12-2011

Pedometers Accelerometers and Observational Methods: A Comparison of Measurements of Physical Activity in Fourth-Grade Students.

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Pedometers, Accelerometers, and Observational Methods: A Comparison of Measurements of Physical Activity in Fourth-Grade Students

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A dissertation

presented to

the faculty of the Department of Educational Leadership and Policy Analysis

East Tennessee State University

In partial fulfillment

of the requirements for the degree

Doctorate of Education in Educational Leadership

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by

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December 2011

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Keywords: Physical Activity, Pedometer, Accelerometer, Direct Observation, Childhood Obesity

ABSTRACT

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In recent years physical inactivity among students has become a matter of great concern. Nearly 65% of students do not meet the daily recommended level of physical activity, which is 60 minutes or more of moderate to vigorous physical activity each day, with 50% of that time being spent in moderate to vigorous levels of activity (CDC, 2010*b*). As a result, the 21st century has shown to be a time of many health problems such as, obesity, diabetes, and heart disease. In fact, nearly one third of all children are considered obese or overweight (Slawta & DeNeui, 2009). Researchers suggest that these health problems are directly related to students' sedentary lifestyles (Pate et al., 2006). Schools play a pivotal role in addressing and increasing physical activity during the school day.

The purpose of this research study was to measure levels of physical activity in elementary students during school hours. Specifically, the study sought to discover if there were increased levels of physical activity while students were using a cross-curricular adventure playground, as compared to when they were engaged in free play or physical education class. The study also compared the different measurement types (pedometers, accelerometers, and the observational method) used to assess physical activity, to indicate which measurement types were most feasible in the elementary school setting. Schools are ideal locations for assessing levels of

physical activity, as 95% of all children are enrolled in these learning institutions (National Center for Educational Statistics, 2005).

The data indicate that physical education provided for the highest levels of moderate to vigorous activity, while both free play and cross-curricular activity still rendered adequate levels of physical activity. After studying the different measurement protocols (pedometers, accelerometers, and the observational method) used in this study, results suggested the pedometer to be the most feasible device to use for measuring children in these types of physical activity settings. One implication for practice was implementing cross-curricular physical activity as a supplement to other physical activities or as an addition to physical education classes in an effort to allow more time for academic instruction while having students engaged in physical activity. Another recommendation for practice was to use pedometers as a cost-effective physical activity measurement device for elementary students.

DEDICATION

I would like to dedicate my dissertation to my loving and supportive husband, Brett. Without his encouragement, I would not have had the patience or dedication to finish. Brett, you have been my strong tower when I wanted to give up, you have been my wisdom when the words were just not coming together, and most of all you have believed in me from day one of this adventure, which truly gave me the confidence to prevail. I would also like to dedicate this dissertation to my beautiful babies Keeley and Braden. It is because of them that I had the desire to better our future and pursue this dream of obtaining my doctoral degree. I wish for them to see this document and realize that dreams are not meant to remain dreams forever but are meant to be pursued and obtained! Lastly, I would like to dedicate this dissertation to my father Billy Cross, who has known this to be a dream of mine since I first started college at the age of 18. My dad deserves this dedication for so many reasons but mostly for instilling in me the desire to better my future and the future of my family through my education. The help he provided Brett and me with the kids throughout this process was yet another reason this dream was able to be turned into a reality. This challenge has not been mine alone but has been a challenge for Brett, my kids, and all my parents (Billy and Carol Cross, Linda and Steve Lahr, and Ken and Ann Greene), who have all sacrificed of their time and energy, thus allowing me to finish this dissertation.

ACKNOWLEDGEMENTS

Words cannot express the gratitude I have for all of those who supported and encouraged me though out this process. I want to thank each of you for the assistance you provided me through this endeavor. It is impossible to point out one individual that made this dream a possibility because there were so many mentors, encouragers, and editors involved. I will forever feel indebted to each of you.

First, I would like to thank the following professors serving on my committee: Dr. Jim Lampley, Chair of Committee; Dr. Don Good; Dr. Terry Tollefson; and Dr. Andrew Dotterweich. To each of you I am grateful for your willingness to endure my endless list of questions, numerous emails to set up meetings to discuss my worries, and most of all for sharing your wisdom in which each of you contributed from your areas of expertise. The completion of this dissertation was a group effort and I am thankful for such a supportive committee.

Second, I would like to thank my family for their unconditional love even when stress was high and no amount of productiveness seemed sufficient. It was my family that would not let me quit, it was my family that was there to lift me up when there seemed to be more problems with my paper than positives, and it was my family that constantly reminded me how blessed I was to have the opportunity to pursue my dream.

Third, I would like to thank the Department of Kinesiology, Leisure, and Sport Sciences. It is an understatement to say that the faculty in this department supported me through the dissertation process. This crew offered comfort, constructive critique, encouragement, and even humor through out this whole process. Without Chris Ayres, Andrew Dotterweich, Gary Lhotsky, Mauro Palmero, Jason Davis, Michael Ramsey, and Diana Mozen, I would have remained in a constant state of being overwhelmed by the magnitude of a dissertation and all it

entails. It was through each coworker's willingness to stop by my office and ask for updates on my progress, or offer advice on ways to stay motivated and productive, that I was given the assurance that I could tackle writing a dissertation.

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CHAPTER 1

INTRODUCTION

In recent years physical inactivity among students has become an area of great concern. Nearly 65% of students do not meet the daily recommended level of physical activity, which is 60 minutes or more of moderate to vigorous physical activity each day (CDC, 2010*b*). Schools play a pivotal role in addressing and increasing physical activity during the school day. Physical education has been present in American schools since the 1800s. At that time several recess breaks were offered daily to increase physical activity during school, and then many students would ride their bikes home, thus participating in even more physical activity (Pate et al., 2006). However, students do not have access to physical activity as they did in the past. As a result the 21st century has been shown to be a time of many health problems such as obesity, diabetes, and heart disease. In fact nearly one third of all children are considered obese or overweight (Slawta & DeNeui, 2009). Researchers suggest that these health problems are directly related to students' sedentary lifestyles (Pate et al., 2006).

Another concern is that only one state, Alabama, meets the current national recommendations for physical education in schools. The national recommendations are as follows: 150 minutes of physical activity per week and 30 minutes of physical education instruction per day for elementary students. Recommendations for middle and high schools are 225 minutes of physical activity per week and 45 minutes of physical education instruction per day (National Association for Sport and Physical Education, 2010*a*). Forty-eight states have their own state standards for physical education, but only 34 require any kind of compliance by local school districts. Researchers at the National Association for Sport and Physical Education (NASPE) (2010*b*) also found that only 19 states require any type of fitness assessment of the students to gauge improvements or problems in fitness levels. With many loopholes and exemptions in place, most schools are not meeting daily requirements for student physical activity, thus depriving children of the many physical, health, and psychological benefits that adequate physical activity can supply (Warburton, Nicol, & Bredin, 2006).

Schools have been designated the primary institution for providing opportunity for students to be more active during the school day, to improve their health. The problem lies within the lack of knowledge about which of the three typical physical activity opportunities (physical education, free-play, and interactive playgrounds using cross-curricular activities) provides for the highest physical activity levels in children. The resulting data were compared and contrasted to determine if curricula using the adventure playground system provide comparable levels of physical activity to standard physical education curricula and if either is comparable to free play during school hours. Another problem is the lack of knowledge of different types of physical activity measurement instruments. Study data were also used to compare three different types of measurement protocols (pedometers, accelerometers, and observational methods) to determine if each produce comparable results.

Although schools are primary avenues for increasing physical activity, states and local school boards have actually been eliminating physical activity programs and limiting recess opportunities. Only 3.8% of elementary schools offer daily physical education (American Council on Exercise, 2009). After the implementation of *No Child Left Behind Act of 2001* (NCLB), schools were held to higher academic standards, with standardized testing of academic subjects playing a major role. NCLB forced educational institutions to focus on academics, thus placing less emphasis on physical activity and developing healthy bodies (Weshler, McKenna, Lee, & Dietz, 2004). It is unlikely that the sedentary behavior of children will change without enforcing strict school policies focusing on increasing physical activity during the school day.

Physical benefits are often cited as the primary benefit of being physically active, but along with physical benefits, the body also benefits in areas such as health improvements and psychological implications. Some of the physical benefits of being physically active are increased flexibility, decreased injury, assistance in controlling blood pressure, and lowering risk of colon cancer. Other physical benefits include strengthening of bones and increasing cardio respiratory endurance (United States Department of Agriculture, 2010*a*). To maximize benefits of physical activity individuals must know what types of physical activities are most advantageous, such as aerobic activities (brisk walking, swimming, or jogging), resistance and strength-building activities (lifting weights, push-ups), and balance and stretching activities (dancing, yoga, and martial arts) (United States Department of Agriculture, 2010*c*). Physical activity is also of great importance when examining an individual's health. Engaging in just 30 minutes of light to moderate physical activity each day has helped to reduce weight, to lower blood pressure, to decrease chance for certain types of cancers, to reduce risk of cardiovascular disease, to reduce risk of developing type II diabetes, strengthen bones and muscles, improve mental health, and to reduce risk of depression and anxiety (CDC, 2010*c*; Warburton et al., 2006).

Research supports the many benefits of physical activity for children during the school day. School administrators often overlook this research in an effort to better standardized test scores; however, numerous studies have shown that physically active students are scoring equal or higher on academic tests as compared to those students who receive less physical activity during the school day (Chromitz et al., 2009; Dwyer, Sallis, Blizzard, Lazarus, & Dean, 2001;

Ekeland, Hagen, Abott, & Norman, 2004). Wuest and Bucher (2009) stated that physical activity was not limited to just supplying children with physical benefits. The affective domain greatly benefits from physical activity. This domain focuses on the student's self-esteem and general attitude toward learning. Research also supports the belief that properly supervised physical activity during the school day can combat anti-social behaviors; thus allowing students to develop social networks through physical activity (Bailey, 2006). Studies focusing on benefits of physical activity and how being physically active has a positive impact on academic achievement are vital in advocating the need for increased physical activity in schools. A recent study of 12,000 elementary students showed that active students were 20% more likely to earn As in school than their classmates that chose sedentary lifestyles (American Council on Exercise, 2009).

Different opportunities to provide physical activity during the school day are physical education class, recess, and incorporation of cross-curricular teaching methods. It is not only important for schools to provide these opportunities for students to be active, but also administrators need to be able to assess which types of physical activities are providing for the most moderate to vigorous physical activity (MVPA) (Tudor-Locke, Williams, Reis, & Pluto, 2002). With schools having limited time to allot for exercising, it is important to be able to calculate the amount of activity the children are getting in each of the physical activity settings. Pedometers, accelerometers, and observational methods are all common ways of measuring physical activity, some of which are costly and time consuming.

To improve the health of our children, prevent obesity, and lower medical costs our schools should focus on getting students more physically active. The state of Tennessee ranks 6^{th} in the nation with regards to childhood obesity, and is just one of many states striving to make changes to improve the health of its children (Trust for America's Health, 2007). In response to this statistic, Tennessee's General Assembly created a decree in 2006 calling for schools to require students to engage in a minimum of 90 minutes of physical activity per week. For Tennessee to effectively enforce this decree schools must take initiative in designing and implementing effective physical activity programs. One county in Tennessee answered the decree by receiving a grant that allowed for interactive playgrounds to be built to increase physical activity (Webb, 2009). The Center for Disease Control and Prevention estimates that if current sedentary lifestyles continue, one third of all children born in 2000 will develop diabetes (National Conference of State Legislatures, 2006).

Statement of the Problem

The purpose of this research study is to measure levels of physical activity in elementary students during school hours. Specifically, I sought to discover if there are increased levels of physical activity while students are utilizing a cross-curricular adventure playground, as compared to when they are engaged in free play or physical education class. Schools are ideal locations for assessing levels of physical activity, as 95% of all children are enrolled in these learning institutions (National Center for Educational Statistics, 2005).

Significance of the Study

This study is significant because it will lead to greater knowledge about physical activity in children as well as increased knowledge of several different types of physical activity measurement protocols that can be used in a school setting. This study will be useful to school administrators, teachers, parents, and government officials as results of this research will add to the body of knowledge about different physical activity opportunities during the school day and which types of physical activity sessions allows for the most MVPA. The study will also add to existing research about feasibility of using pedometers, accelerometers, or observational studies in schools as a means of assessing physical activity levels in children.

Research Questions

The following research questions guide this study. The questions are focused on the different types of physical activity during the school day, specifically which types produce higher levels of activity. The questions also address possible differences in physical activity measurement protocols.

Research Question 1: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by accelerometers?

Research Question 2: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by pedometers?

Research Question 3: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by the observational method?

Research Question 4: Is there a significant difference among accelerometers, pedometers, and the observational method when measuring the different types of physical activity (physical education class, free-play, and cross-curricular activity) during the school day?

Research Question 5: Is there a significant difference between male and female 4th grade students' physical activity intensity levels among physical education class, free play, and cross-curricular activity as measured by the observational method.

Definitions of Terms

The following definitions are provided in an effort to clarify terms and instruments that were used throughout the study. These terms are germane to assessment of physical activity.

Accelerometer- An accelerometer is a device used to measure physical activity. Having the ability to record data continuously over a specific time allows for estimations of physical activity intensities to be measured. The accelerometer provides information such as time spent in moderate or vigorous levels of physical activity, which is more detailed information than the pedometer can provide (Actigraph Activity Monitor Devices, 2006).

Body Mass Index (BMI) - A calculation that produces a number value that is an indicator of healthy weight range. Height and weight are used to produce the number value. A BMI of 30 or higher is labeled obese. The formula for BMI: Weight in pounds multiplied by 703 and then divided by height in inches^2. The metric formula for BMI: Weight in kilograms divided by height in meters^2 (CDC, 2011*b*).

Cross-curricular- This teaching method combines more than one subject area in an effort to enhance learning of both areas. One example of cross-curricular teaching is combining math and physical activity (Fischesser, 2008). A student would have to complete a math problem in order to know how many laps to complete. Another example would be to use science to teach art by way of painting all of the planets (Knox et al., 2009).

Free play- Play promotes healthy brain development, encourages creativity, increases confidence, and strengthens decision making skills (Ginsburg, 2007). Free-play or recess, is an opportunity to acquire additional physical activity, by playing on playgrounds, kicking ball, swinging, etc. (Tsao, 2002).

Interactive Playground- The Beanstalk Fitness Adventure Playground was developed by Mike Fischesser as a product that would offer additional physical activity through the use classroom and nutritional curricula on the playground. This particular interactive playground offers up to 200 feet of linear, low ropes challenges. Equipment includes ropes, tunnels, bridges, and swings. Activities include balance, climbing, and swinging (Fischesser, 2008).

Moderate activity- Moderate physical activity is defined as activity that noticeably increases heart rate. When performing a moderate exercise one should be able to carry on a conversation with little trouble. Examples of moderate intensity activities are brisk walking, easy jogging, swimming, ballroom dancing, and bike riding (CDC, 2011*c*).

Obesity- This is a range of weight that is greater than what is considered a healthy weight. When determining if a child is obese, the 2000 CDC Growth Chart is used, which is age and gender specific (CDC, 2011*a*).

Observational method- This type of measurement of physical activity is subjective in nature because researchers are observing physical activity and scoring it into different intensity categories such as low, moderate, or vigorous intensity. Most often researchers will observe the child for a period of time and record data in a coding form. Recording takes place every 20 seconds for the duration of the physical activity session (McKenzie, 2009).

Pedometer- A pedometer is a device used to measure levels of physical activity. This device senses when the body is in motion such as walking. The pedometer gauges distance traveled by counting number of steps taken and is attached at the hip or worn on the shoe (Yamaxx.com, 2011).

Physical Activity- Physical activity is the act of moving the body in a way that requires energy expenditure above normal physiological requirements (Department of Education, 2011*b*). American College of Sport Medicine (2010) recommends at least 30 minutes of moderate activity on all or most days of the week.

Vigorous activity- When performing vigorous intensity the heart rate is raised significantly and it is possible to speak only a few words between breaths. Examples of vigorous activities are swimming laps, running, playing basketball, singles tennis, or riding a bike up a hill (CDC, 2011*c*).

Limitations and Delimitations

The pedometers and accelerometers are limited to the accuracy of proper placement by the researcher or student. However, it is assumed the data are valid and accurate. Additional limitations of this study are external and internal validation. Ecological external validity is a potential limitation because subjects have the tendency to act differently when they are being observed. This study is also limited by population external validity because generalizability is restricted to schools within the participating area that have the Beanstalk interactive playground. The research conducted may not be generalizable to other populations.

Overview of the Study

The study consists of five chapters. Chapter 1 contains the introduction, the statement of the problem, significance of the study, research questions, definitions of terms, delimitations, limitations, and an overview of the study. Chapter 2 is the review of literature and focuses on physical activity, measurements of physical activity, and school-based physical activity. Chapter 3 describes methods used in collecting data. Chapter 4 reveals results of the data analysis. Chapter 5 consists of the summary of findings, conclusions, recommendations for practice, and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

The literature review includes information relevant to physical activity, physiological and psychological affects of physical activity, physical activity intensities, school-based physical activity, different measurements of physical activity, and information on the Beanstalk Interactive Playground. Chapter 2 is divided into three main sections: 1. Physical Activity; history of physical activity, recommendations for physical activity, benefits of physical activity, barriers to being physically active, and levels of intensities. 2. Measuring physical fitness levels; pedometers, accelerometers, and observational methods. 3. School-based physical activity programs; types of physical activity in schools, benefits of physical activity that is specific to schools, and school-based physical activity curricula.

History of Physical Activity

Physical activity has always been very important in our society, dating back to the colonial period when physical activity was used for survival by way of hunting, fishing, and building. Colonists were engaged in physical activity all hours of the day. When they were not being physically active hunting and fishing, they would engage in recreational physical activities such as sport, dance, and dramatic enactments. The types of recreational physical activity engaged in by the colonists differed depending on their rituals, heritage beliefs, and religion. For example, certain religions saw dancing as a sin and prohibited this type of activity (Wuest & Bucher, 2009). These types of physical activities were also found in the barbaric tribes of Northern Europeans, where survival was dependent on hunting and fishing. With cultural changes that occurred after the Renaissance, Europeans had the opportunity to promote fitness and physical education to emerging European nations. This widespread promotion would soon find its way to the United States where many of the European physical activity programs would be adopted (Dalleck & Kravitz, 2011).

The rise of physical education and physical activity can be attributed to several pioneers during the early 18th century. One such pioneer was Johann Bernhard Basedowe. Basedowe was instrumental in promoting physical activity during school hours, specifically gymnastics (Wuest & Bucher, 2009). In late 1700s Basedowe founded a school for boys in Dessau, Germany. This school was guided by the philosophy of naturalism and focused on developing the whole individual and meeting the needs of his students, which included the addition of physical exercise (LaVague-Manty, 2006). Basedowe's ideas went away from the strict ways of education that included physical abuse, and centered the school in Dessau on the enjoyment of learning. It was of great importance to Basedowe that physical exercise and games be incorporated into daily routines at the school. His ideas were so influential that many schools began mirroring this type of education, which included physical activity (Chernin, 1986).

Other European contributors to physical education were Johann Christoph (1759-1839), Friedrich Ludwig Jahn (1778-1852), Per Henrick Ling (1776-1839), and Archibald Maclaren (1820-1884). All of these individuals had profound impacts in developing physical education programs. Most of these pioneers of physical education where interested in activities such as gymnastics, fencing, dancing, running, and marching. However, Maclaren made significant contributions in physical education as it pertains to health. He taught that the mind and body represented "oneness" and strongly believed that physical education should be a part of the school curriculum (Wuest & Butcher, 2009).

As a result of these influential individuals, physical education was slowly introduced to the school curriculum in the early 1800s. It was shortly after this, during the mid-1800s, that increased opportunities for engaging in physical activities such as gymnastics and swimming became available through schools and colleges. To meet the demand of increased interest in physical activity, the Young Men's Christian Association (YMCA) was created in the 19th century and today is engaged in over 10,000 neighborhoods across the United States (Young Men's Christian Association, 2011*a*). The first YMCA was created in Boston, Massachusetts in 1851 by Thomas Valentine Sullivan. This organization had a profound impact on physical fitness and health of individuals. The YMCA focused on developing the whole person through physical training and unity of the mind, body, and spirit (Wuest & Butcher, 2009). The YMCA was not only committed to building healthier individuals, this organization was also committed to strengthening communities. One way in which the YMCA was successful at this mission was through inclusion. This organization partnered with local businesses to provide sponsorships that in return allowed everyone in the community the opportunity to learn through programs offered at the YMCA (Young Men's Christian Association, 2011*a*). Some programs offered through the YMCA are swimming, recreation, youth sports, and competitive sports. The YMCA also offers educational classes that help children and adults learn to read among many other educational topics that serve to help individuals become more successful citizens (Young Men's Christian Association, 2011*a*). Another significant part of the history of physical activity was the first Olympic game in 1896, which was of great importance in raising awareness and interest in physical activity. The 19th century was a time of great growth in physical activity in society for both men and women (Wuest & Butcher, 2009).

Sir Thomas Valentine Sullivan, as stated previously, created the first YMCA in Boston, Massachusetts in 1851. Sullivan was a retired sea captain, serving as a marine missionary, who saw a need for a safe haven for marines and sailors to go. He was inspired by the YMCAs of England, and wished to create a “home away from home” for these men. Sullivan, along with many others such as Anthony Bowen served as pioneers of wellness, which included opportunities for their members to be physically active. Bowen, a freed slave, was the first to open a YMCA for blacks in 1853, which provided opportunity for those in Washington DC to have a safe place to learn and be active (Young Men’s Christian Association, 2011*b*).

Before the 19th century exercise and certain types of physical activity were reserved for men. Strenuous activity such as hunting, fishing, and building houses was seen as masculine; therefore, women were discouraged from engaging in such types of activity as well as exercise for enjoyment (Chernin, 1986). In the mid 1800s another pioneer of physical education was Elizabeth Blackwell. Her interests differed from those before her in that she focused her efforts on physical activity by women. Blackwell had extensive medical training and knew of the great physiological and anatomical benefits of physical activity for both men and women Blackwell educated school administrators of the importance of offering daily physical education for both girls and boys. Lack of knowledge of the benefits of physical activity led to many girls having impaired health before maturity (Park, 1978). Kennard (1977) stated that historical research had done a poor job recognizing prominent women who had contributed to physical education and physical activity. Catherine Beecher was one of those prominent women who introduced women to the world of callisthenic exercises, or exercises that used a person’s body as the mechanism for resistance. Beecher was an important figure in the establishment of women’s colleges in the West in the 1830s. Whereas Beecher’s focus was on educating women, she was equally interested in implementing physical activity, which at this time was reserved mostly for men (The Beecher Tradition, 2011). Another female pioneer in the area of physical education was Adele Parot, a teacher and gymnastics leader, who played an important role in bringing about mandatory physical education in California in the 1860s. Dudley Sargent and Mary Hemenway were also important figures in physical education and the creation of gymnastics in schools for both boys and girls. Gymnastics would quickly become the tool for introducing physical activity and discipline to children (Park, 1978).

Physical education was supported in academic curricula by the early 20th century in order to educate students on the importance of physical activity; however, physical education was soon removed from the schools because of decreased budgets during the depression. WWII proved to our nation the importance of educating the people on physical fitness because one third of all eligible men were seen as physically unfit to fight in the war (Wuest & Bucher, 2009). As a result of so many unhealthy Americans at the time of the war, President Eisenhower took a more formal approach to physical education, making sure all children and youth had the opportunity to be physically conditioned. This was the start of the Physical Fitness Movement, which prompted organizations such as YMCAs and AAU leagues to form (Vaughan, 1960). Research showed increased interest in sports during the late 20th century, but there still remained an alarming number of health concerns related to physical inactivity and poor nutrition (Johnson & Deshpande, 2000). Olshansky et al. (2005) found that obesity levels remained steady in the 1960s and 1970s but increased 50% each decade throughout the 1980s and 1990s.

At the start of the 21st century the focus of physical activity shifted from sports and competition to engagement for recreational and health reasons. Because of the rise in obesity, researchers started producing studies showing positive connections between good health and being physically active. Programs such as Coordinated School Health were created in an effort to address these health issues and create additional opportunities for physical activity. These programs were seen as very important in the school setting because obesity in children had become an epidemic. Children developed sedentary lifestyles by watching television and playing video games, thus gaining weight and becoming increasingly unhealthy (Johnson & Deshpande, 2000).

According to Federal legislation, Minimum Rules and Regulations Chapter 0520-1-3, of October 2003, schools (grades K-8) are mandated to provide health and physical education programs in each state. These programs are based on specific state standards and therefore vary across the nation (Department of Education, 2011*a*). Tennessee legislation requires all schools to provide 90 minutes of physical activity per week to elementary students. There are no state-mandated time requirements for physical education. The physical activity can therefore come from a number of different activities such as sports and recess (NASPE, 2010*a*). Virginia mandates physical education for K-8 and a minimum of 150 minutes of physical activity per week, plus daily recess. Exemptions, which are ways in which schools and students get exempt from participating in the mandatory physical activity requirements, are not allowed in Tennessee or Virginia. In continuing the physical education comparisons from the Eastern region of the United States, South Carolina mandates 60 minutes of physical education per week, and does not require daily recess. This state does not allow exemptions. Alabama and Florida both mandate 150 minutes of physical education per week for K-5 and do not require daily recess. Both of these states allow considerations for exemptions from participating. Louisiana mandates 150+ minutes of physical education per week in K-8 and does not require daily recess. Louisiana only grants exemptions for health reasons (NASPE, 2010*b*). Although most states have developed their own standards for physical education, all but one state falls below the Center for Disease Control's recommendations of 20 minutes of daily recess and 150 minutes of physical education per week for elementary students (CDC, 2010*b*).

State governments have developed physical education and physical activity requirements for schools to follow; however, some schools have eliminated or severely decreased the physical activity programs because of increased demands to improve grades and standardized testing scores (American Council on Exercise, 2009). The American Council on Exercise (2009) revealed the importance of physical activity in schools. The authors stated that a study of 12,000 adolescents showed active adolescents were 20% more likely to earn As, than their sedentary classmates. The active adolescents were involved in sports and school physical education. Even with those results showing the importance of being physically active, in 2006 only 3.8% of United States elementary schools offered daily physical education.

Recommendations for Physical Activity

Recommendations for appropriate amounts of physical activity for our nation, including school age youth, have been developed by many organizations and associations. The National Association for Sport and Physical Education (NASPE, 2010*a*) described physical activity as any sport, dance, exercise, or any other type of movement. NASPE recommended at least 60 minutes of physical activity or more per day for school aged children. The 60 minutes of physical activity should include several periods of physical activity lasting about 15 minutes each. NASPE also discouraged extended periods (2 or more hours) of inactivity in youth during the daytime (NASPE, 2010*a*).

The Center for Disease Control (CDC) focused on three types of physical activity for youth ranging in ages from 6 to 17 years. The first and second are muscle and bone strengthening. The third is aerobic activity, which the CDC recommended be engaged in 1 hour per day (CDC, 2009). Both NASPE (2010*a*) and CDC (2009) agreed that all three of these types of physical activity should be participated in at least three times per week. NASPE (2010*a*) and CDC (2009) also agreed that the aerobic portion should comprise the majority of the 60 minutes of physical activity per day.

Aerobic activities include walking, hiking, biking, tennis, aerobic dancing, running, yard work, and swimming (Mypyramid.gov, 2010). These activities can be divided into groups depending on the level of intensity, moderate or vigorous. CDC (2009) explained that when performing a moderate intensity aerobic activity one should be able to carry on a conversation while being active. When individuals engaged in a vigorous activity, the exerciser should not be able to speak more than a few words when being active (CDC, 2009). JSC Engineering (2008) set a physical activity goal for the general population that stated a person should take 10,000 steps per day. However, NASPE recommended school age girls acquire 12,000 steps per day and school age boys acquire 15,000 steps per day (Tudor-Locke et al., 2004).

Healthy People 2010 recommendations for physical activity were at least 30 minutes of moderate physical activity for more than 5 days per week or at least 20 minutes of vigorous activity on at least 3 days per week. This amount of physical activity is needed in order to see health benefits (U.S. Department of Health and Human Services, 2010).

Despite physical activity recommendations, a recent report by the CDC on Health Topics revealed that participation in physical activity had declined with age. Results of this study showed 77% of children age 9 to13 reported participating in free-time physical activity. Only

18% of high school students participated in 60 minutes of daily physical activity. The percentage of high school students who attended physical education classes daily decreased from 42% in 1991 to 25% in 1995, and in 1999 only 22% of 12th grade students had daily opportunity for physical education (CDC, 2010*e*).

The National Association for Sport and Physical Education (NASPE) (2010*b*) indicated that only one state (Alabama) meets the nationally recommended minutes for physical education. "NASPE and American Heart Association recommend that schools provide 150 minutes per week and 30 minutes per day of instructional physical education for each elementary school child, and 225 minutes per week and 45 minutes per day for middle and high school students for the entire school year" (NASPE, 2010*a*). While a majority of the states mandate physical education for each student, there are many loopholes that allow substitutions and exemptions for students. This prevents some students from having to engage in daily physical education class (NASPE, 2010*a*).

Benefits of Physical Activity

There are many benefits of engaging in physical activity.   Being physically active can help individuals in the following ways: balance calories, lose weight, reduce risk of cardiovascular disease, reduce risk of developing type II diabetes, strengthen bones and muscles, improve mental health, and reduce risk of depression and anxiety (CDC, 2010*d*; Warburton et al., 2006). My Pyramid is a program designed by the U.S. government that provides healthy dietary guidelines and physical activity guidelines to both children and adults. This program added the following to the list of benefits: increased flexibility, decreased injury, helps control blood pressure, and lowers risk of colon cancer. In order to maximize benefits of physical activity individuals must know what types of physical activities are most advantageous, such as aerobic activities (brisk walking, swimming, or jogging), resistance and strength building activities (lifting weights, push-ups), and balance and stretching activities (dancing, yoga, and martial arts) (United States Department of Agriculture, 2010*b*)

Examining the health benefits of being physically active, researchers found a connection between cardio fitness and cognition in youth. Exercise has shown to strongly affect brain plasticity and protect against dementia as well as improve memory (Aberg et al., 2009). Strong et al. (2005) stated they only found small positive gains in academics when students exercised during the school day. This study, however, did find positive influence on memory and concentration of those children who were physically active.

The *Healthy People 2010* health objectives focused on increasing the quality of life and years of healthy life for persons of all ages. This report suggested increasing physical activity for all individuals to help meet this objective (Brown et al., 2003). A report from the Center for Disease Control (2009) stated the many benefits of physical activity including increased life expectancy. Pellegrini and Smith (1998) described a physical activity as symbolic activity such as learning without awareness or games such as, running, jumping, chasing, and climbing. Physical activity is also described as being social or solitary. Being active may be important for more than physical health development, for example, increasing cognitive performance, social organization, and even social skills. This study concluded that physical activity is connected to the well-being of the whole individual, not just the physical aspects (Pellegrini & Smith, 1998).

Brown et al. (2003) agreed with Pellegrini and Smith (1998) that individuals who meet daily recommended amounts of physical activity were associated with a better overall quality of life. Both studies recommended 60 minutes of physical activity per day. An additional study conducted by Strong et al. (2005) shared that school age youth needed to participate in 60 minutes or more of physical activity per day in order to gain optimal beneficial change in skeletal health and muscular strength and endurance.

Ratey and Hagerman (2008) explained that physical activity is directly connected with physiological benefits to individuals as it prompts the release of proteins into the bloodstream. This increases production of brain chemicals, which triggers creation of new neurons, which ultimately resulted in increased focus and a feeling of calmness among physically active individuals.

Researchers have also found that being physically active as a child may significantly increase skeletal mass. Slemenda, Miller, Hui, Reister, and Johnston (1991) tested and surveyed 159 children, and results showed the more active the child the higher the bone mass which results in stronger bones. This research supported recommendations by the CDC (2010*d*) that suggested bone strengthening as one of three focus areas of physical activity.

Physical activity has shown to hold many benefits; however, in a report by the CDC concerning physical activity trends from 1991-2009 students attending physical education classes daily, decreased from 1991 to 2009. The amount of time individuals spent in front of the computer increased from 2003-2009 (CDC, 2010*e*). In the past 20 years obesity more than doubled in children aged 6 through 11, going from 6.5% in 1980 to 17% in 2006 (CDC, 2010*f*). Children who are overweight or obese are more likely to be overweight or obese as adults, thus the importance of allowing children opportunities to be physically active daily (CDC, 2010*f*).

Barriers to Being Physically Active

In contrast to physical activity, physical inactivity is when body movement is very minimal. Researchers have observed many reasons individuals choose to be inactive or sedentary. Examples of sedentary activities are television viewing, reading, and working on the computer (Must & Tybor, 2005). Studies have revealed several causes for individuals choosing to participate in sedentary activities instead of physical activities.

Salmon (2003) concluded that weather was one of the main barriers that kept individuals from being physically active. This study also revealed high cost, lack of sleep, lack of access to physical activity facilities, and time constraints as barriers that heavily contributed to sedentary lifestyles. Tappe and Duda (1989) revealed that even 20 years ago individuals faced many of the same type barriers to physical activity. These barriers included time constraints, weather, lack of interest, and technology. Computer use, gaming systems, and cell phones were all on the rise during this time, which proved to consume individual's time and interests; therefore, technology was seen as a barrier even many years ago.

A more recent study focused on television and video games as barriers to being a physically active person. This study revealed mixed results in determining whether or not moderate to high television and video game use was a cause of obesity or overweight status (Must & Tybor, 2005). They also found one additional hour of television time per day was associated with doubling the risk of obesity. Locard et al. (1992) found in a similar study of 223 obese 7 year olds that television was significantly related to obesity. More specifically, the research revealed that children who engaged in more than 4 hours of television time per day were twice as likely to be obese. While positive correlations have been found associating obesity and electronics use the relationship is slightly contentious. For instance, Vanderwater, Shim, and Caplovitz (2004) contradicted the above findings and stated that obesity caused use of electronics, such as video games, television, and computers; not that use of electronics causes obesity. Must and Tybor (2005) found overweight and obese children to have more pain associated with exercise, more isolation, and fewer friends, adding these to the list of barriers of being physically active. This supported the idea that overweight and obese children were more likely to engage in sedentary activities because of their weight and contradicted ideas that using electronic devices was a cause of overweight and obesity.

Research in the area of technology and obesity in children has produced mixed results. Whereas Locard et al. (1992), Must and Tybor (2005), and Vanderwater et al. (2004) agreed on the many barriers to physical activity for inactive individuals, they disagreed in the types of sedentary activities that led to obesity. Vanderwater et al. (2004) found negative correlations between obesity and television viewing, while Locard et al. (2004) found television watching and obesity to be positively correlated. Dietz and Gortmaker (1993) stated reasons for many studies producing mixed results in the area of television viewing and video gaming were lack of valid television viewing times and poor population samples. The important thing to note is sedentary behaviors are not conducive to health.

Levels of Intensity of Physical Activity

Our society has many barriers to being physically active; however, this literature review has highlighted the many important benefits of physical activity. Researchers are working to educate individuals on different types and intensities of physical activities and how to work them into everyday life and avoid barriers (Bishop, 2008).

When studying different benefits of physical activity, many researchers focused on levels of intensity in order to designate what durations and types of physical activities would result in health benefits. Levels of physical activity have been studied in many ways, including Metabolic Equivalents (MET) (Lee & Paffenbarger, 2000) and Kilocalories (KCAL) (Warburton et al., 2006). Some researchers have chosen to focus on technology, having used fitness instruments such as pedometers (Haskel & Kieman, 2000) and accelerometers (Seigal, 2006) to gauge levels of physical activity. Another means of measuring levels of physical activity that researchers have used are observational methods (Bailey et al., 1995). Industry standards pertaining to intensity levels of physical activity have also been set by the American College of Sport Medicine (ACSM) and American Heart Association, which stated individuals should engage in at least 30 minutes of moderate exercise, 5 days per week, or 20 minutes of vigorous exercise, 3 days per week. An example of a moderate exercise would be walking or a light jog and a vigorous activity would be more of a run or swimming laps. These standards were derived from previous studies that used accelerometers to determine specific exercises to be labeled moderate or vigorous (American College of Sport Medicine, 2007). Additional industry standards have been set by Center for Disease Control (CDC) and National Association of Sport and Physical Education (NASPE). Both agreed that 1 hour of moderate activity per day of physical activity was needed for health benefits to occur (CDC, 2009; NASPE, 2010*a*).

Measures of Physical Activity

Researchers have discovered many ways in which physical activity can be measured (Noland, Danner, Dewalt, McFadden, & Kothoen, 1990). Some of the most precise techniques to measure energy expenditure are the water technique, room calorimetry, and direct calorimetry (Ekelund, 2009). These techniques are accurate but limited by high cost and subject intrusiveness as well as requiring a large sample size (Ekelund, 2009; Kilanowski, Consakvi, & Epstein, 1999).

Heart rate monitors and self-reporting were additional ways to measure physical activity. These methods were less costly and more simple for youth to use. However, children tended to overestimate time being physically active when self-reporting, and heart rate monitors were still costly (Haskell & Kieman, 2000). Some of the most used methods for collecting data on physical activity are pedometers, accelerometers, and observation methods (Sinard & Pate, 2001). These techniques for assessing energy expenditure in children proved to be the most feasible because of affordability (Bjornson, 2005). These techniques have also shown to be valid and reliable for assessing levels of physical activity (Bassett et al., 1996; Eston, Rowlands, & Ingledew, 1998; Klesges & Klesges, 1987).

Pedometers

Pedometers have been described as small electronic devices (1-2 inch instrument) used to estimate mileage walked or number of steps taken over a period of time (Kilanowski et al., 1999). Pedometers are typically worn on the top of the shoe or on the hip. These devices range in price from $10 to $30 and can calculate and display many things such as distance, steps per minute, and calories burned (Bumgardner, 2010). Sinard and Pate (2001) noted that pedometers were considered a secondary type of measurement because they provided an objective assessment through an electronic device, whereas primary methods (observational method) were subjective and seen as very practical because of low costs and ability to assess large numbers of subjects.

Studies on pedometers have generally concluded that pedometers were not an accurate way to measure physical activity in children (Gayle, Montoye, & Philot 1977; Kemper & Verschuur, 1977). However, newer commercial pedometers have proven reliable and accurate for estimating steps taken (Bassett et al., 1996). Research has suggested pedometers were an accurate way of measuring physical activity because of their objective nature (Kilanoski et al., 1999; Oliver, Schofield, & McEvoy, 2006; Puhl, Greaves, Hoyt, & Baranowski, 1990). Kilanowski et al. (1999) identified four pedometer validation studies that involved children. The results showed a positive correlation between pedometer step counts and VO_2 max. Within these four studies pedometer step counts were compared with the Children's Activity Rating Scale (CARS) and Tritrac accelerometers. The studies indicated that more recently produced pedometers, such as the Yamax Digiwalker DW-200 and Yamax DW-500, were appropriate for assessing physical activity levels (Sinard & Pate, 2001). Eston and Rowlands (1998) conducted a comparative study of the accuracy of heart rate monitoring, pedometry, and accelerometry among 30 children. All measures were positively correlated, and they suggested that pedometers were an effective and affordable means of measuring energy expenditure in children (Eston & Rowlands, 1998). Walk4Life (2011) pedometers are recommended by the Cooper Institute (2010) and Human Kinetics (2011). Beets, Patton, and Edwards (2005) studied the accuracy of pedometers when being used by children. Beets et al. (2005) compared four pedometers, one of which was the Walk4Life pedometer. Their results concluded that two of the four pedometers, DW200 and Walk4Life, had high agreement on observed steps. This specific pedometer was affordable only costing $21 per device and was recently used in the FitnessGram fitness testing curriculum. FitnessGram is the most recognized fitness test for youth in America (Corbin & Pangrazi, 2008).

Accelerometers

The accelerometer is another device commonly used in measuring energy expenditure. Accelerometers provide a way to measure acceleration produced by the body. This device does not use a spring mechanism like the pedometer; accelerometers use piezo-electric transducers and microprocessors that record accelerations and converts data to quantifiable digital signals, called "counts" (Sinard & Pate, 2001). There are several types of accelerometers, single-plane, uniaxial, and tri-axial. All types vary in function and cost. However, even the most simplistic accelerometers are very costly, which is one limitation when using them to measure physical activity levels (Vries, Bakker, Hopman-Rock, Hirasing, & Van Mechelen, 2006).

Klesges and Klesges (1985) found positive but variable associations between the Caltrac, single-plane accelerometer and direct observation methods in young children. The variation was thought to come from the Caltrac's limited ability to detect a wide variety of movements of these young individuals (Klesges & Klesges, 1985). Johnson (1998) concluded that the Caltrac single-plane accelerometer was not a useful predictor of energy expenditure. Another concern for using accelerometers as a form of identifying levels of physical activity was the disagreement among cut-off points for defining intensity levels. To illustrate this discrepancy, ActiGraph established a cut-point of 3,000 counts per minute to describe "vigorous" activity. This count was within the recommended range of 2,000-3,600 counts per minute described as "moderate to vigorous" activity. Standards should be set for all accelerometers in order to avoid loose interpretation of data that are collected (ActiGraph Monitor Devices, 2009).

More recent studies have focused on the uniaxial or tri-axial accelerometers and have found them to be a much more reliable form of measuring energy expenditure in children than earlier versions of the accelerometer, or even the single-plane accelerometer (Louie et al., 1999;

Metcalf, Voss, & Wilkins, 2002; Rodgers, Stratton, & Faiclogh, 2005). Ridgers and Stratton (2005) studied uniaxial and triaxial accelerometers during three recess breaks on a school day to measure activity intensities of 30 students. They concluded that while the uniaxial accelerometer could assess the pattern and duration of physical activity at different intensities, the triaxial accelerometer proved to be the most accurate because of the three dimensions in which it could collect data. However, the study validated both accelerometers and suggested the uniaxial to be more feasible as a measurement tool because it was less costly than the tri-axial accelerometer (Ridgers & Stratton, 2005). Eston and Rowlands (1998) also agreed that the tri-axial accelerometer was the best predictor of energy expenditure, but because of high cost it was not feasible to use in testing large groups. Many researchers agreed that uniaxial accelerometers as well as pedometers were valid tools for measuring physical activity levels (Bouten, Westerterp, Verduin, & Janssen, 1994; Eston & Rowlands, 1998; Louie & Eston, 1999; Vries & Bakker, 2005). It is important to note that because of the high cost of accelerometers, most studies have a low number of participants from whom to collect data. Research suggests this is typical of this type of study.

Observational Methods

Another prevalent technique for measuring physical activity levels is direct observation. This is a primary type of measurement that is subjective in nature and seen as a practical method of assessing physical activity in children because of cost efficiency and ability to assess large groups (Sinard & Pate, 2001). Puhl (1990) stated direct observation was important because it had the ability to capture short term patterns and sudden changes in physical activity. The author also stated that direct observation had little subject reactivity of the observers. Only 16.6% of 5 and 6 year olds reacted to the observers in one study using this method (Puhl, 1990). The direct observation method has its drawbacks, as training and many personnel are needed to record data (Bailey, Olson, & Pepper, 1995). When using direct observation, there were a number of protocols, but most often researchers would observe a child for a period of time and record data in a coding form. Different types of activities were divided into categories and recorded in 5 second to 1 minute intervals (Trost, 2007).

There are many different types of direct observation that researchers have used and are considered reliable in measuring physical activity levels in children (Sinard & Pate, 2001; Trost, 2007). Each of these different types of direct observation methods shows variations in time allowed between scoring, type of coding system, and how much time is allowed for scoring of each subject. (See Appendix A)

While direct observation was one of the most practical means for assessing children's physical activity levels, it did have drawbacks, just as other measurement techniques. One drawback to this method was the amount of time and effort that was required to prepare for and collect data (Welk, Corbin, & Dale, 2000). Subject reactivity was another concern because observers must be in viewing area in order to properly record participants. Reactivity was more of an issue with young children (Trost, 2007). Many researchers opined that direct observation was too subjective and would rather rely on objective data when measuring physical activity (Bailey, Olson, & Pepper, 1995; Noland, Danner, & Dewalt, 1990; Sinard & Pate, 2001).

Three prevalent methods (pedometers, accelerometers, and direct observation) of assessing physical activity levels in children have been discussed. There are many other techniques for measuring energy expenditure, but research showed that these three were the most often used and most feasible (Eston & Rowlands, 1998; Trost, 2007; Tudor-Locke et al., 2002;

Sinard & Pate, 2001). Kilanowski et al. (1999) and Puhl et al. (1990) stated that pedometers were a suitable means of assessing physical activity levels in children and were more affordable and durable than other monitoring devices. The primary function of a pedometer was to count steps and distance (Tudor-Locke et al., 2002). Accelerometers were more sophisticated mechanical devices that were used to measure acceleration and different intensities during physical activity. These devices were among the most used in measuring energy expenditure, but were very costly, thus a limitation of the accelerometer (Ridgers et al., 2005). The Direct Observation method was the final technique discussed and Appendix A showed many different types of this method, all of which had been validated within different studies. Direct observation was seen as the most practical and affordable but was time consuming and required many trained personnel (Jennings-Aburto et al., 2008; Welk et al., 2000). Studies have shown positive correlations between pedometer and accelerometer measures during physical activity (Kilanowski et al., 1999; Tudor-Locke et al., 2002). Studies have also shown direct observation to have positive correlations when compared with pedometers and accelerometers (Kohl, Fulton, & Caspersen, 2000; Tudor-Locke et al., 2002; Welk et al., 2000).

School Based Physical Activity

With over 50 million children enrolled in K-12 schools in the United States, educational institutions are the primary means for reaching the nation's children (President's Council on Physical Fitness and Sports, 2009). One way schools can positively impact students is by offering daily physical activity. The Tennessee General Assembly's 2006 decree called for schools to require students to complete a minimum of 90 minutes of physical activity each week. This legislation was put in place in order to help fight the childhood obesity rate in Tennessee, which was at 6th in the nation (Trust for America's Health, 2011). With only 3.8% of elementary schools providing daily physical education (Lee, Burgeson, Fulton, Christine, & Spain, 2007), there was a need for schools to provide different avenues of physical activity throughout the school day.

Standardized testing in schools brought about a great concern, thus causing educators to be hesitant in allowing more time for physical activity, resulting in less time in the classrooms (Lee et al., 2007). However, research has shown that giving a physical activity break during the school day resulted in students having similar or higher test scores than compared to those students who did not receive a physical activity break. The research suggested that not only do students benefit physically by being active throughout the school day, there were also fewer behavioral problems and fewer absences (Jarrett et al., 1998).

Various types of physical activity provided by schools are free play, recess, cross-curricular activities, and physical education. Students attained many benefits including academic achievement and social development from each type of physical activity provided throughout the school day (Ginsburg, 2007). To go along with these activities, schools used a variety of curricula to help achieve fitness goals and increase physical activity levels. Some of the most popular school-based physical activity curricula were: Sport, Play, and Active Recreation for Kids (SPARK), Coordinated Approach to Child Health (CATCH), FitnessGram Fitness Testing, and the Beanstalk Playground Cross-Curricular. According to MyPyramid.gov (2010) no matter what type of physical activity a school chooses or what curriculum it follows, one thing remains true; as long as the students are being physically active at least 30 minutes during the school day they would gain both health and physical benefits.

Benefits of Physical Activity in Schools

The Tennessee Coordinated School Health suggested it was important for schools to provide additional or alternate types of physical activity during the school day in order to effectively fight childhood obesity. In Tennessee 40.0% of students who participated in health screenings were found to be overweight or obese and of those, 23.4% were found to be obese (Webb, 2009). Research has shown that physical activity can not only lead to physical benefits as cited previously but also is directly associated with learning, in areas such as academic achievement, social development, psychological developments, and affective domains (Bailey, 2006; Fox & Riddoch, 2006). Vanderwater et al. (2004) found that sedentary children were absent more often, obtained lower test scores, and had higher Body Mass Index (BMI) scores, while physically active children attended school more regularly, were healthier, scored higher on tests, and had lower BMI scores.

Dwyer et al. (2001) and Tomporowski, Davies, Miller, and Naglieri (2008) found exercise to be a simple yet important method of enhancing students' mental functioning, specifically pertaining to cognitive development and brain function. Dwyer et al. (2001) studied 8,000 Australian children (7 through 15 years of age) who participated in a fitness test where sit-ups, push-ups, and long jump were measured. After an overall score for the fitness test was applied, the children's grades were compared to fitness level, and the study showed a significant positive association between high fitness levels and high grades (Dwyer et al.,, 2001). A similar study was conducted by the California Department of Education (2004), and the results agreed with Dwyer et al.'s study and showed a strong positive correlation between physical fitness and standardized test scores. Chromitz et al.(2009) compared the Massachusetts Academic Achievement (MAA) Assessment to fitness achievement assessments of the same students.

Results show that increased opportunity for physical activity during school may support academic achievement. The results also stated that the likelihood of passing both math and English on the MAA increased as the number of physical fitness test passed increased (Chromitz et al., 2009). Another positive effect of being physically active during school was the lowering of anxiety and stress, which would allow for better attainment of information and allow for better test taking ability (Ekeland et al., 2004; Flook, Repetti, & Ullman, 2005). Academic achievement in our youth is of great importance in advancing our society and strengthening our nation (Brown et al., 2003).

Physical activity has been used in many different ways to enhance several different aspects of psychological development in children. One specific psychological area that could be positively affected by physical activity was affective development. Development of the affective domain focused on areas such as self-esteem and general attitudes (Wuest & Butcher, 2009). When applying the affective domain components to the school setting, it was important that children maintained high self-esteem and had positive attitudes towards learning to be successful in school. Bailey (2006) stated that physical education and physical activity both contributed to higher self-esteem and positively enhanced self-confidence, thus resulted in better performance in school activities. Fox and Riddoch (2006) and Talbot (2001) agreed with Bailey that physical activity provided during the school day resulted in children having more self-confidence and a better developed affective domain that allowed for greater academic achievement and less behavioral issues. Schools have reported more violence, behavior disturbances, and higher absents on days when no physical activity was offered (Jarrett et al., 1998).

Social development was another psychological area that physical activity may enhance. Physical activity when provided in a safe and controlled environment such as schools could offer both naturally occurring and arranged social interactions among the students (Miller, Bredemeier, & Shields, 1997). Research found that properly administered and supervised physical activity could combat antisocial and criminal behaviors in youth and result in more positive social behavior (Morris, Sallybanks, Willis, & Makkai, 2003). Socially there were many positives that were derived from physical activity throughout the school day; however, social exclusion was one area that was of concern. Collins and Kay (2003) stated that physical activity at school could cause social exclusion in some individuals. Bailey and Dishmore (2004) argued that physical activity during school hours more often resulted in social inclusion because students from different social and economic backgrounds were brought together in a shared interest and were then able to develop social networks through physical activity at school.

According to the President's Council on Physical Fitness and Sports (2009) physical activity in the school setting had many benefits for students. With children spending so much time at school, it made sense that school was where physical activity could be introduced and engaged in on a daily basis. With childhood obesity on the rise, school administrators were charged with combating this problem, and one way to fight obesity was through physical activity (Diez, 2004). As stated earlier, there were many benefits of being physically active during the school day. Physical benefits were what one typically thought of when speaking of exercise and physical activity, but in this section of the literature review it was evident through research that academic, social, and psychological benefits also occur from being physically active while at school (Bailey, 2006). Students should not be limited to exercising their mind only, but should be given opportunities during the school day to exercise their bodies as well.

School Based Physical Activity Curricula

Castelli and Williams (2007) suggested many physical education programs were characterized by inappropriate instruction such as teaching short units that offered little chance for application, students' picking teams, or assessments based solely on the number of days the student participated. Diez (2004) agrees that while this type of physical education program does exist, many physical education programs meet higher standards and were doing their part to increase physical activity levels of the students, collaborate with parents, and use curricula to help ensure the highest levels of physical activity were being met during school hours.

Academic curricula were of great importance in each subject and were used to guide teachers so they would stay on track throughout the school year, which resulted in less wasted time and more productivity (Solomon, Standish, & Orleans, 2009). If this was true of all curricula in the classrooms, curricula should play an important role in the subject of physical education as well. There are many different types of physical activity curricula, and choosing the right one depends on a school's goals and needs (Siedentop, 2009). Some of the most popular physical activity curricula are the Sports, Play, and Active Recreation for Kids (SPARK), Coordinated Approach To Child Health (CATCH), Take 10!, and Cross-curricular/ integrated curricula. Of these four main physical activity curricula, SPARK and CATCH are designed for use in the gymnasium as part of a physical education program, and TAKE 10! is an in-class physical activity program. TAKE 10! is a form of cross-curricular educating. Cross-curricular, also known as integrated curriculum, is a method that focuses on merging two subjects in order to improve upon both (Kerry, 2011).

The SPARK program has been disseminated nationally with SPARK training completed in over 3,000 schools. The curriculum primarily focuses on children kindergarten through 6^{th}

grades (Trost & Loprinzi, 2008). The SPARK curriculum is designed to maximize physical education class time and improve upon the following areas: strength, flexibility, locomotor and nonlocomotor skills, and cardiovascular endurance (Sallis et al., 1999). SPARK is intended for a minimum of 3 days per week for 36 weeks, and each class should be 30 minutes in length. The classes are broken up into two sections, 15 minutes for health instruction and 15 minutes of fitness activity (Owen, Glanz, Sallis, & Kelder, 2006). Upon schools purchasing the SPARK curriculum, they would have a representative from the school attend training. With this purchase the school received training, physical activity equipment, and activity cue cards (SPARK, 2011). A recent study revealed 80% sustainability after 4 years (Sallis et al., 2005). The SPARK curriculum has been linked to academic achievement through physical activity, specifically the SPARK program. One such study also stated that trained teachers were more likely to obtain higher levels of physical fitness throughout the duration of the SPARK program (Jensen, 1998). There are many benefits of the SPARK curriculum to schools and students, one of which was higher activity levels and more motivated teachers to properly instruct students on physical activities and health topics.

CATCH is another school-based physical activity curriculum that came highly recommended by the Center for Disease Control (CDC) and had been used in many of their studies to determine activity levels in youth (Brown, Perez, & Hoelscher, 2007). This particular curriculum is based on the CDC coordinated school health model in which eight components came into play: health education, physical education, health services, child nutrition services, counseling, healthy school environment, health promotion for staff, family, and community involvement (CATCH, 2011). CATCH had a strong evidence-base, which showed the success of the curriculum in areas of reducing weight and positive academic improvements. One particular study was conducted in Travis County, Texas. The CATCH curriculum was implemented into elementary schools in this county, where it was recorded that a significant weight reduction among the Hispanic population was found (Hoelscher, Springer, & Ranjit, 2010).

The CATCH curriculum was designed to promote physical activity, raise awareness about tobacco use, and teach nutritional guidelines to teachers and students. This program has been implemented in thousands of elementary and middle schools across the nation and was designed specifically for kindergarten through 8th grade. CATCH now has expanded its efforts to afterschool programs where they have designed a curriculum specific to afterschool activities for students. When purchasing this curriculum a school is provided with lesson plans and equipment. CATCH does not just promote physical activity among students, but stresses the involvement of the teachers as well (CATCH, 2011).

TAKE 10! is another physical activity curriculum that has been implemented into many schools in an effort to increase physical activity throughout the school day. TAKE 10! was created by teachers and was designed for classroom use. Physical education teachers do not need to be present to have this type of curriculum be successful. TAKE 10! offers activities that were intended to last 10 minutes. These activities could be performed in the classroom and be led by the classroom teacher (TAKE10!, 2011). TAKE 10! is different from the other curricula discussed because it uses a cross-curricular design to help promote not only physical activity but integrate math, reading, and English material into the physical activity. When ordering this curriculum a classroom teacher would receive a materials kit that included the following: activity cards, posters, assessments, and teacher's resources. Stewart, Dennison, Kohl, and Doyle (2004) explained that TAKE 10! had resulted in high energy expenditure among the students, and teachers rated the curriculum highly because of the simple and quick preparation time. The TAKE 10! curriculum is designed for kindergarten through fifth grade.

Cross-curricular teaching was a method mentioned with the TAKE 10! curriculum. This method of teaching combines two different subjects in an effort to enhance learning of both subjects (Beckmann, 2011). An example of a cross-curricular lesson plan would be merging math and art. Beckmann conducted a study of eighth and ninth graders who completed a school project that used cross-curricular teaching to learn both math and art. The project conclusion showed that many algebraic terms could be learned and applied to art when creating art. This project used math to create art and art to learn mathematic equations. Overall students assessed in this type of cross-curricular method stated this type of teaching was both surprising and fun, and they were allowed to be creative which helped them learn better (Beckmann, 2011). Cross-curricular methods allow students to find their creative strengths that were a fundamental aspect of learning. When teachers have the freedom to be creative with their lessons and apply cross-curricular methods, it promoted thinking and reasoning skills in the students, as well as, excitement about the subjects (Brodie & Thompson, 2009). Some scholars oppose cross-curricular teaching because they feel each subject has its own domain. Within each domain comes a certain type of thinking and constructing of knowledge, cross-curricular methods would not be effective with this mindset (Kerry, 2011). However, many studies have been performed on cross-curricular teaching methods that show positive learning outcomes (Beckman, 2011; Brodie et al., 2009; Knox et al., 2009; Oliver et al., 2006).

Math and art, science and reading, or English and history were all typical cross-curricular subjects. Physical activity and math, physical activity and science, or physical activity and reading are also cross-curricular subjects that are being introduced to schools across our nation

(Knox et al., 2009). In a recent study researchers aimed at increasing physical activity by an additional 2 hours per week for 18 weeks. This particular intervention involved all academic subjects. The interventions were designed and delivered by classroom teachers. Students participated in two cross-curricular lessons per day, thus increasing their physical activity level as well as practicing subject material. Results from this study showed that there were positive psychological outcomes that served as motivators for students to learn. Additional results showed that physical activity levels were raised on a daily basis (Oliver et al., 2006).

Another type of cross-curricular method was used in the Beanstalk Fitness Adventure Playground. This particular playground was interactive in nature and was designed to help prevent childhood obesity. The playground and cross-curriculum supplied schools and teachers with information, activities, and interactive playgrounds that aided students in physical activity and healthy lifestyles (Fischesser, 2008).

Nonschool-Based Physical Activity Programs

To further show the importance of physical activity there are many programs throughout the nation that focus on physical activity and youth that are not school-based. While most children spend 180 days, 7 hours per day in school, there is still time to get physically active outside of school (How do Children Spend their Time?, 2000). Research suggested that communities and other organizations have realized the importance of children and families having additional opportunities to be physically active outside of school (World Health Organization, 2004). Because of this recognition, many physical activity programs have been put in place in our nation that promote families being active together as well as offering children different options for increasing their daily physical activity, especially in the summer months when schools are not in session. Some of the most recognized nonschool based physical activity programs that are currently offered are NFL Play 60, NBA Fit, Michelle Obama's Let's Move, and the YMCA Healthy Kid's Day. All of these programs have the goal of creating safe and effective ways for children to become or remain physically active during nonschool hours.

While there are several government sponsored physical activity initiatives for children, there are also several professional sport organizations that have gotten on board, such as National Football League (NFL) Play 60. This program offers flag football for boys and girls, after-school physical activity, and mini-football camps. From their website individuals can access details about different types of activities that are offered. NFL Play 60 also has a program called *Youth Fitness Zones* where over 25 NFL clubs go into communities and construct fitness zones that are areas for children to come and get physically active (Play60, 2011). Other professional sport organizations that provide opportunities for children to be active are the National Basketball Association (NBA) and Women's National Basketball Association (WNBA). Their program is called Fit and focuses on both health and wellness to encourage physical activity and healthy living. This program uses many of their fit athletes to provide tips and education to parents and children about living a healthy lifestyle. Two specific programs offered by NBA Fit are the NBA Fitness Challenge which gave over 100,000 children the chance to workout with NBA players and showcase their own fitness levels. A second program is the *Dribble, Dish, and Swish Program* which was held in over 100 communities and gave children the chance to learn fundamental basketball skills (NBA Fit, 2011). Other sport organizations involved with promoting physical activity and wellness in youth are Major League Soccer and National Hockey League in which both focus on fighting childhood obesity by way of getting kids active (MLS Works, 2011; NHL Street Fit, 2011).

Another highly recognized program focusing on increasing physical activity in children and families is Michelle Obama's *Let's Move* initiative. Created in 2010, this program provides information about how and where to get physically active. The *Let's Move* webpage has information to help communities get involved with getting their citizens active, such as walking trails and safe playgrounds. The program also supplies information on specific places a family can go that will provide them with physical activity, such as hiking trails, parks, and fitness centers. In an effort to support her program, the First Lady created a summer South Lawn series in which local children and families will come to the South Lawn to participate in sports and activities throughout the summer (Let's Move, 2011).

The Young Men's Christian Association (YMCA) is another nonschool based program that has long been promoting physical activity among youth. One specific program of this organization is the YMCA Healthy Kid's Day, which will be held summer of 2011 at over 1,600 YMCA locations. YMCAs also host many after-school programs in which they strive to get students active after 7 hours of schooling. One way in which this organization is successful at getting kids active is through youth sports. These sports allow children to engage in physical activity while learning many positive characteristics such as teamwork and dedication (YMCA, 2011).

Summary

In recent years physical inactivity in youth has become an area of great concern among school administrators, health care providers, and parents. Wuest and Bucher (2009) stated that physical inactivity was a contributing factor of childhood obesity, development of chronic diseases, and rising medical costs in our nation. To improve the health of our children, limit obesity and disease, and lower medical costs our schools and households must focus on getting youth more physically active.

Physical education and physical activity during the school day has the potential to promote healthy lifestyles as well as prevent and decrease childhood obesity. Nearly 12 years of a child's life is spent in a school. Because of this, schools were the primary institution for providing physical activity and health resources (McKenzie & Lounsbery, 2008). Research has shown the many benefits of physical activity such as reduces risk of cardiovascular disease, reduces risk of diabetes, reduces risk of obesity, decreases stress, decreases anxiety, increases self-esteem, and many more (CDC, 2010*d*). Another area that physical activity aids in is academic achievement. As stated in the review of literature, students who have higher levels of fitness most often have higher test scores in academic subjects (Dwyer et al., 2001). Physical activity has also shown to have positive psychological impacts such as social behavior, body image, and overall attitude (Morris, 2003).

In an effort to increase physical activity it is important for school administrators and teachers to understand the literature that supports the many benefits of being physically active during school hours. NASPE (2010*a*) recommended 60 minutes of moderate to vigorous physical activity per day in order to see health benefits. They specifically recommended that children obtain their 60 minutes of activity in several small bouts throughout the school day. The literature suggested the following ways to obtain the recommended amount of physical activity was through recess, physical education, and cross-curricular activities. By using different types of physical activity programs students can achieve several small bouts of activity throughout the school day, as recommended by Center for Disease Control (2010*b*). Studies showed that physical education alone would not provide sufficient activity for children to meet the health-related recommendations of 60 minutes or more of moderate to vigorous physical activity (MVPA). Recess was an additional avenue that schools could offer students to increase physical activity (Verstraete, Greet, Cardon, DeClercq, & DeBourdeaudhuij, 2006). Ridgers and Stratton (2004) studied elementary students engaging in recess and the data suggested that while most students did not engage in the recommended 50% of recess time being MVPA, recess still proved to be a salient opportunity for children to take part in physical activity. Cross-curricular methods have also proven to be successful in motivating students to learn while being physically active, thus increasing physical activity during the school day (Knox et al., 2009).

CHAPTER 3

RESEARCH METHODOLOGY

The obesity rate among children has dramatically increased over the past decade with physical inactivity being a major factor (Trust for America's Health, 2011). Schools have been designated the primary avenue for providing opportunity for students to be more active during the school day in order to improve their health. The purpose of this research study was to measure levels of physical activity in elementary students during school hours. Specifically, I sought to find if there are increased levels of physical activity while students are using an adventure playground as compared to when they are engaged in free play or physical education class. The resulting data were compared and contrasted to determine if cross-curricular lessons using the adventure playground system provide comparable levels of physical activity to standard physical education curricula and if either is comparable to free play during school hours.

This study was a quantitative study that examined levels of physical activity in elementary students during school hours as well as observed any differences among physical activity measurement protocols. Physical activity levels during physical education class, free-play, and cross-curricular activity on the interactive playground, were all analyzed. Measurements were taken using pedometers and accelerometers that were attached to the students. The pedometer and accelerometers are small devices that were attached to the students and objective data were produced. The observational method produced subjective data because researchers were directly observing the children's physical activity and recording data. It is important for school administrators to know which types of physical activity periods (physical education class, free-play, or cross-curricular activity) provide for the greatest level of activity in order to maximize all of the benefits of physical activity and to be able to choose the best form of physical activity for the students when under strict time constraints.

Research methods that were designed and used for this study are discussed in Chapter 3. Within this section the following are provided: research questions, instrumentation, population, data collection, data analysis, and summary.

Research Questions

The following research questions and hypotheses guide this study. The questions address differences in levels of activity during the different types of physical activity during the school day. The questions also focus on possible differences in the different physical activity measurement protocols used in this study.

Research Question 1: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by accelerometers?

H_0 1: There is no significant difference in level of physical activity among students participating in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by accelerometers.

Research Question 2: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by pedometers?

H_0 2: There is no significant difference in level of physical activity among students participating in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by pedometers.

Research Question 3: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by the observational method?

H_0 3: There is no significant difference in level of physical activity among students participating in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by the observational method.

Research Question 4: Is there a significant difference among accelerometers, pedometers, and the observational method when measuring the different types of physical activity during the school day?

H_0 4_1: Regardless of physical activity setting, there is no significant difference among measurements of accelerometers, pedometers, and the observational method.

H_o 4_2: There is no significant difference among measurements of accelerometers, pedometers, and the observational method when assessing physical education classes.

H_o 4_3: There is no significant difference among measurements of accelerometers, pedometers, and the observational method when assessing cross-curricular activities on the interactive playground.

H_o4_4: There is no significant difference among measurements of accelerometers, pedometers, and the observational method when assessing free-play sessions.

Research Question 5: Is there a significant difference between male and female 4th grade students' physical activity intensity levels among physical education class, free play, and cross-curricular activity as measured by the observational method.

H_0 5_1: There is no significant difference between male and female 4th grade students' physical activity intensity levels among physical education class, free play, and cross-curricular activity as measured by the observational method.

H_o 5_2: There is no difference between male and female 4th grade students' physical activity intensity levels during free play as measured by the observational method.

H_o 5_3: There is no difference between male and female 4th grade students' physical activity intensity levels during cross-curricular activity as measured by the observational method.

Instrumentation

Yamax Digiwalker SW-401Y pedometers were attached to 20 students for three (30 minute) sessions for each of the following; physical education class, play on the Beanstalk playground with use of cross-curricular lessons, and recess. The pedometers estimate steps taken over a period of time and help determine the physical activity level of students. The pedometers were placed on the right hip at the start of each session and removed at the end of each session. The cost of a Yamax Digiwalker SW-104Y pedometer is approximately $30 (Yamaxx.com, 2011).

The GT3X Activity Accelerometers were attached to four boys and four girls for three (30 minute) sessions. The accelerometer is a more sophisticated electronic device that measures accelerations produced by body movements. Each accelerometer was placed on the right hip of the student at the beginning of the session and removed at the end of the session. The cost of this accelerometer is approximately $300 each (Actigraph, 2011).

The SOFIT (System for Observing Fitness Instruction Time) program was created to assess variables associated with students' activity levels and opportunities to become physically fit. SOFIT uses a systematic observational method to record students' activity levels, curriculum context variables, and teacher behavior. This system uses time sampling and an interval recording system in order to quantify information believed to promote physical activity. SOFIT consists of three phases.

Phase 1 was making a decision on the activity level of the individual learners. Individual learners were observed to determine their activity level. Every 20 seconds throughout the class time the observer(s) recorded the active engagement level of their assigned learner. This equals three recordings per minute and 90 recordings per 30-minute session. The engagement level provides estimations of intensity at which the student was being physically active, using activity codes validated by SOFIT. Codes 1-4-1) lying down, 2) sitting, 3) standing, 4) walking, and 5) was high-level activity. The observer did not record until the 20-second interval was complete and the code signified what the student is doing at the end of the interval.

Phase 2 was coding the curricular lesson context of the class. At the end of each 20-second interval a code was assigned depending on whether class time is being allocated for general content (management) or actual subject matter (physical education) content. If a large amount of physical education content is being presented, then an additional decision must be made on whether the class focus is on knowledge content (general knowledge) or on motor content (physical activity). If motor content is being recorded, yet another decision must be made to code whether the context is one of game play, skill practice, or fitness.

Phase 3 was coding the teachers' involvement during class. Six categories exist: 1) Promotes fitness. 2) Demonstrates fitness. 3) Instructs generally. 4) Manages. 5) Observes. 6) Off-task. These provide important information on how teachers spend their time (McKenzie, 2009).

Population

A school system in East Tennessee was selected for the study because of access to the Beanstalk Adventure Playgrounds and incorporation of cross-curricular studies with the playground. Two hundred fifty fourth grade students at three different elementary schools in the participating county were chosen for this study because of accessibility and use of the adventure playgrounds as well as, physical education class and recess. Each fourth grade class was observed three different times during each of the physical activity times mentioned above. All participants were given pedometers to wear, minus six participants who wore accelerometers. Three students per class were given a jersey and observed by the direct observational method. These students also wore either a pedometer or accelerometer for measurement. So, while there were 250 research participants, many of the students were observed more than once under different measurement protocols.

The sampling technique included two types of nonprobability sampling techniques, reliance on available subjects and purposive sampling. Because only fourth grade classes were included, the study relied on the subjects who were enrolled in those particular classes. For the other research activities a purposive sampling technique was used. Schools were chosen based on availability of the Beanstalk Playgrounds, the fourth grade classes were chosen on the basis of meeting the study's criteria, and researchers chose equal numbers of boys and girls when placing accelerometers. The number of participants wearing accelerometers was low but in line with previous research of this nature. Cost of this type of measurement instrument is one reason for lower numbers when collecting data.

Data Collection

Approval was attained from East Tennessee State University's Institutional Review Board before data were collected. Approval was also granted by the participating school system. Individual identifiers were not requested for this study. The Department of Kinesiology, Leisure, and Sport Sciences, at East Tennessee State University, granted me permission to use pedometer, accelerometer, and observational method data for use in this dissertation. All data were collected May 2010. Data analyses are presented in Chapter 4.

Before collecting data, persons were trained on proper application of pedometers and accelerometers as well as calibration of both. At the start of each physical activity session students were read an introductory script explaining the study. The equipment was then calibrated by researchers to ensure all data were cleared from previous use. Students then formed a line and researchers placed either a pedometer or accelerometer on each of the student's right hip. The class then resumed as scheduled. At the conclusion of the class the students lined up and researchers removed the devices. A closing script was read at this time. Data were immediately retrieved from the pedometers and documented by researchers and then data were cleared from the device. Data from the accelerometers were immediately downloaded to a laptop and cleared from the device to prepare for the next participant. This process continued throughout each physical activity session observed.

Before collecting data by the observational method, persons were trained on specific coding for the three levels of activity (low, moderate, and high). For each class, three students were chosen at random to wear a jersey, each a different color. Data collectors were each equipped with a clipboard, scoring sheet, and pen. One data collector was equipped with a stopwatch and had the responsibility to notify collectors at the 20-second mark, 40-second mark, and 1-minute mark for the duration of the 30-minute class. The person with the stopwatch signaled other data collectors with a cue of “go” to notify it was time to locate the children in the jerseys and score their action immediately. The data collectors did not discuss with each other the actions of the students before scoring their action. At the end of each class the jerseys were collected and scoring sheets collected.

Data Analysis

The collected data were analyzed using the IBM-SPSS statistical package. Research questions 1 and 2 were analyzed using an ANOVA to determine significant differences between groups. Research question 3 was analyzed using chi-square tests to determine significant differences between the types of physical activity as measured by the observational method. Research question 4 was analyzed using chi-square tests to determine significant differences among the physical activity measurements. Research question 5 was analyzed using an independent-sample t-test to determine significant differences among 4^{th} grade male and female levels of intensities in the different physical activity classes, when measured by the observation method.

To analyze data from Research question 4, data that were collected from all three types of physical activity measurements needed to be manipulated into the same metric scale.

Pedometers provide step counts, which were categorized into three categories: low intensity, moderate intensity, and vigorous intensity. Accelerometers collect many different types of data, one of which is step counts. The accelerometer step counts were also categorized into three categories: low intensity, moderate intensity, and vigorous intensity. The observational method uses a systematic method of coding students' activity levels, which are already labeled low intensity, moderate intensity, and high intensity.

Because pedometers and accelerometers cannot directly measure physical activity intensities, researchers conducted studies in labs to measure oxygen uptake of individuals wearing pedometers and accelerometers in order to correlate a step count to an intensity level. The assigning of step counts to intensity levels allowed pedometer and accelerometer step counts collected during this study to be categorized into low or moderate to vigorous activity levels. Specifically, 100 steps per minute was considered moderate to vigorous activity, or 2,000 or more steps in a 30 minute session was also considered moderate to vigorous activity (NASPE, 2010*a*). The observational method data were already categorized in three intensity levels that were then consolidated into just two main categories, low and moderate to vigorous physical activity (MVPA). This allowed data collected from all three different physical activity measurement protocols to be placed in the same metric scale; low intensity or moderate to vigorous intensity. The chi-square test was then able to compare data from pedometer, accelerometer, and the observational method and show relationships within both categories (low or moderate to vigorous). The test was repeated for each type of physical activity (physical education, interactive playground, and free play).

Chapter Summary

The research design, participants, instruments, procedures, research questions, statistics, and summary are all presented in Chapter 3. In this quantitative study I examined the levels of physical activity in elementary students during school hours. In addition, I compared differences among the physical activity measurement protocols used by the 4^{th} grade students.

CHAPTER 4

DATA ANALYSIS

The purpose of this study was to examine the relationship between 4th grade physical activity classes offered during the school day and intensity levels produced by each. The study also compared each of the three types of physical activity measurement protocols to examine differences in physical activity level outputs. The focus was to determine which type of physical activity class practiced the most moderate to vigorous physical activity for students participating in this study. The focus was also to determine which measurement type was most accurate and feasible when examining intensity levels during school activity classes.

Secondary data collected by East Tennessee State University Department of Kinesiology, Leisure, and Sport Sciences were used for this study with approval of the department chair and the Institutional Review Board of East Tennessee State University. The quantitative data indicators were intensity level scores produced by pedometers, accelerometers, and the observational method. These scores were divided into two groups: low intensity and moderate to vigorous intensity. The scores were derived from the following physical activity classes: physical education, free play, and cross curricular activity on the interactive playground.

The study sample consisted of 4th grade students in three different East Tennessee elementary schools. Each of these schools was equipped with interactive playgrounds, which are used for cross-curricular activities, physical education programs, and designated free play time during the school day. Overall, the study consisted of 360 participants; 152 of whom were measured in physical education, 114 measured in free play, and 94 cross-curricular measured activities. The study sample size for students measured by pedometers in physical education, free play, and cross-curricular activity were, 90, 66, and 45, respectively. The study sample size for students observed by accelerometers in physical education, free play, and cross-curricular activity were, 14, 11, and 10, respectively. While this sample size is lower than pedometer and the observational method, it is consistent with previous research regarding accelerometers and this age group (Sinard & Pate, 2001; Vries et al., 2006). The sample size for students observed by the observational method in physical education, free play, and cross-curricular activity were, 48, 37, and 39, respectively.

For the pedometer data the study revealed a mean step count per minute of 87.12, with a range of 13.5 steps per minute to 359.5 steps per minute. Research suggests that 100 steps per minute are needed to produce moderate to vigorous activity levels. This data set showed the overall mean in the low intensity category for all physical activity types included. When pedometer data were separated by physical education, free play, and cross-curricular activity, the mean step count was 84.9 steps per minute, 80.25 steps per minute, and 107.95 steps per minute, respectively. For the accelerometer data the study revealed time spent in moderate to vigorous intensity as 43.59%, which included all three types of physical activity classes measured. National recommendations state an average of 50% of physical activity classes should be spent in moderate to vigorous activity (NASPE, 2010). When accelerometer data were separated by physical education, free play, and cross-curricular activity, the mean times spent in moderate to vigorous activity were, 50.51%, 34.35%, and 61.26%, respectively. When looking at the observational method data, the study showed overall time spent in moderate to vigorous intensities as 60.16%. When the observational method data were separated by physical education, free play, and cross-curricular activity, the mean times spent in moderate to vigorous activity were, 68.85%, 60.75%, and 48.9%, respectively.

Analysis of Research Questions

Research Question 1

Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free play, and cross curricular activity (Interactive playground) as measured by accelerometers?

Percentage of time spent in moderate to vigorous intensity levels of physical activity as measured by accelerometers was the information used to answer this research question. Percentages produced from all three physical activity programs were then compared. A one-way analysis of variance was conducted to test the following null hypothesis:

H_0 1: There is no significant difference in level of physical activity among students participating in physical education class, free play, and cross curricular activity (Interactive playground), as measured by accelerometers.

The ANOVA indicated a significant difference among the physical activity classes. The factor variable was the type of physical activity class: physical education, free play, or the cross-curricular interactive playground. The dependent variable was the level of physical activity as produced by accelerometer measures. The ANOVA was significant, $F(2, 32) = 7.84$, $p = .002$. Therefore, the null hypothesis was rejected. There was a strong effect ($\eta^2 = .334$) between the type of physical activity class and the level of intensity as produced by accelerometer results. Sample size was low; however, it is in line with other studies that have used accelerometers as a measurement protocol in young children (Sinard & Pate, 2001; Vries et al., 2006) .

Because the overall *F* test was significant, post-hoc multiple comparisons were conducted to evaluate pairwise differences among the means of the three groups. A Tukey procedure was selected for the multiple comparisons because equal variances were assumed. There was a significant difference in the means between physical education and cross curricular ($p = .001$) in favor of physical education. However, there was not a significant difference between physical education and free play ($p = .297$) or between free play and cross curricular ($p = .063$). It appears that physical education and free play produce similar physical activity levels, as measured by accelerometers. It also appears that free play and cross-curricular produce similar levels of intensities, as measured by accelerometers. It is noteworthy to state that one particular instructor in cross-curricular activity produced very high moderate to vigorous scores, thus skewing the cross-curricular accelerometer data, which resulted in cross curricular physical activity having the highest percent time spent in moderate to vigorous activity. The 95% confidence intervals for the pairwise differences, as well as, the means and standard deviations for the three physical activity classes are reported in Table 1.

Table 1

Means and Standard Deviations with 95% Confidence Intervals of Pairwise Differences as Measured by Accelerometers

Type of Physical activity	N	M	SD	P.E.	Free Play
P.E.	14	31.66%*	23.08		
Free Play	11	42.70%*	7.05	-28.95 to 6.86	
Cross Curricular	10	61.26%*	18.39	-48 to -11.21	-37.97 to .86

** % time spent in Moderate/Vigorous Activity*

<u>Research Question 2</u>

Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by pedometers?

The pedometer step counts produced from each of the three different types of physical activity were used to answer this research question. The dependent variable was the pedometer step count. Two-hundred one step counts were recorded during this study. Using these step counts, a one-way analysis of variance was used to test the following null hypothesis:

H_0 2: There is no significant difference in level of physical activity among students participating in physical education class, free play, and cross curricular activity (Interactive playground) as measured by pedometers.

The ANOVA resulted in significant differences among the three physical activity types and their intensity levels as measured by pedometers. The dependant variable was the step count as produced by pedometer measures. The ANOVA was significant, F (2, 198) = 49.6, $p < .001$. Therefore, the null hypothesis was rejected. There was a strong relationship ($\eta^2 = .334$) between the type of physical activity class and the level of intensity.

Because the overall F test was significant, post-hoc multiple comparisons were conducted to evaluate pairwise differences among the means of the three groups. A Tukey procedure was selected for the multiple comparisons because equal variances were assumed. There was a significant difference in the means between physical education and cross curricular ($p < .001$) and between free play and physical education ($p < .001$) both comparisons in favor of physical education. However, there was not a significant difference between free play and cross curricular ($p = .664$). It appears that both free play and cross curricular activity produce similar physical activity levels as measured by pedometers. The 95% confidence intervals for the pairwise differences as well as the means and standard deviations for the three physical activity classes are reported in Table 2.

Table 2

Means and Standard Deviations with 95% Confidence Intervals of Pairwise Difference as Measured by Pedometers
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Type of Physical activity	N	M*	SD	P.E.	Free Play
P.E.	90	2,470.26	1,207.98		
Free Play	66	1,090.67	556.56	1,021.72 to 1,737.46	
Cross Curricular	45	1,743.37	725.18	820.19 to 1,626.54	-583.13 to 270.69

**Means presented in pedometer step count*

Research Question 3

Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free play, and cross curricular activity (Interactive playground) as measured by the observational method?

Evaluating observational method output required the scores be placed into two categories: low intensity and moderate to vigorous intensity. Then a percentage of time spent in the moderate to vigorous category was calculated. This percentage became the dependent variable. A one-way analysis of variance was conducted to assess the following null hypothesis:

H_0 3: There is no significant difference in level of physical activity among students participating in physical education class, free play, and cross curricular activity (Interactive playground) as measured by the observational method.

The ANOVA results showed a significant difference among the types of physical activities. The dependent variable was the different levels of physical activity as produced by the observational method scores. The ANOVA was significant, F (2, 121) = 22.37, $p < .001$.

Therefore, the null hypothesis was rejected. A weak effect between the type of physical activity class and the level of intensity was found ($\eta^2 = .083$).

Because the overall *F* test was significant, post hoc multiple comparisons were conducted to evaluate pairwise differences among the means of the three groups. A Tukey procedure was selected for the multiple comparisons because equal variances were assumed. There was a significant difference in the means between physical education and cross curricular ($p < .001$) and between physical education and free play ($p < .001$) both in favor of physical education. However, there was not a significant difference between free play and cross curricular ($p = .154$). It appears that both free play and cross curricular activity produce similar physical activity levels as measured by the observational method. Correlation coefficients were computed among the six raters to address interrater reliability. Ten of the 15 groups were significant, with a correlation range of .782 to .990, and a mean range of 56.41% to 64.31%. The 95% confidence interval for the pairwise differences as well as, means and standard deviations for the three physical activity classes are reported in Table 3.

Table 3

Means and Standard Deviations with 95% Confidence Intervals of Pairwise Differences, as Measured by the Observational Method

Type of Physical activity	N	M*	SD	P.E.	Free Play
P.E.	48	86.06%	39.67		
Free Play	37	57.90%	15.9	-55.57 to -25.71	
Cross Curricular	39	45.43%	22.99	25.71 to 55.57	12.47 to 6.7

** Percent Time Spent in Moderate to Vigorous Activity*

Research Question 4

Is there a significant difference among accelerometers, pedometers, and the observational method when measuring the different types of physical activity during the school day?

The evaluation of accelerometer, pedometer, and the observational method outputs required data to be categorized. Separate analyses were conducted for each of the three measurement types to create two variables: low intensity and moderate to vigorous intensity. Calculating a percentage of time spent in moderate to vigorous activity was done for both accelerometers and the observational method. This percentage then was placed in one of the two variable categories: low intensity or moderate to vigorous intensity. Previous research and recommendations guided the categorical cut-off points for the two levels of intensities, suggesting that 50% of a 30-minute physical education class should be spent in moderate to vigorous activity (NASPE, 2010; Pangrazi, 2009). The pedometer step counts were converted into the two categories of intensities by using previous research and recommendations, which suggest any step count over 2,000 in a 30-minute class is considered moderate to vigorous activity (HealthyPeople, 2010; NASPE, 2010). Two-way contingency table analyses were conducted to test the following null hypotheses:

H_0 4_1: Regardless of physical activity setting, there is no significant difference among measurements of accelerometers, pedometers, and the observational method.

The chi-square results showed a significant difference among the measurement outputs and type of physical activity class, thus rejecting the null hypothesis. The two variables were level of physical activity intensities with two levels (low intensity and moderate to vigorous intensity) and type of physical activity measurement protocol with three methods (pedometer, accelerometer, and the observational method). A significant difference was found between physical activity measurement types and intensity levels, χ^2 = (2, N= 280) = 97.22, $p < .001$, Cramer's V = .589. The proportion of moderate to vigorous activity levels produced among pedometers, accelerometers, and the observational method were .32, .40, and .92 respectively.

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. Table 4 shows the results of these analyses. The Holm's sequential Bonferroni method was used to control for Type 1 error at the .05 level across all three comparisons. Significant difference was found between the observational method and pedometers, χ^2 = (1, N = 245) = 93.33, $p < .001$, Cramer's V = .617, with the observational method producing higher levels of moderate to vigorous activity levels. Another significant difference was found between the observational method and accelerometers, χ^2 = (1, N = 158) = 46.48, $p < .001$, Cramer's V = .542, with observational method producing higher levels of moderate to vigorous activity levels. There was no significant difference found between pedometers and accelerometers χ^2 = (1, N = 157) = .785, p = .376, Cramer's V = .071.

Table 4

Results for the Pairwise Comparisons Using the Holm's Sequential Bonferroni Method, Regardless the Physical Activity Setting

Comparison	N	χ^2	p	V
Pedometer vs. accelerometer	157	.785	.376	.071
Pedometer vs. observational method	245	93.33	<.001*	.617
Accelerometer vs. observational method	158	46.48	<.001*	.542

**significant difference*

$H_0 4_2$: There is no significant difference among measurements of accelerometers, pedometers, and the observational method with physical education class.

A two-way contingency table analysis was conducted to evaluate whether activity levels produced in physical education were consistent among each of the physical activity measurement types (pedometers, accelerometers, and the observational method). The two variables were level of physical activity intensities with two levels (low intensity and moderate to vigorous intensity) and type of physical activity measurement protocol with three levels (pedometer, accelerometer, and the observational method). Only data pertaining to physical education classes were used for this hypothesis. A significant relationship was found among physical education classes and intensity levels produced by the three measurement types, $\chi^2 = (2, N = 172) = 16.8, p < .001$, Cramer's V= .313. The proportion of moderate to vigorous activity levels produced among pedometers, accelerometers, and the observational method were .63, .33, and .84 respectively.

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. Table 5 shows the results of these analyses. The Holm's sequential Bonferroni method was used to control for Type 1 error at the .05 level across all three comparisons. When looking at physical education class, a significant difference was found between pedometers and accelerometers, the analysis resulted in $\chi^2 = (1, N = 105) = 4.79, p = .045$, Cramer's V = .21. Results from this comparison show pedometers to rate higher levels of moderate to vigorous activity than the accelerometers. Another significant difference was found between the observational method and pedometers, $\chi^2 = (1, N = 157) = 7.80, p = .005$, Cramer's V = .223, which showed the observational method to rate higher levels of moderate to vigorous activity than the pedometers. The last comparison, between the observational method and accelerometers resulted in a significant difference, $\chi^2 = (1, N = 82) = 16.24, p < .001$, Cramer's V = .445, with the observational method rating higher amounts of moderate to vigorous activity than the accelerometers.

Table 5

Results for the Pairwise Comparisons Using the Holm's Sequential Bonferroni Method for Activity in Physical Education

Comparison	N	χ^2	*p*	V
Pedometer vs. accelerometer	105	4.79	.045*	.021
Pedometer vs. observational method	157	7.8	.005*	.223
Accelerometer vs. observational method	82	16.24	< .001*	.445

**Significant Difference*

$H_o 4_3$: There is no significant difference among measurements of accelerometers, pedometers, and the observational method during free play.

A two-way contingency table analysis was conducted to evaluate whether activity levels produced during free play were consistent among each of the physical activity measurement types (pedometers, accelerometers, and the observational method). The two variables were level of physical activity intensities with two levels (low intensity and moderate to vigorous intensity) and type of physical activity measurement protocol with three levels (pedometer, accelerometer, and the observational method). Only data pertaining to free play activities were used for this analysis. A significant difference was found among free play classes and intensity levels produced by the three measurement types, $\chi^2 = (2, N = 127) = 86.5$, $p < .001$, Cramer's V = .825. The proportion of moderate to vigorous activity levels produced among pedometers, accelerometers, and the observational method were .12, .3, and .98 respectively.

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. Table 6 shows the results of these analyses. The Holm's sequential Bonferroni method was used to control for Type 1 error at the .05 level across all three comparisons. When looking at free play, a significant difference was found between pedometers and the observational method, $\chi^2 = (1, N = 117) = 84.96$, $p < .001$, Cramer's V = .852, with the observational method producing higher amounts of moderate to vigorous activity than the pedometers. Another significant difference was found between the observational method and accelerometers, the analysis resulted in $\chi^2 = (1, N = 61) = 33.97$, $p < .001$, Cramer's V = .746, which showed the observational method to rate significantly higher amounts of moderate to vigorous activity when compared to the accelerometers. The last comparison, between the pedometers and accelerometers resulted in no significant difference, $\chi^2 = (1, N = 76) = 2.24$, $p = .153$, Cramer's V = .172.

Table 6

Results for the Pairwise Comparisons Using the Holm's Sequential Bonferroni Method for Activity in Free Play

Comparison	N	χ^2	*p*	V
Pedometer vs. accelerometer	76	2.24	.153	.172
Pedometer vs. observational method	117	84.96	< .001*	.852
Accelerometer vs. observational method	61	33.97	< .001*	.746

**Significant Difference*

$H_o 4_4$: There is no significant difference among measurements of accelerometers, pedometers, and the observational method with cross curricular activity.

A two-way contingency table analysis was conducted to evaluate whether activity levels produced while using cross-curricular activity on the interactive playground were consistent among each of the physical activity measurement types (pedometers, accelerometers, and the observational method). The two variables were level of physical activity intensities with two levels (low intensity and moderate to vigorous intensity) and type of physical activity measurement protocol with three levels (pedometer, accelerometer, and the observational method). Only data pertaining to cross-curricular activities were used for this hypothesis. A significant difference was found among cross-curricular activity and intensity levels produced by the three measurement types, $\chi^2 = (2, N = 63) = 17.78$, $p < .001$, Cramer's V = .531. The proportion of moderate to vigorous activity levels produced among pedometers, accelerometers, and the observational method were .22, .67, and .89 respectively.

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. Table 7 shows the results of these analyses. The Holm's sequential Bonferroni method was used to control for Type 1 error at the .05 level across all three comparisons. When looking at cross-curricular activity, a significant difference was found between pedometers and accelerometers, Pearson's chi-square resulted in $\chi^2 = (1, N = 54) = 7.11$, $p = .014$, Cramer's V = .363, with accelerometers showing higher amounts of moderate to vigorous activity. Another significant difference was found between the observational method and pedometers, $\chi^2 = (1, N = 54) = 15.0$, $p < .001$, Cramer's V = .527, with the observational method showing higher amounts of moderate to vigorous activity. The last comparison, between the observational method and accelerometers resulted in no significant difference, $\chi^2 = (1, N = 18) = 1.29$, $p = .576$, Cramer's V = .267.

Table 7

Results for the Pairwise Comparisons Using the Holm's Sequential Bonferroni Method for Activity in Cross Curricular Physical Activity

Comparison	N	χ^2	*p*	V
Pedometer vs. accelerometer	54	7.11	.014*	.363
Pedometer vs. observational method	54	15.0	< .001*	.527
Accelerometer vs. observational method	18	1.29	.576	.267

**Significant Difference*

Research Question 5

Is there a significant difference between male and female 4th grade students' physical activity intensity levels among physical education class, free play, and cross-curricular activity as measured by the observational method.

Data pertaining to males and female subjects measured by the observational method were used to answer this research question. Combined *N* for all three types of physical activity classes revealed, male *N* = 63 and female *N* = 61. An independent-sample t test was conducted to test the following null hypotheses.

H_o 5_1: There is no significant difference between male and female 4th grade students' physical activity intensity levels during physical education class as measured by the observational method.

The independent-sample t test showed no significant difference between male and female students' intensity levels when participating in physical education class and being measured by the observational method. The amount of time spent in moderate to vigorous physical activity was the test variable and the grouping variable was male or female. The test was not significant, $t(46) = .55$, $p = .585$. Therefore, the null hypothesis was retained. Males engaging in moderate to vigorous activity during physical education ($M = 25$, $SD = 19.87$) tended to expend similar physical activity intensity as the females engaging in moderate to vigorous activity during physical education ($M = 23$, $SD = 15.67$). The 95% confidence interval for the difference in means was -7.6 to 13.32.

H_o 5_2: There is no significant difference between male and female 4th grade students' physical activity intensity levels during free play as measured by the observational method.

The independent-sample t test showed no significant difference between male and female students' intensity levels when participating in free play and being measured by the observational method The amount of time spent in moderate to vigorous physical activity was the test variable and the grouping variable was male or female. The test was not significant, $t(35) = .322$, $p = .749$. Therefore, the null hypothesis was retained. Males engaging in moderate to vigorous activity during physical education ($M = 20$, $SD = 7.24$) tended to expend similar physical activity intensity as the females engaging in moderate to vigorous activity during free play ($M = 17$, $SD = 7.25$). The 95% confidence interval for the difference in means was -4.08 to 5.62.

H_o 5_3: There is no significant difference between male and female 4th grade students' physical activity intensity levels during cross-curricular activity as measured by the observational method.

The independent-sample t test showed no significant difference between male and female students' intensity levels when participating in cross-curricular activity and being measured by the observational method. The amount of time spent in moderate to vigorous physical activity was the test variable and the grouping variable was male or female. The test was not significant, $t(37) = .003$, $p = .971$. Therefore, the null hypothesis was retained. Males engaging in moderate to vigorous activity during physical education ($M = 18$, $SD = 15.01$) tended to expend similar physical activity intensity as the females engaging in moderate to vigorous activity during cross curricular ($M = 21$, $SD = 13.01$). The 95% confidence interval for the difference in means was -8.92 to 9.26.

CHAPTER 5

SUMMARY, FINDINGS, CONCLUSIONS, RECOMMENDATIONS

Chapter 5 includes a summary of findings of research questions, conclusions, and recommendations for future implementation of physical activity measurement protocols in elementary schools as well as implications for future research. The research examined intensity levels produced by 4^{th} grade students in three different physical activity settings during the school day (physical education, free play, and cross-curricular activity on the interactive playground). The study also examined differences among outputs of three types of physical activity measurement types (pedometers, accelerometers, and the observational method), which were used in each of the three physical activity settings. The study focused on whether or not physical activity classes during the school day are providing adequate levels of physical activity as well as which types of physical activity measurement protocols service elementary grades most effectively.

Methodology Review

The examination of physical activity intensity levels in different physical activity settings and evaluation of differences among the measurement types resulted in a quantitative study. Secondary data were used for this study and were provided by East Tennessee State University's Department of Kinesiology, Leisure, and Sport Sciences. Fourth grade classes from three different elementary schools in East Tennessee participated in this study. Measurements from each of the different types of protocols (pedometers, accelerometers, and the observational method) were gathered to gage intensity levels for each of the physical activity settings during the school day (physical education class, free play, and cross-curricular activity on the interactive playgrounds).

Pedometer step counts were used as a means of measuring physical activity intensity level, while accelerometer and observational method data used percent time spent in moderate to vigorous intensity as a means of measuring and categorizing data into physical activity intensities. Level of intensity depended upon categorical thresholds that were created using previous research and national recommendations. The data were then analyzed accordingly.

Subjects

The sample consisted of 4^{th} grade students in one school system in East Tennessee. Three elementary schools participated in this study, each of the schools having an interactive playground designed for cross-curricular activity. The three schools each had existing physical education programs, designated free play, as well as designated cross-curricular activity on the interactive playgrounds. A sample size of 360 was represented in this study, with 152 measurements from physical education classes, 114 measurements from free play segments, and 94 measurements from cross-curricular activity. Within physical education measurements, 90 cases were gathered from pedometers, 14 cases were gathered from accelerometers, and 48 cases were gathered from the observational method. Within free play measurements, 66 cases were taken from pedometers, 11 cases derived from accelerometers, and 37 cases derived from the observational method. Within cross-curricular activity, 45 cases were gathered from pedometers, 10 cases were gathered from accelerometers, and 39 cases derived from the observational method. It is important to note that while accelerometer samples are lower than both pedometer and the observational method samples this study is consistent with previous research using accelerometers and measuring youth (Sinard & Pate, 2001; Vries et al., 2006). Sample sizes differ because of different measurement protocols as well as technical errors resulting in data that could not be retrieved.

Findings

Five research questions guided this study and were evaluated at the .05 level of significance. Analysis of research questions 1, 2, and 3 used a one-way analysis of variance. Research question 4 used a two-way contingency table analysis, while research question 5 employed an independent-sample t test.

Research Question 1: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by accelerometers?

The one-way analysis of variance (ANOVA) indicated a significant difference among the physical activity classes. The ANOVA was significant, $F(2, 32) = 7.84$, $p = .002$. There was a strong relationship ($\eta^2 = .334$) between the type of physical activity class and the level of intensity as produced by accelerometer results. Sample size was low although in line with other studies that have used accelerometers as a measurement protocol in young children (Eston et al., 1998; Hands et al., 2006; Weston et al., 1997). Because of the significant difference a post hoc multiple comparisons test was conducted. The Tukey procedure resulted in a significant difference between physical education and cross-curricular activity (p=.001) and no significant difference between physical education and free play (.297) or free play and cross-curricular activity (.063).

The accelerometer data rated both physical education and free play as having similar amounts of time spent in moderate to vigorous physical activity. Free play and cross-curricular also show that when measured by accelerometers they tend to have similar time spent in moderate to vigorous physical activity. Results show physical education and cross curricular physical activity to have significantly different times spent in moderate to vigorous physical activity, with cross curricular physical activity having 61.26% time spent in moderate to vigorous activity and physical education having 31.66% and free play having 41.7%. Thus indicating cross curricular activity renders the highest amount of class time in moderate to vigorous physical activity when measured by accelerometers. This differs from previous research, which stated that physical education provides the highest amounts of moderate to vigorous activity (Sallis et al., 2001). The difference in studies could result from the different types of activities provided on this particular interactive playground that used cross-curricular activity. Another reason for cross-curricular activity to show such high amounts of moderate to vigorous activity was in part because of one instructor who was very effective at getting the students engaged in higher levels of activity. When data from that particular instructor were removed, the analysis shows cross-curricular activity to significantly decrease. Additionally, Welk (2000) stated that accelerometers may not be the best form of physical activity measurement for children because acceleromters are a better measure for long periods of time, not short bouts of activity, as this study was measuring.

Research Question 2: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by pedometers?

The ANOVA resulted in significant differences among the three physical activity types and their intensity levels as measured by pedometers. The ANOVA was significant, $F(2, 198) = 49.6$, $p < .001$. Therefore, the null hypothesis was rejected. There was a strong relationship ($ŋ^2$=.334) between the type of physical activity class and the level of intensity.

The pedometer data demonstrated a significant difference between physical education and cross-curricular activity ($p < .001$) as well as free play and physical education ($p < .001$). Physical education step counts averaged 2,470.26 per class, while cross-curricular step counts averaged 1,743.37 per class. This shows that when measured by pedometers physical education would provide more moderate to vigorous activity than cross curricular physical activity. When free play (1,090.67 average steps per class) and physical education (2,470.26 average steps per class) were compared, data revealed again that physical education produced the highest amounts of moderate to vigorous activity. When free play and cross-curricular pedometer step counts were analyzed, the ANOVA found there to be no significant difference between the two. This suggests that both free play (1,090.67 average steps) and cross-curricular activity (1,743.37 average steps) tend to produce like amounts of moderate to vigorous activity. Study participants with a step count above 2,000 steps per 30-minute class were placed in the moderate to vigorous intensity category. Recommendations from National Standards for Physical Education (2010) and Healthy People 2010 stated 2,000 steps per 30-minute class were categorized as moderate to vigorous activity.

Research Question 3: Is there a significant difference in the level of physical activity among fourth grade students engaging in physical education class, free-play, and cross-curricular activity (Interactive playground) as measured by the observational method?

The ANOVA results showed a significant difference among the types of physical activities. The ANOVA was significant, $F(2, 121) = 22.37$, $p < .001$. Therefore, the null hypothesis was rejected. A weak relationship between the type of physical activity class and the level of intensity was found ($\eta^2 = .083$). Correlation coefficients were computed among the six raters to address inner-rater reliability. Ten of the 15 groups were significant, with a correlation range of .782 to .990, and a mean range of 56.41% to 64.31%.

The analysis of the observational data when compared among the different physical activity settings resulted in a significant difference between physical education and cross curricular activity ($p < .001$) as well as physical education and free play ($p < .001$). The data illustrated no significant difference between free play and cross-curricular activity (p=.154). Results show free play (57.9%) and cross-curricular activity (45.43%) to produce similar percent time spent in moderate to vigorous activity when measured by the observational method. Observational data also showed physical education had an average of 86.06% time spent in moderate to vigorous activity, which was the highest percent time spent in moderate to vigorous activity of the three measurement types. These results differ from previous research that suggests that elementary students only average 40% of their time in moderate to vigorous activity during physical education and in some cases not even that high of a percentage (Fairclough & Stratton, 2005). National recommendations state children should spend 50% of a 30-minute physical education class in moderate to vigorous activity (NASPE, 2009; US Department of Health & Human Services, 2000). While our findings show students far above this threshold, most studies show students falling below the 50% mark. Previous research has also suggested ways in which this percent time spent in moderate to vigorous activity could be increased, such as the SPARK or CATCH curricula, which have proven to make increases in moderate to vigorous activity (President's Council on Physical Fitness and Sports, 2009).

Research Question 4: Is there a significant difference among accelerometers, pedometers, and the observational method when measuring the different types of physical activity during the school day?

The chi-square results showed a significant difference among the measurement outputs and type of physical activity class, thus rejecting the null hypotheses. A significant difference was found between physical activity measurement types and intensity levels, χ^2 = (2, *N*= 280) = 97.22, $p < .001$, Cramer's V = .589. The proportion of moderate to vigorous activity levels produced among pedometers, accelerometers, and the observational method were .32, .40, and .92 respectively.

Follow-up pairwise comparisons were conducted to evaluate the differences among these proportions. Table 4 shows the results of these analyses. The Holm's sequential Bonferroni method was used to control for Type 1 error at the .05 level across all three comparisons. Significant difference was found between the observational method and pedometers, χ^2 = (1, *N*= 245) =93.33, $p < .001$, Cramer's V = .617. The strong effect size demonstrates that the probability of a student scoring in the moderate to vigorous category when being measured by observational method versus pedometers was significantly higher. Another significant difference was found between the observational method and accelerometers, χ^2 = (1, *N*= 158) = 46.48, $p < .001$, Cramer's V = .542. The strong effect size demonstrates the probability of a student scoring in the moderate to vigorous category of physical activity intensities when being measured by observational method versus accelerometers was significantly higher. There was no significant difference found between pedometers and accelerometers, χ^2 = (1, *N*=157) = .785, $p = .376$, Cramer's V= .071.

When comparing overall data of the three measurement protocols (pedometers, accelerometers, and the observational method), and comparing them to each other results show a significant difference between the observational method and pedometers ($p < .001$) as well as the observational method and accelerometers ($p < .001$) regardless the type of physical activity.

Hands et al., (2006) disagrees with these findings, as this researcher used Pearson's correlation coefficient and the coefficient of determination to reveal moderate to strong correlations among all three types of physical activity measurements (pedometers, accelerometers, and the observational method), with the strongest relationship between pedometer data and accelerometer data. After the data were analyzed no significant difference was found between the pedometers and accelerometers ($p = .376$), which was found to be true in previous research (Vries et al., 2006; Weston, Petosa, & Pate, 1997). It is important to note that the pedometers and accelerometers are objective measurement devices, while the observational method is a subjective measurement method. Across all three types of physical activity, these data showed pedometers and accelerometers to have the highest correlation when measuring levels of physical activity. Some reasons for discrepancies among the observational method when compared to the pedometers and accelerometers may have been because of rater training as well as the different types of activities students were engaged in during the different activity settings. Again, the observational method is subjective and relies upon human perception of an action, whereas the other devices were objective and rely on calculations of movements to produce data.

When comparing data produced by physical education alone there was a significant difference found among all three comparisons: pedometers and accelerometers ($p = .029$), pedometers and the observational method ($p = .005$), and accelerometers and the observational method ($p < .001$). While discrepancies were found among all measurement types when looking at physical education data, there was only a 3.4% chance of being rated moderate to vigorous by a pedometer verses an accelerometer, which is minor in comparison with the other measurement analyses. A strong effect size was found when individuals were measured by the observational method versus pedometers, while a weak effect size was found when measured by the observational method verses accelerometers. This tells that these two objective devices (pedometers and accelerometers) showed the slightest discrepancy in their measurements when looking at physical education data. Again it is important to note that the larger differences were found with cases involving the observational method.

When comparing data produced by free play chi-square resulted in significant differences among the three types of physical activity settings. The pairwise comparison follow-up test then showed significant differences between pedometers and the observational method ($p < .001$) and accelerometers and the observational method ($p < .001$). There was no significant difference found between pedometers and accelerometers ($p = .153$) when looking at free play. This data explains that once again the objective devices (pedometers and accelerometers) have similar measurement outputs, while the observational method differs greatly from both pedometers and accelerometers. The observational method had only 2% of students rated in the low intensity category, while pedometer ratings showed 87.9% of students in the low intensity category and accelerometer rating showed 70% of students rated in the low intensity category; thus, suggesting the observational method was much more likely to rate a participant in the moderate to vigorous category verses the low category.

When comparing data analyzed by cross-curricular activity alone the chi-square test revealed a significant difference among the three physical activity settings. The follow-up pairwise comparison test then showed that the significant differences were found between pedometer and accelerometers ($p = .008$) and between pedometers and the observational method ($p < .001$). There was no significant difference found between accelerometers and the observational method ($p = .576$), which meant these two measurement types rated students' physical activity levels similarly. While there was a significant difference between pedometers and accelerometers in this data set, it is important to note that the effect size was very low when comparing data from accelerometers to pedometers in cross-curricular activity, thus suggesting slight differences between ratings in the moderate to vigorous category between these two devices. The effect size was much higher for those being rated in moderate to vigorous category when measured by the observational method verses pedometers, which suggests a larger discrepancy between these two measurement types when looking at cross-curricular activity.

To summarize findings from research question 4, many significant differences were found among the different measurement types when compared to each of the physical activity settings. However, there were also some significant relationships found as well. Overall, the data revealed the smallest discrepancies when comparing pedometers and accelerometers to each other, as indicated by the small effect size.

Research Question 5: Is there a significant difference between male and female 4th grade students' physical activity intensity levels among physical education class, free play, and cross-curricular activity, as measured by the observational method.

The independent-sample t test showed no significant difference between male and female students' intensity levels when participating in physical education class and being measured by the observational method. The test was not significant, t (46) = .55, p = .585. Males engaging in moderate to vigorous activity during physical education (M = 25, SD = 19.87) tended to expend similar physical activity intensity as the females engaging in moderate to vigorous activity during physical education (M = 23, SD = 15.67). A similar study that examined differences in boys and girls in physical education class as measured by the observational method revealed boys to engage in higher amounts of moderate to vigorous activity (Nader, 2003), which is not congruent with the findings from the current study.

When comparing free play measurements by the observational method, once again the independent-sample t test showed no significant difference between male and female students' intensity levels. The test was not significant, $t(35) = .322$, $p = .749$. Males engaging in moderate to vigorous activity during physical education ($M = 20$, $SD = 7.24$) tended to expend similar physical activity intensity as the females engaging in moderate to vigorous activity during free play ($M = 17$, $SD = 7.25$). These findings are in line with previous research that suggests boys and girls engage in similar physical activity levels during free play (Bailey et al., 1995).

When comparing cross-curricular data with measurements taken by the observational method, the independent-sample t test showed no significant difference between male and female students' intensity levels when participating in cross-curricular activity. The test was not significant, $t\ (37) = .003$, $p = .971$. Males engaging in moderate to vigorous activity during physical education ($M = 18$, $SD = 15.01$) tended to expend similar physical activity intensity as the females engaging in moderate to vigorous activity during cross curricular ($M = 21$, $SD = 13.01$). Limited research is available for cross-curricular activity on interactive playgrounds due to new interest and growth of this type of physical activity. Therefore, it was difficult to draw conclusions on whether findings from this study were similar to other findings. This implies future research on cross-curricular physical activity is necessary for comparisons to be made.

Findings from research question 5 suggest that males and females exert similar levels of physical activity during the three different types of physical activity settings tested. This is not consistent with previous studies that compare male and female physical activity with pedometers and accelerometers (Sarkin, McKenzie, & Sallis, 1997; Stratton, 1999). Literature suggests that depending on the type of activity setting, boys typically have higher physical activity levels. Specifically, Hands, Parker, and Larkin's (2006) study revealed boys to be significantly more active than girls, t (22) = 3.61, p < .001 when measured by an observational method. However, select studies did reveal that in the case of recess boys and girls were similar when it came time to report physical activity levels (Bailey et al., 1995).

Summary

Multiple implications from findings in this study can be used in conjunction with previous research to create a basic understanding of physical activity levels in 4th grade students during school hours as well as the feasibility of certain physical activity measurement protocols for elementary students. Trost and van der Mars (2010) stated 44% of school districts had recently cut physical activity, particularly physical education, from their elementary schools in an effort to have more time devoted to classroom subjects. At the same time childhood obesity is at an all time high in the United States, with Tennessee being ranked 3rd in the nation for highest percentage of children who are overweight or obese (CDC, 2010). Statistics such as these serve as motivators for this study. Schools are the obvious avenue for providing the recommended daily physical activity, with over 50 million children enrolled in schools (President's Council on Physical Fitness and Sports, 2009). This study serves to contribute to the educational leadership literature relating to physical activity types that are producing high levels of intensities during school hours. This study also provides many implications for those in the field, specifically looking at levels of physical activity and types of measurement protocols that are successful and feasible when assessing youth. While a high percentage of results produced from this research were in line with previous studies, some discrepancies were found as well.

The first implication to discuss is the importance of students being engaged in moderate to vigorous activity throughout the school day. NASPE (2010) recommends that youth spend

60- minutes or more per day being physically active, and of that time, 30-minutes should be spent in moderate to vigorous activity. Additionally, 50% of physical activity classes should be engaged in the moderate to vigorous category in order to receive maximum health benefits (United States Department of Human Services, 2000). Results from this study show that students are not always meeting this recommendation for physical education, which is in line with previous research (President's Council on Physical Fitness and Sports, 2009). However, the data did show that free play and cross-curricular activity both produced adequate amounts of physical activity. This implies that students may not be reaching the goal of 50% moderate to vigorous activity in physical education. However, when total time from the different types of physical activity offered throughout the school day are taken into consideration, many students could meet the goal of 60 minutes of accumulated daily physical activity, 30 minutes of which are to be spent in moderate to vigorous physical activity.

One issue to address is that nearly 44% of school districts are cutting physical education and physical activity programs in order to have more time to devote to classroom subjects. Increased demand for higher test scores has been the driving force behind the decision to cuts physical activity. Studies have also shown that children are less likely to be physically active outside of school hours, with one particular study stating that on average boys engaged in 6% of their time being physically active outside of school, and girls engaged in only 2% (Sallis et al., 2001).

These statistics are important because they enlighten educational leaders to the reality of school being the most vital avenue for providing appropriate amounts of physical activity. Results from this study revealed that cross curricular activity may be an adequate addition to physical activity provided throughout the school day. This is an important implication because schools are actively looking for ways to cut physical activity in order to devote more time to teaching academic subjects. As previously stated in the literature review, cross-curricular activity is a combination of physical activity and academic teaching. While there were some discrepancies, overall our study showed cross-curricular activity to have students engaged in efficient amounts of physical activity while learning subject material. One such discrepancy was found in the overall high ratings of each of the three measurement types (pedometers, accelerometers, and the observational method), which resulted in this type of physical activity rendering the highest levels of physical activity. One reason for this was outlying data produced from one specific instructor. This instructor was very efficient in obtaining high levels of activity among her students during cross-curricular activity, through extreme involvement and preparation. These data were outside the norm found in other data sets collected for this study. Therefore, when this particular set of data were removed, cross-curricular physical activity levels decreased significantly, placing this study in line with others, which state that physical education provides for the higher amounts of moderate to vigorous activity than other types of physical activity settings during the school day (United States Department of Human Services, 2000).

Even with the outlier data removed, cross-curricular activity still engaged children in levels of physical activity that contain some moderate to vigorous intensities, which shows it could be a good addition to physical education programs. It is also important to note, that while this study was conducted at schools that had interactive playgrounds specifically designed for cross-curricular activity, it is not a necessity to have this type of structure when planning cross-curricular activities. Another important point to make when educational leaders are looking at cross-curricular activity, they must be mindful that only those instructors who can effectively deliver this type of curriculum and are dedicated to increasing physical activity are the ones that adequately contribute to overall daily physical activity recommendations, as found in this study.

Another implication that can be drawn from results of this study is feasibility and efficiency of three different types of physical activity measurement protocols (pedometers, accelerometers, and the observational method). Overall results show that pedometers and accelerometers are equivalent in their measurements of physical activity levels, which agrees with previous research (Hands et al., 2006; Weston et al., 1997). This implies to school administrators, that while accelerometers can assess in three dimensions and pedometers can only assess step count, the results indicate pedometers to be just as effective in measuring moderate to vigorous activity levels in children during the school day. This is also important for school administrators because the pedometers are much more affordable and easier to use when measuring physical activity among classes. It is important to note that in this study it was found that the accelerometers were much more expensive and more difficult to use, download, and analyze.

Overall, pedometers and accelerometers were found to measure similarly; however, there were some discrepancies among the measurement types and outputs of intensity levels. When looking at the observational method conducted throughout this study, I can see that our raters, while mostly equivalent with each other, seemed to rate moderate to vigorous activity in higher amounts when compared to other research looking at similar measurement types (Hands et al., 2006). One reason my observational method might have rated students slightly higher in moderate to vigorous (in most physical activity settings) than pedometers or accelerometers could be attributed to the types of activities that were being observed. A specific example of this could be taken from cross-curricular activity engaged on the interactive playground. In this specific setting, a rope bridge is suspended six inches off the ground. The students have to use core body strength and balance to cross this bridge with minimal guide ropes for hand holds. Here it is easy to see how a rater trained on the SOFIT observational method could see this collection of isotonic exercises to be vigorous activity. The SOFIT observational method uses terms such as lying, sitting, jumping, and running to describe activity levels (McKenzie, 2009). In this specific scenario our observers are witnessing an activity that is not specific to their training, and as a result they were more prone to rating those activities as moderate to vigorous because they saw a child using muscular strength, balance, and core strength to successfully cross the bridge. I realize that this could also be a limitation of the study, as training could have been geared more toward activities produced on the interactive playground.

A third implication that can be addressed from results of this study would be directly related to educational leaders and policies dealing with physical activity during the school day. This study found that while not all types of physical activity settings (physical education, free play, and cross-curricular activity) produced a high enough level of moderate to vigorous activity to meet national recommendations, these particular activity settings did provide for sufficient amounts of physical activity during the school day. We can relate this to school policy in two specific ways: 1) creating policy that mandate teachers to not only have their classes involved in physical education, but recess, and possibly cross-curricular activities, and 2) having teachers and physical educators use standardized physical activity curricula.

After reviewing the literature, the importance of daily physical activity is obvious and can benefit a child in many ways such as health benefits, enjoyment, social development, and academic achievement (Bailey, 2006; Sallis et al., 1999). Meeting the daily recommendation for physical activity results in maximum benefits in the above areas (CDC, 2010*a*). Results from this study reveal to school administrators that all three types of physical activity settings measured rendered sufficient amounts of moderate to vigorous activities to reap the many benefits of physical activity. Policies could be put in place to ensure these students are getting multiple physical activity settings throughout the day in order to accumulate moderate to vigorous activity and reach the goal of 50% of activity time spent in the moderate to vigorous category. Previous research has also used standardized curricula, such as SPARK and CATCH to increase levels of physical activity during different settings throughout the school day. Trost and Loprinzi (2008) specifically found intensity levels to increase significantly when using the SPARK or CATCH curricula in physical education. This approach to increasing physical activity levels is especially important for the 44% of school districts that are actively cutting physical activity programs (Trost & van der Mars, 2010). By schools using standardized curricula like SPARK or CATCH, the students would have a better chance of reaching the goal of accumulating 30 minutes of moderate to vigorous activity in fewer physical activity settings, because these curricula have proven to increase intensity levels during physical activity classes.

Conclusions

The focus of this study was the levels of physical activity in elementary students during school hours. Specifically, I examined if there were increased levels of physical activity when students were using a cross-curricular adventure playground as compared to when they were engaged in free play or physical education class. The study was used to analyzed differences among measurement protocols to seek which types would be most accurate and feasible for assessing physical activity in elementary students. Overall the outcomes of the hypotheses in conjunction with the literature review suggests that physical education provides the highest levels of moderate to vigorous activity during school hours. Outcomes also suggest that pedometers and accelerometers are equivalent in their measurements of physical activity in most instances. Some discrepancies between this study and previous research may have to do with the study's methodology.

Physical education represented the overall highest amounts of moderate to vigorous activity when outliers were removed, placing this study in line with other similar studies. While physical education ranked highest in this category, most of these students still fell below the national recommendation of 50% of each physical activity class being spent in moderate to vigorous activity. Findings from this study allow me to imply that free play and cross-curricular activity render lower amounts of moderate to vigorous activity. In most instances they still play a vital role in accumulating the daily recommendations by CDC (2010*b*) of 60 minutes or more per day of physical activity, 30 minutes of which are to be spent in moderate to vigorous activity. Cross-curricular activity is of particular importance because schools are actively removing physical activity programs in an effort to have more time for academic teaching. It is important to note cross-curricular activity can be used in playground like settings, not specifically interactive playgrounds. I found that this type of activity engages students in adequate amounts of moderate to vigorous activity which means cross-curricular physical activity could be a good addition to physical education classes or substitution for lost physical activity programs.

When comparing the different measurement protocols (pedometers, accelerometers, and the observational method) used in this study, results suggest the pedometer to be the most feasible device to use for measuring children in these types of physical activity settings. There were some discrepancies among analyses, but these may have been due to the specific type of activity being performed. Overall this study found pedometers to be easiest to operate, cost efficient, and reliable in terms of positive correlations with accelerometers.

In conclusion, cross-curricular physical activity may be a vial supplement to physical activity during the school day for schools that have eliminated physical education or other physical activity classes to increase academic teaching. It is also important to note that all three physical activity types (physical education, free play, and cross curricular physical activity) render scores below the national recommendation. However, as a group they can work together to allow students to accumulate acceptable amounts of daily physical activity that will provide more health benefits as well as possible academic benefits.

Recommendations for Practice

The following recommendations were guided by findings from this study and previous research focused on assessing physical activity throughout the school day in elementary students:

1. Previous research supports the many benefits of being physically active, such as better health, improved psychological state, and academic achievement. Results from this study indicate that students are not receiving the recommended amount of daily physical activity in physical education class alone, and therefore I am recommending that schools provide multiple physical activity opportunities for students throughout the day. This would help meet nationally recommended MVPA per day.
2. Analysis of this data also revealed physical education to render higher amounts of MVPA than free play or cross-curricular activity on the interactive playground. While 44% of school districts are actively cutting physical education programs (Trost & van der Mars,

2010), this study revealed it is still the most effective avenue for increasing MVPA during the school day.

3. While there is not a lot of previous research on cross-curricular physical activity, this study indicated cross curricular activity on the interactive playground engaged students in low but efficient amounts of MVPA, while learning academic subjects. I am recommending schools use cross curricular physical activity as a way to increase MVPA during the school day and not lose time teaching academic subject material.
4. It is important for schools to assess levels of physical activity of their students to ensure they are receiving amounts that will allow them to experience all the benefits of physical activity. I am recommending pedometers as the most cost efficient and feasible measurement instrument for this age group. Analysis of data revealed pedometers to produce equivalent measures as accelerometers in large sample sizes, while the observational method most often produced significantly different physical activity levels when compared to pedometer and accelerometer data.
5. Previous research reveals physical education curricula such as SPARK or CATCH to be effective in producing higher levels of MVPA. While I did not include such curricula in this study, I would recommend schools adopt a physical education curriculum to help increase physical activity levels in students.

Recommendations for Future Research

Below are recommendations for future research derived from findings and methods of this study. The following recommendations will serve to guide researchers seeking to expand on this topic:

1. It would be beneficial to conduct this study with a larger sample size to ensure adequate amounts of data for more reliable results. I realize with the nature of this study, which included many measurement devices and personnel, it may not be possible to increase the sample size by large amounts.
2. Collect data concerning sex, height, and weight for pedometers, accelerometers, and the observational method. This study only collected gender information for the observational method.
3. Add video taping as a fourth measurement protocol to enhance reliability of the observational method.
4. Additional training of raters to include activities specific to the interactive playgrounds to avoid confusion and misreporting by raters, specific to the SOFIT instrument would be beneficial.
5. Measure cross-curricular activity in a typical playground setting to see if an interactive playground is needed in order for similar activity levels to be reached.
6. Previous research states physical activity is linked with academic achievement. For future research it would be of benefit to look at cross-curricular physical activity and academic achievement.
7. Collecting data at schools using standardized curricula such as SPARK or CATCH would provide another avenue by which to look at ways of increasing levels of physical activity during different activity settings throughout the school day, especially when compared to schools not using these curricula.
8. Conduct all measurements at one school with the same instructor. This would give a true representation of different levels of physical activity accumulated throughout each

physical activity setting for a particular class. Instructors have an intense impact on physical activity output of their students depending upon their delivery effectiveness when leading a physical activity class.

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APPENDICES

APPENDIX A

Different Types of Direct Observation Methods

Instrument	Technique	Validation by comparison	Reference
Children's activity rating scale (CARS)	1 min. partial time sampling 5 categories Observed in various conditions	VO_2, Heart Rate	O'Hara, Baranowski, Simons, Morton, Wilson, & Parcel, (1989) Puhl & Greaves (1990)
System for observing fitness instruction time (SOFIT)	10 sec. momentary time sampling 5 categories During PE class	Heart Rate	McKenzie, Sallis, & Nadar (1991) Rowe, Schuldheisz, & Vander Mars (1997)
Children's Physical Activity Form (CPAF)	1 min. partial time sampling 4 categories During PE class	Heart Rate	O'Hara, & Baranowski (1989)
System for Observing Play and Leisure Activity (SOPLAY)	Designed to capture groups of children Observer scans target area in a cyclical manner, recording number of boys and girls and level of activity	Self-reporting	Trost (2007)
System for Observing Play and Recreation in Communities (SOPARC)	Scan park or community recreation area from left to right, noting activity level of boys and girls	N/A	McKenzie, Cohen, Sehgal, Williamson, & Golinelli (2006)

APPENDIX B

Parental Consent Letter

Date________________

Dear Parent/Guardian:

Your child's school has been chosen to take part in the physical activity study coordinated by East Tennessee State. The purpose of the study is to gather information on students' level of physical activity while they participate in physical education classes and recess using the new Beanstalk adventure playgrounds recently installed at your child's school.

During the study, a researcher and/or teacher will be providing your child with a pedometer (step counter) and/or an accelerometer (movement counter) to wear on their waist while they go about their normal physical education or recess activities. The class as a group will also be observed by a research team to rate general levels of physical activity. Your child will not be asked any questions nor be asked to do anything outside of their normal class activities and their teachers will be present. Participation is voluntary and if you or your child chooses not to participate, there will be no penalty.

As you may know, the health of our children here in Tennessee is an important issue and physical activity levels are an important part of total health and. By letting your child take part in this study, you will help contribute new information that may benefit all of Tennessee's children through innovative new programs aimed at increasing the levels of physical activity while children learn.

If you have any questions about the study, please contact Dr. Andy Dotterweich at (423)-439-5261 or by email at dotterwa@etsu.edu. You may also contact Amy Greene at (423)-439-6714 or by email at greenea@etsu.edu. If you have questions regarding your child's rights as a research subject you may call the Chairmen of the ETSU Institutional Review Board at (423)-439-6054

Sincerely,

Andy R. Dotterweich, Ph.D., CPSI, CSCS
Assistant Professor/Director of Graduate Assistants
Department of KLSS East Tennessee State University

Please check the NO box, sign and return to your child's teacher if you do not want your child to participate in this study. You will have until Monday May 17, 2010 to return the form. If you are willing to have your child participate then you do not have to return the form. Thank you!

Child's Name:____

Child's Teacher:____

_____ ***NO***, I do not want my child to participate in this study

________________________________ ________________________

Parent/Guardian Signature Date

APPENDIX C

Inter-Rater Reliability

In terms of reliability of raters, the correlation range was .782 to .990, the mean range was 56.41% to 64.31%, and the standard deviation range was 15.41 to 24.55. Of the fifteen groups analyzed, 10 were found to be significantly correlated (Rater 1 and Rater 2, $p < .001$; Rater 2 and Rater 3, $p = .001$; Rater 3 and Rater 4, $p = .020$; Rater 1 and Rater 5, $p < .001$; Rater 1 and Rater 6, $p < .001$; Rater 2 and Rater 5, $p < .001$; Rater 2 and Rater 6, $p < .001$; Rater 3 and Rater 6, $p < .001$; Rater 4 and Rater 6, $p < .001$; Rater 5 and Rater 6, $p < .001$). Table 9 illustrates differences and similarities among the raters.

Table 9

Inter-rater reliability for observational method

	Rater 1	Rater 2	Rater 3	Rater 4	Rater 5	Rater 6
Rater 1						
Rater 2	Significantly related					
Rater 3	Not relation $p = .429$	Significantly related				
Rater 4	No relation $p = .081$	Significantly related	Not relation $p = .088$			
Rater 5	Significantly related	Significantly related	Not relation $p = .916$	Not relation $p = .176$		
Rater 6	Significantly related	Significantly related	Significantly related	Significantly related	Significantly related	

APPENDIX D

Child Verbal Consent Script

Start of class-
Good morning 4th grade class,
We are representatives from East Tennessee State University and we will be conducting a research study on your class. We will be measuring your level physical activity during participation in this class (Physical education, beanstalk with curriculum, or free-play) using pedometers and accelerometers. We will be attaching these pedometers and accelerometers to your clothes before you begin any activity. Once you have the equipment attached please do not touch them. If you have any problems with them please tell your teacher. Participation is voluntary so if you do not wish to participate, please let us know and we will not attach a device to you. Do you have any questions?

End of class-
We will come around and gather each device. We will go back to ETSU and record the data we have found about your levels of physical activity. Once you have placed your pedometer or accelerometer in the box we will not be able to identify which one was yours, therefore we will not keep up with individual data, just data from your class as a whole.

VITA

AMANDA E. GREENE

Personal Data:	Date of Birth: July 14, 1982 Place of Birth: Barstow, CA Marital Status: Married
Education:	Ed.D., East Tennessee State University, Johnson City, TN 2011 *Major:* Educational Leadership and Policy Analysis, Post-Secondary/Private Sector *Dissertation Title:* Accelerometers, Pedometers, and Observational Methods: A Comparison of Measurements of Physical Activity in Fourth Grade Students. M.A.Sport Management, East Tennessee State University, Johnson City, TN 2005 B.S. Sport Management, East Tennessee State University, Johnson City, TN 2003
Professional Experience:	Adjunct Faculty, Department of KLSS; East Tennessee State University, 2007-present University Online Course Development, Department of KLSS; East Tennessee State University, 2009-2010 Coordinator of Fit Kids Program, Department of KLSS; East Tennessee State University, 2006-present
Publications:	Dotterweich, A.R., Greene, A., Palmero, M. & Blosser, D. (in revision). Utilizing innovative playgrounds and cross-curricular design to increase physical activity. Submitted to *JOPHERD.* Dotterweich, A.R., Greene, A., Palmero, M., Walker, J.T., & Blosser (in process). The use of social media by NASCAR tracks. Expected submission October 2011 to *The Sport Journal*.
Honors and Awards:	Fit Kids Program Awarded: 2010 Shining Star Award by Tennessee Governor's Council on Physical Fitness and Health