute.

Daley, A. J., & Ryan, J. (2000). Academic performance and participation in physical activity by secondary school adolescents. *Perceptual and Motor Skills, 91*, 531-534.

Datar, A., & Strum, R. (2004). Addressing childhood obesity. *American Journal of Public Health, 94*(9), 1501-1506.

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

Drinkard, B., McDuffie, J., McCann, S., Uwaifo, G. I., Nicholson, J., & Yanovski, J. A. (2001). Relationships between walk/run performance and cardiorespiratory fitness in adolescents who are overweight. *Physical Therapy, 81*(12), 1889-2001.

Dwyer, T., Coonan, W. E., Leitch, D. R., Hetzel, B. S., & Baghurst, R. A. (1983). An investigation of the effects of daily physical activity on the health of primary school students in South Australia. *International Journal of Epidemiology, 12*, 308-313.

Etnier, J. L., Salazar, W., Landers, D. M., Petruzzello, S. J., Han, M., & Nowell, P. (1999). The influence of physical fitness and exercise upon cognitive functioning: A meta-analysis. *Journal of Sport & Exercise Psychology, 19*, 249-277.

Faigenbaum, A. D. (2003). Youth resistance training. In C. B. Corbin, R. P. Pangrazi, & D. Franks (Eds.), *President's Council on Physical Fitness and Sports: Research Digest* (Series 4, No. 3). Washington D.C.: President's Council on Physical Fitness and Sports.

Fisher, M., Juszczak, L., & Friedman, S. B. (1996). Sports participation in an urban high school: Academic and psychologic correlates. *Journal of Adolescent Health, 18,* 329-334.

Georgia Department of Education. (2007). *2007-2008 Report Card*. Retrieved July 1, 2008, from Georgia Department of Education Web site: http:// public.doe.k12.ga.us/ReportingFW.aspx?PageReq=102&SchoolId=43709&T=1& FY=2008

Georgia General Assembly. (2009). B. Coleman, T. Dickson, H. Maxwell, M. Kaiser, K. Ashe, & S. Cooper (Eds.), *House Bill 229*. Retrieved September 1, 2009 from Georgia General Assembly Web site: http://www.legis.ga.gov/legis/2009_10/pdf/ hb229.pdf

Grissom, J. B. (2005). Physical fitness and academic achievement. *Journal of Exercise Physiology Online*, *8*(1), 11-20. Retrieved December 1, 2008 from Journal of Exercise Physiology Online Web site: http://www.asep.org/files/Grissom.pdf

Hager, R. L., Tucker, L. A., & Seljaas, G. T. (1995). Aerobic fitness, blood lipids, and body fat in children. *American Journal of Public Health, 85*(12), 1702-1706.

Hall, E. (2007). Integration: Helping to get our kids moving and learning. *Physical Educator, 64*(3), 123-128.

Hills, A. (1998). Scholastic and intellectual development and sport. In K.M. Chan & L. Micheli (Eds.), *Sports and children* (pp. 76-90). Champaign, IL: Human Kinetics.

Jarrett, O. S. (2002). *Recess in elementary school: What does the research say?* Champagne: University of Illinois. (ERIC Document Reproduction Service No. EDO-PS-02-5)

Jensen, E. (1998). *Teaching with the brain in mind*. Alexandria, VA: Association for Supervision and Curriculum Development.

Keays, J. J., & Allison, K. R. (1995). The effects of regular moderate to vigorous physical activity on student outcomes. *Canadian Journal of Public Health, 86*, 62-66.

Knight, D., & Rizzuto, T. (1993). Relations for children in grades 2, 3, and 4 between balance skills and academic performance. *Perceptual and Motor Skills, 76*, 1296-1298.

Lambourne, K. (2006). The relationship between working memory capacity and physical activity rates in young adults. *Journal of Sports Science and Medicine, 5*, 149-153.

Lazzer, S. (2005). Longitudinal changes in activity patterns, physical capacities, energy expenditure, and body composition in severely obese adolescents during multidisciplinary weight-reduction program. *International Journal of Obesity, 29*, 37-46.

Leger, L. A., & Lambert, J. (1982). A maximal multistage 20-m shuttle run test to predict VO2 max. *European Journal of Applied Physiology and Occupational Physiology, 49*(1), 1-12.

Luder, E., Melnik, T. A., & Dimaio, M. (1998). Association of being overweight with greater asthma symptoms in inner city black and Hispanic children. *Journal of Pediatrics, 132*, 699-703.

Mallory, G. B., Fiser, D. H., & Jackson, R. (1989). Sleep-associated breathing disorders in morbidly obese children and adolescents. *Journal of Pediatrics, 115*, 892-897.

Martin, L. T., & Chalmers, G. R. (2007). The relationship between academic achievement and physical fitness. *Physical Educator, 64*(4), 214-221.

Meredith, M. D., & Welk, G. J. (2008). *FITNESSGRAM / ACTIVITYGRAM Reference guide* (3rd ed.) . Dallas, TX: The Cooper Institute.

Mood, D. P., Jackson, A. W., & Morrow, J. R. (2007). Measurement of physical fitness and physical activity: Fifty years of change. *Measurement in Physical Education and Exercise Science, 11*(4), 217-227.

Nassis, G. P., Psarra, G., & Sidossis, L. S. (2005). Central and total adiposity are lower in overweight and obese children with high cardiorespiratory fitness. *European Journal of Clinical Nutrition, 59*, 137-141.

National Association for Sport & Physical Education. (2004). *Physical activity for children: A statement of guidelines for children*. Reston, VA: Author.

National Association for Sport, & Physical Education. (2006). *2006 Shape of the nation report: Status of physical education in the USA*. Reston, VA: Author.

Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flagal, K. M. (2006). Prevalence of overweight and obesity in the United States. *Journal of the American Medical Association, 295*, 1549-1555.

Ogden, C. L., Flegal, K. M., Carroll, M. D., & Johnson, C. L. (2002). Prevalence and trends in overweight among US children and adolescents. *Journal of the American Medical Association, 288*, 1728-1732.

Pangrazi, R. P., Beighle, A., Vehige, T., & Vack, C. (2003). Impact of promoting lifestyle activity for youth (PLAY) on children's physical activity. *Journal of School Health, 73*(8), 317-321.

Pate, R. R., Wang, C. Y., Dowda, M., Farrell, S. W., & O'Neill, J. R. (2006). Cardiorespiratory fitness levels among US youth 12 to 19 years of age: Findings from the 1999-2002 National Health and Nutrition Examination Survey. *Archives of Pediatric and Adolescent Medicine, 160*, 1005-1012.

Philanthropic Collaborative for a Healthy Georgia & The Georgia Youth Fitness Assessment Advisory Committee of the Philanthropic Collaborative for a Healthy Georgia. (2007). *Georgia youth fitness assessment*. Retrieved March 30, 2008 from Georgia State University: Georgia Health Policy Center Web site: http:// www.gsu.edu/ghpc

Plante, T. G., & Rodin, J. (1990). Physical fitness and enhanced psychological health. *Current Psychology, 9*(1), 3-24.

Plowman, S. A., Sterling, C. L., Corbin, C. B., Meredith, M. D., Welk, G. J., & Morrow, J. R. (2006). The history of FITNESSGRAM. *Journal of Physical Activity* (Suppl. 2), S5-S20.

Prochaska, J. J., Pate, R. P., & Sallis, J. F. (2008). Correlates of youth physical activity. In G. J. Welk & M. D. Meredith (Eds.), *FITNESSGRAM/ ACTIVITYGRAM Reference Guide* (pp. 12.2-12.11). Dallas, TX: The Cooper Institute.

Raviv, S., & Low, M. (1990). Influence of physical activity on concentration among junior high-school students. *Perceptual Motor Skills, 70*, 67-74.

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*(2), 127-134.

Satcher, D. (2005). Healthy and ready to learn. *Educational Leadership*, 26-30.

Shephard, R. J. (1996). Habitual physical activity and academic performance. *Nutrition Reviews*, *54*, 32-36.

Shephard, R. J. (1997). Curricular physical activity and academic performance. *Pediatric Science, 9*, 113-126.

Sigman, A. (2008, October 31). Brain & behaviour. *The Times Educational Supplement, 4812*, 24.

SPARK (1989). SPARK: Countering childhood obesity since 1989. Retrieved July 1, 2009, from the SPARK website: http://www.sparkpe.org/about-us/

Strong, W. B., Malina, R. M., Bumke, C. J., Daniels, S. R., Dishman, R. K., Gutin, B., et al. (2005). Evidence-based physical activity for school-aged youth. *Journal of Pediatrics*, *146*(6), 732-737.

Suskind, R. M., Blecker, U., Udall, J. N., von Almen, T. K., Schumacher, H. D., & Sothern, M. S. (2000). Recent advances in the treatment of childhood obesity. *Pediatric Diabetes, 1*, 23-33.

Swartz, M. B., & Puhl, R. (2003). Childhood obesity: A societal problem to solve. *Obesity Reviews, 4*(1), 57-71.

Taras, H. (2005). Physical activity and student performance. *Journal of School Health, 75*(6), 214-218.

Taras, H., & Potts-Datema, W. (2005). Obesity and student performance at school. *Journal of School Health, 75*(8), 291-295.

Togashi, K., Masuda, H., Rankinen, T., Tanaka, S., Bouchard, C., & Kamiya, H. (2002). A 12 year old follow-up study of treated obese children in Japan. *International Journal of Obesity and Related Metabolic Disorders, 26*(6), 770-777.

Tremblay, M. S., Inman, J. W., & Willms, J. D. (2000). The relationship between physical activity, self-esteem, and academic achievement. *Pediatric Exercise Science, 12*, 312-323.

Trudeau, F., & Shephard, R. J. (2008). Physical education, school physical activity, school sports and academic performance. *International Journal of Behavioral Nutrition and Physical Activity, 5*(10), 12.

U.S. Department of Education. (2001). *Public Law print of PL 107-110, the No Child Left Behind Act of 2001*. Retrieved July 1, 2008, from the U.S. Department of Education website: http://www.ed.gov/policy/elsec/leg/esea02/index.html

U.S. Department of Health & Human Services. (1999). Physiologic responses and long-term adaptations to exercise. In *Physical activity and health: A report of the Surgeon General*. Washington, DC: U.S. Government Printing Office.

U.S. Department of Health & Human Services. (2007). *Prevalence of overweight among children and adolescents: United States 2003-2004*. Retrieved March 4, 2008 from the Centers for Disease Control and Prevention web site: http://www.cdc.gov/nchs/products/pubs/hestats/overweight/overwght_adult_03.htm

U.S. Surgeon General. (1996). *A report of the Surgeon General: Physical activity and health*. Washington, DC: U.S. Government Printing Office.

Vail, K. (2008). Mind and body. In K.M. Cauley & G.M. Pannozzo (Eds.), *Annual editions: Educational psychology* (22nd ed., pp. 18-20). Dubuque, IA: McGraw-Hill.

Welk, G. J., & Blair, S. N. (2008). Health benefits of physical activity and fitness in children. In *FITNESSGRAM / ACTIVITYGRAM Reference guide* (3rd ed., pp. 4.2-

4.11). Dallas, TX: The Cooper Institute.

Whitaker, R. C., Wright, J. A., Pepe, M. S., Seidel, K. D., & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *New England Journal of Medicine, 37*(13), 869-873.

Xiaofen, D. K., & Silverman, S. (2004). Teachers' use of fitness tests in school-based physical education programs. *Measurement in Physical Education and Exercise Science*, *8*(3), 145-165.

APPENDIX A: FITNESSGRAM REPORT FOR PARENTS

FITNESSGRAM®

Report for Parents

Jane Jogger
Grade: 5 Age: 11
Cooper Institute Elementary School

Instructor: Jan Smith

	Date	Height	Weight
Current:	10/05/2006	5' 1"	105 lbs
Past:	05/05/2006	5' 0"	100 lbs

People come in all shapes and sizes, but everyone can benefit from regular physical activity and a healthy level of physical fitness. The FITNESSGRAM fitness test battery evaluates five different parts of health-related fitness, including aerobic capacity, muscular strength, muscular endurance, flexibility, and body composition. Parents play an important role in shaping children's physical activity and dietary habits. This report will help you evaluate your child's current level of health-related fitness and help you identify ways to promote healthy lifestyles in your family.

AEROBIC CAPACITY

Aerobic capacity is a measure of the ability of the heart, lungs, and muscles to perform sustained physical activity. In general, the more your child exercises, the higher his or her aerobic capacity level will be. Aerobic capacity is measured with the PACER test, the one-mile run, or the walk test.
Importance: Good aerobic capacity can reduce risks of heart disease, stroke, and diabetes. Although generally not present in children, these diseases can begin during childhood and adolescence.

Healthy Fitness Zone for 11 year-old girls = 15 - 41 laps

MUSCLE STRENGTH, ENDURANCE, & FLEXIBILITY

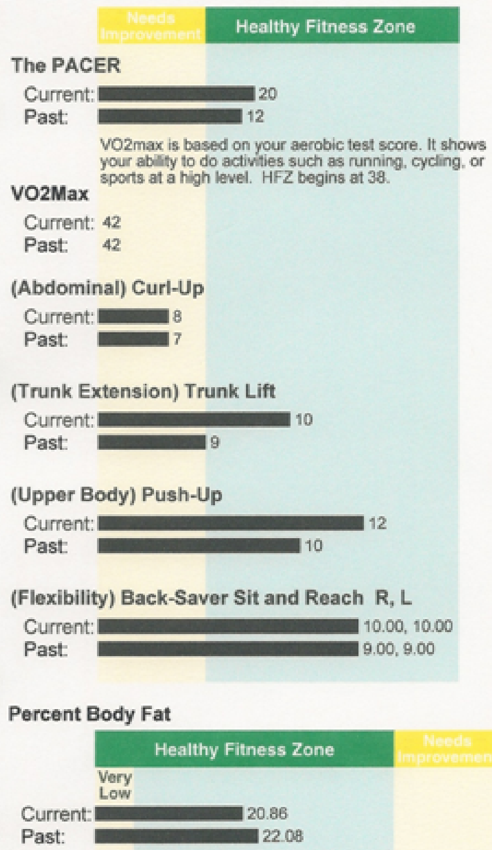
These components of health-related fitness measure the overall fitness of the musculoskeletal system. A variety of tests are used to assess these different components.
Importance: The fitness level of muscles is important for injury prevention and overall body function. Strength, endurance, and flexibility are important for maintaining good posture, low back health, and total body function.

Healthy Fitness Zone for 11 year-old girls
Curl-Up = 15 - 29 repetitions
Trunk Lift = 9 - 12 inches
Push-Up = 7 - 15 repetitions
Back-Saver Sit and Reach =
At least 10 inches on R & L

BODY COMPOSITION

The body composition measure refers to the relative proportion of fat and lean tissue in the body. Body fat percentage can be estimated by skinfold calipers or other measuring devices. The Body mass index (BMI) is another indicator that determines if a person is at a healthy weight for his or her height.
Importance: Overweight youth are at high risk for being overweight adults. Adult obesity is associated with a number of chronic health problems. Many of these health problems can begin early in life. It is important to begin healthy eating and regular activity early.

Healthy Fitness Zone for 11 year-old girls = 13.00 - 32.00 %



Being too lean or too heavy may be a sign of (or lead to) health problems. However, not all people who are outside the Healthy Fitness Zone are at risk for health problems. For example, a person with a lot of muscle may have a high BMI without excess fat.

INTERPRETING THE FITNESSGRAM REPORT

Health-related fitness includes a variety of factors. With regular physical activity most children will be able to score in the Healthy Fitness Zone for most of the tests. It is important for all children to be physically active every day (a total of 60 minutes is recommended) even if they are already fit. If your child is in the Needs Improvement area on a particular test, it is important to provide additional opportunities to be active so they can improve their levels of fitness.

Please refer to the back page of the parent report for a description of the Healthy Fitness Zone and for tips on promoting physical activity in your family.

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APPENDIX B: ABOUT FITNESSGRAM

about FITNESSGRAM®

FITNESSGRAM PHILOSOPHY

H **HEALTH** comes from regular physical activity and the development of health-related fitness.

E Physical activity and fitness are for **EVERYONE** regardless of age, gender, or ability.

L Physical activity and physical fitness are for a **LIFETIME**. Aim to develop lifelong patterns of physical activity.

P Physical activity programs should be designed to meet **PERSONAL** needs and interests.

UNDERSTANDING THE HEALTHY FITNESS ZONE

A unique feature of FITNESSGRAM is that it uses scientifically determined standards that are based on how fit children should be for good health. Most children can achieve the health-related fitness standards if they perform sufficient amounts of physical activity on a regular basis. The standards are set specifically for boys and girls and take into account changes with age. Regular participation in aerobic physical activity, which involves sustained movement of large muscle groups, may help children improve their aerobic capacity and maintain healthy body composition. Regular muscular and flexibility exercise can help to improve strength and flexibility.

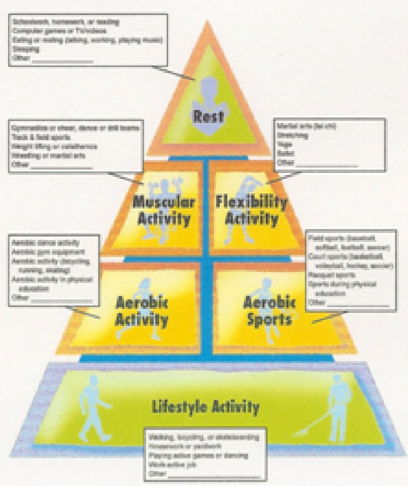
HOW CAN YOU HELP?

The FITNESSGRAM philosophy spells HELP because we need your help to promote physical activity and fitness for your child. If parents value physical activity and encourage their children to be active regularly, children are more likely to view physical activity as an important part of their daily lives. These tips may help you encourage your child to be active:

- Provide a safe play area for your child to play and opportunities to be active.
- Provide equipment and supplies that allow your child to be active.
- Put limits on television time and video game usage (especially right after school).
- Participate in physical activity with your child.
- Help your child develop good physical skills so that he or she can feel competent.

For additional information on the FITNESSGRAM *tests or to learn about how the Health Fitness Zones were established, visit the* FITNESSGRAM *Reference Guide at* **www.fitnessgram.net**.

THE PHYSICAL ACTIVITY PYRAMID FOR CHILDREN



The Physical Activity Pyramid provides a way of describing the variety of physical activities that contribute to good health. Children are encouraged to learn and perform activities from each of the first three levels of the pyramid.

- Level 1 of the pyramid includes lifestyle activities, or activities that can be done as part of daily living. Activities at this level include walking to school, riding a bike, raking leaves, cleaning house, and general outdoor play of all kinds. These types of activity are emphasized because people are more likely to do them throughout their lifetimes.
- As children grow older, they will be interested in activities at level 2, including aerobic sports and other aerobic activities.
- Activities in level 3 include flexibility and muscular fitness activities.

Children should be introduced to the level 2 and level 3 activities gradually and at a rate consistent with their skills, age, and level of maturation.

Long periods of inactivity are inappropriate for children. For this reason it is important that children have several play periods in the form of recess or physical education each day and that they have opportunities to be active before and after school.

FITNESSGRAM was developed by The Cooper Institute and is endorsed by the American Alliance for Health, Physical Education, Recreation and Dance. For information, go to www.fitnessgram.net.
Based in Dallas, The Cooper Institute (www.cooperinst.org) is a nonprofit research and education center dedicated to advancing the understanding of the relationship between living habits and health and to providing leadership in implementing these concepts to enhance the physical and emotional well-being of the individual.
FITNESSGRAM is published by Human Kinetics. FITNESSGRAM is a registered trademark of The Cooper Institute, Dallas, Texas.

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APPENDIX C: FITNESSGRAM TESTS

The Cooper Institute
Healthy Living…Down to a Science

HUMAN KINETICS
The Information Leader in Physical Activity

FITNESSGRAM® Tests

Six Recommended Tests Are Bolded

2

AEROBIC CAPACITY

1) **PACER** (Progressive Aerobic Cardiovascular Endurance Run) – Set to music, a paced, 20-meter shuttle run increasing in intensity as time progresses

Or:

- One-Mile Run – Students run (or walk if needed) one mile as fast as they can
- Walk Test – Students walk one mile as fast as they can (for ages 13 or above since the test has only been validated for this age group)

3

BODY COMPOSITION

2) **Skin Fold Test** – Measuring percent body fat by testing the tricep and calf areas

Or:

- Body Mass Index – Calculated from height and weight

4

MUSCULAR STRENGTH AND ENDURANCE

3) **Curl Up** – Measuring abdominal strength and endurance, students lie down with knees bent and feet unanchored. Set to a specified pace, students complete as many repetitions as possible to a maximum of 75

4) **Trunk Lift** – Measuring trunk extensor strength, students lie face down and slowly raise their upper body long enough for the tester to measure the distance between the floor and the student's chin

5

5) **Push-Up** – Measuring upper body strength and endurance, students lower body to a 90-degree elbow angle and push up. Set to a specified pace, students complete as many repetitions as possible

Or:

- Modified Pull-Up (proper equipment required) – With hands on a low bar, legs straight and feet touching the ground, students pull up as many repetitions as possible
- Flexed Arm Hang – Students hang their chin above a bar as long as possible

6

FLEXIBILITY

6) **Back-Saver Sit and Reach** – Testing one leg at a time, students sit with one knee bent and one leg straight against a box and reach forward

Or:

- Shoulder Stretch – With one arm over the shoulder and one arm tucked under behind the back, students try to touch their fingers and then alternate arms

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APPENDIX D: HEALTHY FITNESSGRAM ZONE FOR BOYS

*FITNESS*GRAM ® Standards for the Healthy Fitness Zone™

BOYS

Age	$\dot{V}O_2$max (ml · kg⁻¹ · min⁻¹)	$\dot{V}O_2$max (ml · kg⁻¹ · min⁻¹)	20-meter PACER (Enter # laps in software)	20-meter PACER (Enter # laps in software)	15-meter PACER (Use conversion chart; enter in software)†	15-meter PACER (Use conversion chart; enter in software)†	One-mile run (min:sec)	One-mile run (min:sec)	Walk test ($\dot{V}O_2$max)	Walk test ($\dot{V}O_2$max)	Percent fat	Percent fat	Body mass index	Body mass index
5			Participation in run. Lap count standards not recommended.				Completion of distance. Time standards not recommended.				25	10	20	14.7
6											25	10	20	14.7
7											25	10	20	14.9
8											25	10	20	15.1
9											25	7	20	13.7
10	42	52	23	61	30	80	11:30	9:00			25	7	21	14.0
11	42	52	23	72	30	94	11:00	8:30			25	7	21	14.3
12	42	52	32	72	42	94	10:30	8:00			25	7	22	14.6
13	42	52	41	83	54	108	10:00	7:30	42	52	25	7	23	15.1
14	42	52	41	83	54	108	9:30	7:00	42	52	25	7	24.5	15.6
15	42	52	51	94	67	123	9:00	7:00	42	52	25	7	25	16.2
16	42	52	61	94	80	123	8:30	7:00	42	52	25	7	26.5	16.6
17	42	52	61	106	80	138	8:30	7:00	42	52	25	7	27	17.3
17+	42	52	72	106	94	138	8:30	7:00	42	52	25	7	27.8	17.8

Age	Curl-up (no. completed)	Curl-up (no. completed)	Trunk lift (inches)	Trunk lift (inches)	90° push-up (no. completed)	90° push-up (no. completed)	Modified pull-up (no. completed)	Modified pull-up (no. completed)	Flexed arm hang (seconds)	Flexed arm hang (seconds)	Back-saver sit and reach* (inches)	Shoulder stretch
5	2	10	6	12	3	8	2	7	2	8	8	Healthy Fitness Zone = touching fingertips together behind the back on both the right and left sides.
6	2	10	6	12	3	8	2	7	2	8	8	
7	4	14	6	12	4	10	3	9	3	8	8	
8	6	20	6	12	5	13	4	11	3	10	8	
9	9	24	6	12	6	15	5	11	4	10	8	
10	12	24	9	12	7	20	5	15	4	10	8	
11	15	28	9	12	8	20	6	17	6	13	8	
12	18	36	9	12	10	20	7	20	10	15	8	
13	21	40	9	12	12	25	8	22	12	17	8	
14	24	45	9	12	14	30	9	25	15	20	8	
15	24	47	9	12	16	35	10	27	15	20	8	
16	24	47	9	12	18	35	12	30	15	20	8	
17	24	47	9	12	18	35	14	30	15	20	8	
17+	24	47	9	12	18	35	14	30	15	20	8	

Number on left is lower end of HFZ; number on right is upper end of HFZ.
*Test scored Pass/Fail; must reach this distance to pass.
†Conversion chart on page 94.

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APPENDIX E: HEALTHY FITNESSGRAM ZONE FOR GIRLS

*FITNESS*GRAM ® Standards for the Healthy Fitness Zone™

GIRLS

Age	$\dot{V}O_2$max (ml · kg^{-1} · min^{-1})		20-meter PACER (Enter # laps in software)		15-meter PACER (Use conversion chart; enter in software)†		One-mile run (min:sec)		Walk test ($\dot{V}O_2$max)		Percent fat		Body mass index	
5			Participation in run. Lap count standards not recommended.				Completion of distance. Time standards not recommended.				32	17	21	16.2
6											32	17	21	16.2
7											32	17	22	16.2
8											32	17	22	16.2
9											32	13	23	13.5
10	39	47	7	41	9	54	12:30	9:30			32	13	23.5	13.7
11	38	46	15	41	19	54	12:00	9:00			32	13	24	14.0
12	37	45	15	41	19	54	12:00	9:00			32	13	24.5	14.5
13	36	44	23	51	30	67	11:30	9:00	36	44	32	13	24.5	14.9
14	35	43	23	51	30	67	11:00	8:30	35	43	32	13	25	15.4
15	35	43	32	51	42	67	10:30	8:00	35	43	32	13	25	16.0
16	35	43	32	61	42	80	10:00	8:00	35	43	32	13	25	16.4
17	35	43	41	61	54	80	10:00	8:00	35	43	32	13	26	16.8
17+	35	43	41	72	54	94	10:00	8:00	35	43	32	13	27.3	17.2

Age	Curl-up (no. completed)		Trunk lift (inches)		90° push-up (no. completed)		Modified pull-up (no. completed)		Flexed arm hang (seconds)		Back-saver sit and reach* (inches)	Shoulder stretch
5	2	10	6	12	3	8	2	7	2	8	9	Healthy Fitness Zone = touching fingertips together behind the back on both the right and left sides.
6	2	10	6	12	3	8	2	7	2	8	9	
7	4	14	6	12	4	10	3	9	3	8	9	
8	6	20	6	12	5	13	4	11	3	10	9	
9	9	22	6	12	6	15	4	11	4	10	9	
10	12	26	9	12	7	15	4	13	4	10	9	
11	15	29	9	12	7	15	4	13	6	12	10	
12	18	32	9	12	7	15	4	13	7	12	10	
13	18	32	9	12	7	15	4	13	8	12	10	
14	18	32	9	12	7	15	4	13	8	12	10	
15	18	35	9	12	7	15	4	13	8	12	12	
16	18	35	9	12	7	15	4	13	8	12	12	
17	18	35	9	12	7	15	4	13	8	12	12	
17+	18	35	9	12	7	15	4	13	8	12	12	

Number on left is lower end of HFZ; number on right is upper end of HFZ.
*Test scored Pass/Fail; must reach this distance to pass.
†Conversion chart on page 94.

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