

AN EXAMINATION OF CHANGES IN SEDENTARY TIME WITH THE
INTEGRATION OF TECHNOLOGY FOR CHILDREN PARTICIPATING IN A
MORNING FITNESS PROGRAM

By

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Schools have played a large role in providing physical activity opportunities to children for more than a century. However, 21st century health trends show that children have high proportions of sedentary time and are not taking the initiative to be physically active (Anderson & Butcher, 2006a & b; Pate et al., 2006). The promotion of physical activity in schools has been shown to improve the overall health and physical fitness level of children by offering alternative activity times such as before, after, and throughout the school day to increase daily physical activity levels (Pate et al., 2006; Stanford Prevention Research Center, 2007). Three hundred K-5th grade students from one elementary school in a rural Nebraska town were invited to participate in a cross-sectional study. The investigator used a quantitative method to determine the association between morning physical activity, technology, total daily physical activity, cardiorespiratory fitness, and sedentary behaviors in children. Approximately 232 children participated in the study by wearing an accelerometer for four consecutive days and a strapless heart rate monitor periodically throughout the testing time frame. The Statistical Analysis System (SAS[®] version 9.1, Cary, N. C.) was used to analyze the data. When a significant omnibus result was obtained for an analysis of variance, the Duncan post-

hoc analysis was used to examine pairwise mean differences when more than two means were being compared. The level of significance chosen for all statistical analyses was 0.05.

The study analyzed the statistics, discussed relevant themes found from the statistics, related the results to previous research, and presented suggestions for further research. The principal findings indicated no significant difference in total daily sedentary time or moderate to vigorous physical activity time when integrating a morning physical activity program. However, a significant difference did exist between morning activities and total daily sedentary time and physical activity time when analyzing *Wii™ Just Dance*, *Wii™ Dance Dance Revolution*, a running/walking program and no physical activity. There was also a significant difference between the morning activities offered and sedentary or moderate to vigorous physical activity during only the morning timeframe of 7:15 a.m.- 8:15 a.m.

DEDICATION

To my family who saw me through the entire way.

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Chapter One

INTRODUCTION

Statement of the Problem

According to the Centers for Disease Control and Prevention (CDC) guidelines, the prevalence of children categorized as overweight or obese has increased for the last three decades (American Heart Association & American Stroke Foundation, 2010; Centers for Disease Control and Prevention, 2010). In the United States, the proportion of children and adolescents classified as overweight or obese increased from 15.5% in 1971-1975 to 31.9% in 2007 (Maloney et al., 2008; Y. Wang & Beydoun, 2007). One of the major contributing factors to the increasing incidence of childhood obesity is the escalation of time children spend in daily sedentary behaviors (Epstein et. al., 2000; Epstei et. al, 2005; Kelly et al., 2005; Reilly, 2005; Rennie et. al., 2005).

Only one-half of children in the United States regularly participate in vigorous physical activity and only 34.7% of children who are physically active meet the 60 minutes per day, five days per week recommendation by the National Association of Sport and Physical Education (NASPE) and CDC (Centers for Disease Control and Prevention, 2002; Centers for Disease Control and Prevention, 2003; Centers for Disease Control and Prevention, 2010; National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health, 2010; Rideout, Foehr, & Roberts, 2010). Furthermore, participation in all types of physical activity declines as age and/or grade in school increases and the relationship between low physical activity levels and the frequency of obesity is

very strong (Centers for Disease Control and Prevention, 2010; Janz, Dawson, & Trost et. al., 2002; National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health, 2010).

The Child Nutrition and WIC (Women, Infants, and Children) Reauthorization Act of 2004 and the Healthy People 2010 report, prepared by the U.S. Department of Health and Human Services, were developed to require school districts to set goals to increase physical activity and other school-based activities designed to encourage healthy lifestyles for children (Department of Health and Human Services, Washington D.C., 2000; National Association of Sport and Physical Education, 2002(a); National Association of Sport and Physical Education, 2008). The Comprehensive School Physical Activity Program (CSPAP), developed through the Child Nutrition and WIC Reauthorization Act of 2004, included provisions for before, during, and after-school physical activity programming for children (National Association of Sport and Physical Education, 2002(a); National Association of Sport and Physical Education, 2008). As a result of the legislative efforts from the Child Nutrition and WIC Reauthorization Act of 2004, a variety of physical activity programs have been implemented into schools to help attenuate increases in body mass and increase the amount of total daily physical activity time for children (Allison & Adlaf, 2000; Chamberlin et. al, 2002; Kaplan, Liverman, & Kraak, 2005; National Association of Sport and Physical Education, 2002(a); Yin et al., 2005; Young et al., 2007).

Within the school day, physical education is one curriculum area identified as a fundamental target for addressing today's challenges to increase daily physical

activity among children (Trudeau & Shephard, 2005). Although increased time in a physical education class may help reduce total daily sedentary time in children, (Gormaker, Peterson, Wiecha, Sobol, & et al., 1999; Stewart et. al., 2004) research has indicated that a very small percentage of children actually meet the NASPE/CDC guidelines of physical activity, 60 minutes a day/5 days a week, during physical education class (Centers for Disease Control and Prevention, 2010; Nettlefold et al., 2010). In an effort to increase physical activity in children outside of the physical education class, public schools at the elementary and middle levels have begun to implement structured recess time, in-class physical activity sessions, and before and after-school physical activity programs (National Association of Sport and Physical Education, 2008; National Association of Sport and Physical Education, 2010; Pate et. al., 2006; Pate et. al., 2010; Stewart et. al., 2004).

After-school programs have shown the potential to provide opportunities for increased levels of physical activity in children through recreational or intramural sports, non-athletic activities that involve physical activity, and physical activity/fitness clubs (Kaplan et al., 2005). In fact, children categorized as being overweight who become involved in after-school physical activity programs have experienced improvements in their health and wellbeing (Centers for Disease Control and Prevention, 2010; Gutin, Riggs, Ferguson, & Owens, 1999; Gutin, et. al., 2005). Similarly, after-school programs for middle and high school children have shown a positive correlation to attenuating increases in body mass and improving physical activity levels (Daniels et. al., 1999). In addition, these programs provide children with a sense of belonging and school cohesiveness in a

pleasant and non-competitive atmosphere, thereby promoting lifelong participation in physical fitness activities (Daniels et. al., 1999). In spite of the possible benefits to before and after-school physical activity programs, there is competition for children's attention from entertaining sedentary activities such as playing video games, watching television, or using a computer.

The use of technology media, also known as "screen time," can be defined as an individual being involved with any electronic and/or technology-based activity (Vize, 2008). Technology media is a contributing factor to the increase in sedentary lifestyle behaviors of children (Gable, Chang, & Krull, 2007; Joosse et. al., 2008; Kann et al., 1998; National Association of Sport and Physical Education, 2010; National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health, 2010; National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health, 2010; Nelson, Benson, & Jensen, 2010; Robinson, 1999; Sisson et. al., 2009; Vandewater, Shim, & Caplovitz, 2004). The popularity of technology media has shown to exert a progressively greater influence in the lives of children (Saettler, 2004). For example, research indicates that the average household owns 3.8 televisions, 2.8 DVD/VCR players, 1 DVR/TiVo, 2 computers, 2.3 video game players, and 84% of children have Internet and cable or satellite TV access (Kaiser Family Foundation report, 2009; Television Bureau of Advertising, Inc., 2010; Arbitron/Edison Research, 2011). Furthermore, half of children ages 8-19 years old own a cell phone and a handheld video game player in addition to an iPod or MP3 player (Arbitron/Edison Research, 2011; Rideout et al., 2010; Roberts et. al., 1999). By contrast, in 1999, the

average home only owned 3 televisions, 2 VCR players, 1 computer, 3 tape player/radios, and 2 CD players, in which they played an hour and 21 minutes less than today (Arbitron/Edison Research, 2011; Roberts et. al., 1999). In 1999, just half of children ages 2-18 years old had access to the Internet in their homes, and averaged only 20 minutes of video game play per day (Roberts et. al., 1999). Daily time spent with radio, television, and Internet combined has increased by 20% in the last 10 years due to the availability of technology (Arbitron/Edison Research, 2011). This increase in usage of technology media in a typical home exemplifies why children today are more likely to engage in sedentary behaviors than in the previous decade.

Most screen time is considered sedentary, but in the past few years several physically active forms of technology media have been introduced (Lanningham-Foster et al., 2006). For example, the Nintendo Wii™ uses hand-held motion sensing remotes to control the on-screen play, thus enabling a person to simulate activities such as boxing, swinging a baseball bat, walking a tight rope, or throwing a ball. Other physically active video games such as Wii™ *Dance Dance Revolution* made by Konami, use floor mats with arrows upon which a player steps left, right, up, or down to control game play. Instead of a floor mat, Xbox 360 *Kinect™* and the Sony *Eye Toy* are examples of games that use a camera to sense and use a person's movements to control screenplay. Initial research suggests that engaging in physically active screen time increases physical activity in children and that physically active technology media could be an effective tool to prevent obesity in children (Lanningham-Foster et al., 2006).

There are a variety of modalities schools can utilize to help lower daily sedentary time of children and influence the occurrence of childhood obesity. One area that needs to be explored further is the use of physical activities in before and after-school programs and the use of physically active technology media in physically active before and after-school programs (Tapscott, 2008; Yelland, 2006).

Purpose Statement

The primary purpose for conducting this quantitative investigation was to determine if the use of a physically active video game in a before-school physical activity program could increase the total amount of daily moderate to vigorous physical activity and decrease the amount of total daily sedentary time in children. The secondary purpose was to compare physically active video games, the Nintendo Wii™ *Just Dance* and Wii™ *Dance Dance Revolution*, a running club, and no activity to determine which, if any, of these activities had an effect on increasing total daily moderate to vigorous physical activity and decreasing total daily sedentary time of children. The final purpose was to evaluate the average physical activity heart rate of the children participating in the before-school physical activity program to determine significant difference between Wii™ *Dance Dance Revolution*, Wii™ *Just Dance*, and a running/walking activity. The activity heart rates were also analyzed to determine which activities increased the heart rate levels of the children to the CDC recommended standard of moderate to vigorous physical activity shown to improve cardiovascular fitness.

Primary aim.

The primary aim of the investigation was to determine if there were differences in total daily moderate to vigorous physical activity and daily sedentary time based on the association between morning fitness activities. Specifically, a comparison between total daily moderate to vigorous physical activity and total daily sedentary time in a before-school physical activity program using two forms of active video games, Wii™ *Dance Dance Revolution* and *Just Dance*, a traditional before-school activity such as a running/walking, and days of no morning physical activity were used for the analysis.

The primary source for the outcome measurement was accelerometer data that objectively measured the quantity and intensity of physical activity. Researchers have found accelerometers to be useful devices in the assessment of children's physical activity and were therefore used in this study (Ainsworth et. al., 2000; Basterfield et al., 2010; Puyau et. al., 2002; Ward et. al., 2005).

Significance

Since 1976, there has been an increase in both the amount of time children spend in sedentary activities as well as their weight (Dehghan et. al., 2005; Troiano & Flegal, 1998; Troiano, 2002). After-school physical activity programs have been suggested as effective tools to decrease total daily sedentary time and body mass, while at the same time improving fitness levels (Pate et. al., 2006). Due to the interest in technology among children as well as educators, integrating a morning activity along with a technology concept is an ideal way to combine both technology

media and physical activity in a school-based program setting. A before-school program integrating a physically active technology component could potentially provide a valid and reliable measurement of how to decrease total daily sedentary time, improve physical fitness, and positively impact obesity among children.

The following study was needed to determine whether a technology-based morning activity can be influential in increasing the amount of time children spend participating in moderate to vigorous physical activity and lowering total daily sedentary time of children. The study will also help determine if a before-school physical activity program has the capability to increase moderate to vigorous physical activity and decrease sedentary levels when only analyzing the morning timeframe. If a technology-based morning activity has a positive influence in decreasing sedentary time of children, this study will assist in determining the type of activity best suited to decrease total daily sedentary time between interactive video games compared to a running/walking physical activity program.

Chapter Two

EXTENDED REVIEW OF LITERATURE

Physical Activity and Enjoyment

Pedagogical evidence from the past two decades illustrates that a child's perception of one's own ability to be physically active directly affects that child's motivation level to participate in daily physical activity (Bell, 1997; Ennis, 2010). Furthermore, the child's acuity of their fitness and skill knowledge positively correlates with the child's decision to be physically active (Biddle & Armstrong, 1992; Ennis, 2010; Stuntz & Weiss, 2010). In addition, research has shown that children participate for increased lengths of time and intensity in tasks and activities the children describe as enjoyable (Dishman, Motl, Sallis et al., 2005; Dishman, Motl, Saunders et al., 2005). Similarly, adults who participate in regular physical activity also describe their chosen physical activity as enjoyable and are more likely to remain physically active for a lifetime (Stodden, Goodway, Legendorfer et al., 2008). Therefore, if a child's perception of their ability to be physically active is positive and the child engages in an activity they enjoy, the chances of establishing consistent physical activity patterns increases. Educating children through physical education courses, health classes, and before and after-school physical activity programs, as well as observing adults modeling healthy behaviors, can help prepare children for a lifetime of healthy living choices (Centers for Disease Control and Prevention, 2003; Centers for Disease Control and Prevention, 2010).

Physical activity has been defined as movement conducted by the body that contracts the skeletal muscles of the body and increases energy expended above the

basal level of the individual participating in the physical activity (Caspersen, Powell, & Christenson, 1985; Centers for Disease Control and Prevention, 2010; Department of Health and Human Services, Washington D.C., 2000). Skeletal muscles, also known as striated muscles, are voluntary muscles that help make up the musculoskeletal system. Muscles, skeleton, and bones work together to give an individual their body power and strength. Total energy expended by the body while being physically active is calculated by evaluating an individual's basal metabolic rate, thermic effect of food, and physical activity levels (Lof, Hannestad, & Forsum, 2003; Ravussin & Bogardus, 1992).

In 1993, NASPE developed physical activity guidelines recommending 30 to 60 minutes of daily physical activity for elementary children (Corbin & Pangrazi, 2004; National Association of Sport and Physical Education, 2010). The NASPE now recommends an accumulation of at least 60 minutes or more of moderate to vigorous physical activity for elementary children on a daily basis (Department of Health and Human Services, Washington D.C., 2000; National Association of Sport and Physical Education, 2008; National Association of Sport and Physical Education, 2010). According to the NASPE *Shape of the Nation Report*, children grades K-12 have declining participation levels in all types of physical activity as their age and grade in school increases (Department of Health and Human Services, Washington D.C., 2000; National Association of Sport and Physical Education, 2010). In addition, the level and type of activities children are selecting to be involved in are becoming more sedentary (Centers for Disease Control and Prevention, 2010; Department of Health and Human Services, Washington D.C.,

2000). Children need to be encouraged to develop a physically active lifestyle due to the correlation between child and adulthood health issues and physical activity time (Centers for Disease Control and Prevention, 2010; Department of Health and Human Services, Washington D.C., 2000; Epstein et al., 2000; Epstein et al., 2005; Singhal, Schwenk, & Kumar, 2007a; Stodden et al., 2008).

Demographic characteristics also impact the variance of physical activity for all ages (Scott, 2009). For example, men have a higher rate of engagement in vigorous exercises than women, who are more likely to be involved in longer, lower intensity activities (Azevedo, et. al., 2007; Livingstone et al., 2001). A difference in education and socioeconomic status accounts for the preferred leisure-time physical activities, which are also associated with the race or ethnicity of the individual (Cerin & Leslie, 2009; White et. al., 1987). Physical and socio-environmental factors can also influence physical activity behaviors in children and adults (Cerin & Leslie, 2009). Thus, when parents and friends do not encourage or exhibit healthy lifestyle habits in front of a child, that child is more likely to follow the lifestyle of their surroundings (Golan & Crow, 2004a; Golan & Crow, 2004b).

Barriers for children to be physically active on a daily basis have increased since the 1980's. These barriers stem from issues such as safety of the neighborhood, parental perspective of the need for physical activity and safety, and lack of transportation for children to and from physical activity opportunities offered by schools (Centers for Disease Control and Prevention, 2003; Kerr et al., 2006; National Safe Routes Task Force, 2008). Inclement weather, availability of transportation, distance to the closest bicycle or walking path, and safety concerns in

the child's neighborhood have been shown to increase the amount of daily sedentary time in children (Belanger et. al., 2009; Rosenberg & Wood, 2010; Sallis, Hovell, & Hofstetter, 1992). Children whose parents transport them to physical activity locations have higher reports of participation in physical activity. However, approximately one half of children depend on parental transportation to and from school and because of elevated safety concerns and decreased parental availability to transport, there has been an increase of daily sedentary time in children due to it being unsafe for the children to walk or bike to school. (Centers for Disease Control and Prevention, 2002; Hoefler et. al., 2001; National Safe Routes Task Force, 2008). Therefore, in today's environment children have less opportunity to be physically active even though 31% of children live less than one mile away from the school they attend (Centers for Disease Control and Prevention, 2002; Hoefler et al., 2001; National Safe Routes Task Force, 2008).

Sedentary Behavior in Children

Physical inactivity, which has resulted in higher sedentary time in today's children, has been linked to an increase in youth obesity and chronic diseases (Janz et al., 2000; Janz, Burns, Levy, & Iowa Bone Development Study, 2005; Nader et. al., 2006; Ogden, Flegal, Carroll, & Johnson, 2002; Trost et. al., 1999; US Preventive Services Task Force, 2010). Twenty-first century trends show that children have less physical activity opportunities during school time and are not as prone to use a physically active mode of transportation to and from school as compared to children in the past (Ahlpor et. al., 2008; Centers for Disease Control

and Prevention, 2002; Davison, Werder, & Lawson, 2008; Dawson et. al., 2007; Saksvig et al., 2007).

Along with increased sedentary time in schools, research shows that unstructured outdoor child's play has decreased by 50% since the late 1970's (Anderson & Butcher, 2006a; Epstein et al., 2000; Matthews et al., 2008; Power et al., 2002; Troiano & Flegal, 1998). In fact, as children increase in age and grade, their levels of participation in all types of physical activity declines (Centers for Disease Control and Prevention, 2010; Department of Health and Human Services, Washington D.C., 2000; Roberts & Foehr, 2008).

Research suggests children with higher levels of sedentary time in school compensate by increasing activity levels later in the day (Pate et al., 2006). Conversely, results from a study conducted with third and fourth grade students in which they wore an accelerometer for four days, showed children do not compensate for a sedentary school day by increasing their levels of physical activity before or after-school (Dale, Corbin, & Dale, 2000). In this study of third and fourth graders, children wore the accelerometer for two days in which the students were "active" via recess and physical education and the other two days in which they had recess "inside" at computers and did not participate in physical education (Dale et al., 2000).

More than 60% of children ages 9 – 13 do not participate in any organized physical activity during their non-school hours and more than 20% do not engage in any free-time physical activity (Department of Health and Human Services, Washington D.C., 2000). Only 36% of children in America today meet the CDC

recommended daily physical activity levels. Furthermore, research has concluded that children who are more active during the day while attending school participate in higher amounts of activity time after-school compared to children who are more sedentary throughout the school day (Centers for Disease Control and Prevention, 2003; Dale et al., 2000; Department of Health and Human Services, Washington D.C., 2000).

According to 2007 data from the Stanford Prevention Research Center, children spend an extensive portion of their day in school and accordingly many of the classes are located in a sedentary environment (Stanford Prevention Research Center, 2007). Due to budget cuts and increased state standards in other curriculum areas, the amount of physical education and recess time where physical activity is normally found have been slowly decreasing throughout the years (National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health, 2010; Stanford Prevention Research Center, 2007). This decline in physical activity is cause for concern because research indicates that the earlier intervention tactics to decrease daily sedentary time for children are introduced, the less likely children will have excessive weight gain (Basterfield et al., 2010; Singhal, Schwenk, & Kumar, 2007b; Sisson et al., 2009; Spear et al., 2007).

Screen Time Among Children

American children have been flooded with a variety of technology media and spend, on average, more time with technology media than any other single activity besides sleeping (Roberts et. al., 1999; Roberts & Foehr, 2008; Robinson, 1999).

Screen time can include interacting with electronic and technology-based media such as watching television, using the Internet, watching a DVD, playing a computer game, using the computer for entertainment, communication or educational purposes, texting on mobile phones, and playing video games (Arbitron/Edison Research, 2011; Kaiser Family Foundation, 2009; Vize, 2008).

On average, the American people spend almost half of their waking day with media, and own either an iPod, iPad, iPhone or other MP3 Media Players, and a cell phone (Arbitron/Edison Research, 2011; Ipsos OTX, 2010). Research shows that a child in America devotes one-third of their day and spends 24.1 hours per week engaging in technology media, which includes TV, computer use, and video games (Roberts et. al., 1999; Roberts & Foehr, 2008; Robinson, 1999). Not only are technology media devices available in the homes and schools of children, but technology is also available in portable forms such as laptop computers, handheld devices, cell phones, and video game devices. Statistics show that this combination of stationary and portable technology media devices have resulted in children 6 years and younger averaging 2 hours and 24 minutes of daily technology media content exposure and 8-18 year olds averaging 7 hours and 50 minutes of daily technology media exposure (Rideout et. al., 2010; Roberts et. al., 1999; Roberts & Foehr, 2008).

Despite all of the newly developed technological media resources, television continues to be the dominant medium in the type of technology media affiliated with sedentary behaviors in children (Roberts et. al., 1999; Roberts & Foehr, 2008; Robinson, 1999). In 1950, only 10% of homes in America had a television and by 1960 the number of televisions in homes had risen to 87% (Genova, 2001; Pardee,

Norman, Lustig, Preud'homme, & Schwimmer, 2007; Television Bureau of Advertising, 2010). Today, 99% of homes have a television in America (Pardee et al., 2007; Arbitron/Edison Research, 2011). Research shows there is a correlation between the amount of television viewing time and the likelihood of childhood obesity (Roberts et al., 1999; Roberts & Foehr, 2008). Children who watch more than five hours of television each day have revealed the highest prevalence of obesity regardless of age, race or ethnicity, and family income (Andersen et al., 1998; Andersen, Crespo, Bartlett, Cheskin, & Pratt, 1998; Dietz & Gortmaker, 1985; Gormaker et al., 1999; Gortmaker et al., 1996; Taveras et al., 2007). In addition, long term effects of screen time on children have shown that increased time of television viewing is directly linked to an individual with lower fitness levels, higher BMI levels than recommended for their height, weight, and gender, and raised cholesterol during adulthood (Hershey & Jordan, 2007; Goldfield et al., 2006; Hancox, Milne, & Poulton, 2004).

The Relationship Between Computers & Interactive Video Games and Sedentary vs. Physical Activity Time

Technology media has become an evaluating factor when assessing children's health and physical activity levels (Anderson & Butcher, 2006a). Recent studies have shown that children with extended computer usage are linked to a higher risk of obesity (Mendoza et al., 2007; Subrahmanyam et al., 2000; Subrahmanyam et al., 2001). One-half of children ages 8-18 years of age not only use a computer on a daily basis, but spend 1 hour and 37 minutes playing on the

computer or regular video games (Becker, 2000; Rideout et al., 2010). However, there are contradictions within research about the relationship of computers and video game usage and their relationship to youth weight gain (Andersen et al., 1998; Biddle, Gorely, & Stensel, 2004; Biddle, Gorely, Marshall, Murdey, & Cameron, 2004; Hancox et al., 2004). Some researchers have concluded that video games in conjunction with obesity among children are too limited to determine the extent of influence on obesity in adolescents at this time (Andersen et al., 1998; Biddle, Gorely, & Stensel, 2004; Biddle, Gorely, Marshall et al., 2004; Gordon-Larsen, McMurray, & Popkin, 2000; Hancox et al., 2004; Vandewater et al., 2004). However, other research indicates playing home video game systems have been tied to childhood obesity for the past two decades as child obesity rates have escalated at the same time as the increase in popularity of video game usage (Brown, 2006).

As a result of this research acknowledging obesity and video game activity, in recent years a variety of interactive video games have been developed which require a physical activity component for the player of the video game to complete. The interactive physical activity component includes eye-hand coordinated based games, music, rhythm and dance activity, and recreational and sport simulator games for the video game player to use (Andrews, 2007; Disney, Keen, Konami, Nintendo, 2010; Höysniemi, 2004; Hämäläinen & Höysniemi, 2002).

Interactive video games use a variety of techniques to involve the player in the video game. Examples of such interactive tools include dance pads, remotes, web cameras, computer-attached skateboards, and exercise bikes (Andrews, 2007; Disney, Keen, Konami, Nintendo, 2010; Höysniemi, 2004; Hämäläinen &

Höysniemi, 2002). Compared to traditional sedentary video game play, the interactive contemporary modes have a physical interaction that allows the player's motor skills, endurance, rhythm, and martial arts movements to interact and move items on the viewing screen (Andrews, 2007; Disney, Keen, Konami, Nintendo, 2010; Höysniemi, 2004; Hämäläinen & Höysniemi, 2002).

In 1983, the joy board video game, which used a player's feet as the controller, was introduced as the first interactive video game in the world (Bogost, 2010; Wikipedia, 2010). Prior to 1994, other designs of utilizing a player's feet as the controller were launched in the video game world, but music, rhythm, and dancing had not been developed within any interactive video game (Höysniemi, 2004; Hämäläinen & Höysniemi, 2002). Konami video game company introduced the *Dance Dance Revolution* interactive dance game in 1996. The *Dance Dance Revolution* game required the video game player to move the player's feet on an interactive footpad to set dance routines while listening to music (Andrews, 2007; Disney, Keen, Konami, Nintendo, 2010; Höysniemi, 2004; Hämäläinen & Höysniemi, 2002).

Recent research on the interactive video game Wii™ version of *Dance, Dance Revolution* has provided evidence that Wii™ *Dance Dance Revolution* has a positive effect on increasing energy expenditure, helping with weight management, movement based learning, and mastering patterns (Höysniemi, 2004; Lanningham-Foster et al., 2006). The interactive video game style of Wii™ *Dance Dance Revolution* and similar games within this genre have been considered an enjoyable means to increase activity for individuals who would not workout otherwise

(Andrews, 2007; Höysniemi, 2004). Wii™ *Dance Dance Revolution* has been shown to help motivate people that are not normal “exercisers” and help work leg muscles, decrease weight, and improve cardiovascular endurance, strength and rhythm in the players (Andrews, 2007; Höysniemi, 2004; Murphy et al., 2009).

Interactive video games such as Wii™ *Dance Dance Revolution* and Wii™ *Fit* encourage healthful eating and increase physical activity among children by educating the video game player about their overall fitness and health (Baranowski et al., 2003). The Konami video game company, the maker of Wii™ *Dance Dance Revolution*, provides a 30-day trial membership to a 24-hour fitness franchise for purchasing the interactive game as an additional incentive to encourage physical activity among their users (Andrews, 2007; Disney, Keen, Konami, Nintendo, 2010).

In Wii™ *Dance Dance Revolution* the player moves their feet on a dance pad and follows patterns shown by arrows on the video screen. Similarly, Wii™ introduced an interactive video game called *Just Dance*, which uses a handheld motion sensor device to detect dance moves the interactive video game player completes. Both Wii™ *Dance Dance Revolution* and Wii™ *Just Dance* are useful tools in achieving increased physical activity through the use of interactive video games (Andrews, 2007; Höysniemi, 2004; Lanningham-Foster et al., 2006).

A recent study found short-term use of interactive video games has a positive relationship to overall physical activity levels in children (Graf, D. et al., 2009). Additionally, when a child plays interactive console video games over short periods of time, the activity level from the interactive video game is similar to light to moderate intensity physical activities (Maddison et al., 2007; Ni Mhurchu et al.,

2008). No specific research was found about the interactive video game Wii™ *Just Dance* and any correlation between children's sedentary behavior, physical activity time, or weight management due to the games recent release in the fall of 2009. However, several interactive video games have been introduced long enough to show correlations between reduced sedentary activity and playtime (Carolipio R., 2005; Lanningham-Foster et al., 2006).

For example, research has shown that children ages 8-12 years of age who participated in playing the interactive video game Wii™ *Dance Dance Revolution* for at least 45 minutes doubled their energy expenditure compared to sedentary time and increased their metabolism and caloric outtake (Carolipio R., 2005; Lanningham-Foster et al., 2006). In addition, a child's average heart rate was 144 beats per minute while playing the interactive video games utilizing the *Eye Toy* by Playstation™ and interactive dance pad video game Wii™ *Dance Dance Revolution*. This heart rate level meets the American College of Sport Medicine minimum guidelines for Heart Rate Reserve (HRR) (60% of their HRR (162.82 +/- 10.78 beats. min (-1)) (Carolipio R., 2005). Within this study the children also met the CDC and the NASPE recommended daily physical activity levels while playing Wii™ *Dance Dance Revolution* and *Eye Toy* by Playstation™ for 45 minutes (Carolipio R., 2005).

Interactive video game play can also be utilized as an overall aerobic exercise program as research indicates players expend significantly more energy than playing sedentary video games, but not as much energy as playing the sport itself (Graves, Stratton, Ridgers, & Cable, 2007; Graves, Stratton, Ridgers, & Cable, 2008; Siegel,

Haddock, Dubois, & Wilkin, 2009). While research has found a strong relationship between the time spent playing electronic games and young children's weight status, further evaluation is needed within the area of interactive video games and children's overall health (Vandewater, Shim, & Caplovitz, 2004).

Childhood Obesity and Health Risks

The incidence of children categorized by the CDC as overweight or obese has continued to increase dramatically for the last three decades (Singhal, Schwenk, & Kumar, 2007a). Over this time period, the number of children ages 6-11 years of age who were considered obese has increased from approximately 6.5% to more than 19.6% shown in Appendix L. The number of children ages 2-19 years of age categorized as overweight or obese in 2009 was 31.9% or approximately 23,500,000 children (American Heart Association & American Stroke Foundation, 2010; Centers for Disease Control and Prevention, 2010).

The most recognized method to screen for obesity in children has been calculating a child's height and weight or BMI. BMI is a noninvasive measure that evaluates an individual's weight in kg and height (National Obesity Observatory, 2009). The individual's weight is divided by the square of his or her height in meters (kg/m^2) (National Obesity Observatory, 2009). BMI calculations do not directly measure the amount of fat on a person, but it is a very reliable indicator of body fat found on an individual completing the BMI test (Singhal, Schwenk, & Kumar, 2007a). There are categorized weight levels developed by the CDC for children that consider body fat and weight of the child to determine if the child is at a

higher risk for health issues in the present and future (Centers for Disease Control and Prevention, 2010). According to the CDC, a child considered at risk for being overweight must have a BMI level of above the 85th percentile for the child's age and sex. A child considered overweight or obese must have a BMI above the 95th percentile for the age and sex of the child (Krebs, Jacobson, & American Academy of Pediatrics Committee on Nutrition, 2003).

Children who are overweight have a higher risk of developing health issues such as type 2 diabetes, hypertension, metabolic syndrome and/or sleep apnea (Daniels et al., 2005). Up to 45% of newly diagnosed type 2 diabetes mellitus patients are children or adolescents (Wang & Dietz, 2002). Research has shown that many of the known health risk factors affiliated with type 2 diabetes, cardiovascular disease, and obesity are present in children (Centers for Disease Control and Prevention, 2010). Physical activity specialists have advocated for an increase in daily physical activity of children to help prevent or delay the onset of chronic diseases (Singhal, Schwenk, & Kumar, 2007a). Research shows that by educating children about the implications of a higher morbidity and mortality rate during adult life that result because of the child's choices made today, children will learn to develop strong health patterns to reduce the likelihood of concerning health care issues in the future (Singhal, Schwenk, & Kumar, 2007a).

Physical Education and Activity Time in Schools

Because the scope of schools reaches most children in America, schools are effective organizations for providing daily physical activity opportunities

(Department of Health and Human Services, Washington D.C., 2000). Physical education class is one method used in schools that can have a significant positive effect on the health-related fitness of children (Department of Health and Human Services, Washington D.C., 2000; National Association of Sport and Physical Education, 2008; National Association of Sport and Physical Education, 2010). However, physical activity participation in physical education courses are directly related to the number of classes offered per week and class size (UCLA Center to Eliminate Health Disparities and Samuels & Associates, 2007). The larger the class size, the less time students spend being physically active (UCLA Center to Eliminate Health Disparities and Samuels & Associates, 2007). A survey completed in 2008, showed 60.26% of public and private schools across the country provided children the opportunity to participate in physical education one to two times per week, 20.43% of public and private schools offered physical education three to four times per week, and only 19.31% of public or private schools offered physical education on a daily basis (Slater, Turner, Chaloupka, & Powell, 2006).

As a result of the lack of physical activity time in physical education class, and other class opportunities and mandates, numerous school systems have reduced the amount of physical education time and days per week required to graduate (Boyce, 2010; National Association for Sport and Physical Education & American Heart Association, 2010). Widespread usage of exemptions and waivers by students to avoid physical education class, combined with many schools no longer requiring physical education for every grade level, physical education can no longer be the only place for daily physical activity to occur (American Heart Association &

American Stroke Foundation, 2010; Department of Health and Human Services, Washington D.C., 2000; National Association of Sport and Physical Education, 2010; National Association for Sport and Physical Education & American Heart Association, 2010).

The Physical Education to Create a Healthier Nation Act was introduced by Republican Joe Baca to Congress in February 2008 (H.R. 4557, 2010). The act would have required schools across America to have a physical education program that would meet nationally recognized weekly minimum activity requirements, including 150 minutes for elementary children and 225 minutes for children in middle and high school levels (National Association of Sport and Physical Education, 2010). The bill was designed to help physical education become a more influential factor in fighting obesity, however the bill has not been passed but has been referred to the Subcommittee on Early Childhood, Elementary, and Secondary Education to be further examined.

Alternative routes to help children acquire the 60-minute a day physical activity recommendation by the CDC have started to be considered by schools. Schools have implemented structured recess time, encouraged physical activity within the normal classroom, and instituted morning and after-school programs to help increase the physical activity time of children (National Association of Sport and Physical Education, 2010; Pate et al., 2006). With regard to structured recess, research is currently underway to determine if a “recess teacher” who facilitates organized games with mandatory participation is an effective method to increase daily physical activity time for children. Preliminary research has shown a positive

effect on elementary children's physical activity levels when more structured recess is provided, though further research is needed to evaluate the short and long-term impact of strategies affiliated with structured recess (Ridgers, Stratton, Fairclough, & Twisk, 2007; Ridgers, Toth, & Uvacsek, 2009; Ridgers, Fairclough, & Stratton, 2010a; Ridgers, Fairclough, & Stratton, 2010b).

Physical activity has also been integrated into the academic curriculum and allows children to be physically active during classroom instruction (Martin, Martin, & Rosengard, 2010; J. Salmon, 2010; J. Salmon, Booth, Phongsavan, Murphy, & Timperio, 2007). The classroom-based physical activity programs for children in grades K-5 provide physical activity sessions on a daily basis while integrating academic learning objectives in language arts, math, social studies, science and health. According to several studies, there is an increase in the amount of energy expenditure in children who participate in classroom-based physical activities (DuBose et al., 2008; Gibson et al., 2008; Martin et al., 2010; Salmon, 2010; Salmon et al., 2007; Stewart et al., 2004).

Before and after-school programs have the potential to provide opportunities for increased levels of physical activity through recreational or intramural sports, non-athletic activities that involve physical activity components, and physical activity clubs (US Department of Health and Human Services. & Let's Move, 2010). Research suggests that after-school programs can enhance physical activity levels and other health-related aspects for all children (Beets, Beighle, Erwin, & Huberty, 2009; Dzewaltowski et al., 2010). Studies conducted on researching obese children when participating in after-school physical activity programs have shown success in

improving health factors (Dzewaltowski et al., 2010; Gutin, Yin, Johnson, & Barbeau, 2008; U.S. Department of Education, National Center for Education Statistics, 2004; Zahner et al., 2006). Research pertaining to before-school physical activity programs and before-school physical activity levels was unavailable and is a key question for future research.

Measuring Physical Activity

Measuring energy expenditure is a common method used to evaluate the amount of active energy expended during a person's structured exercise, as well as in normal daily activities (Besson, Brage, Jakes, Ekelund, & Wareham, 2010; Dzewaltowski et al., 2010; Gutin et al., 2008; Neilson, Robson, Friedenreich, & Csizmadi, 2008; U.S. Department of Education, National Center for Education Statistics, 2004; Zahner et al., 2006). A variety of methods used to estimate daily physical activity have been developed to determine physical activity levels of children, however there is an absence of inexpensive, noninvasive, available, valid and reliable technology for measuring physical activity levels in large numbers of children. Researchers have relied on self-reporting questionnaires to document daily physical activity levels of children, but many of the self-reporting questionnaires have shown limited reliability and validity (Neilson et al., 2008; Shephard, 2003; Troiano et al., 2008; Troiano, 2009; Troiano & Freedson, 2010). Although information provided by self-reported questionnaires has shown substantially lower physical activity levels than other means of measuring activity, like the use of accelerometers, the results found by the self-reporting physical activity

questionnaires are valuable in relative terms and are used to rank group/individual physical activity levels (Bauman et al., 2009; D. E. Rosenberg et al., 2010; Shephard, 2003; Troiano et al., 2008; Troiano, 2009; Troiano & Freedson, 2010).

Two objective devices used to improve the validity and reliability in measuring physical activity are: 1) movement counters such as a pedometer, which is a device that attaches to the waistband in the midline of the thigh on either side of the body and measures steps and distances in ambulatory activity, such as walking or running (Berlin, Storti, & Brach, 2006; Le Masurier & Tudor-Locke, 2003; Troiano, 2009; Tudor-Locke, McClain, Hart, Sisson, & Washington, 2009), and 2) accelerometers, which are small (5.1 x 3.8 x 1.5 cm), lightweight (45g) uniaxial calculators designed to detect vertical acceleration ranging in magnitude from 0.05 to 2.00 G with frequency responses of 0.25 to 2.50 Hz (Bouten, Sauren, Verduin, & Janssen, 1997; Le Masurier & Tudor-Locke, 2003; Troiano et al., 2008; Troiano, 2009; Troiano & Freedson, 2010).

The pedometer is a physical activity tracker where individuals set the pedometer to the individual's own stride and speed to help with reliability and validity (Berlin et al., 2006; Tudor-Locke et al., 2009). While the pedometer can capture ambulatory physical activity behaviors, but is not able to accurately produce evidence of changes in an individual's energy expenditure levels at different speeds, nor utilize an internal clock which could provide information about the pattern or duration of specific activities or intensity (Berlin et al., 2006; Puyau et al., 2002; Saris & Binkhorst, 1977; Tudor-Locke et al., 2009).

Unlike the pedometer, the parameters set by the accelerometers allow for a high detection of normal human movement. Accelerometers can filter out high frequency vibrations like shaking, as opposed to a pedometer that cannot make that distinction. The filtered acceleration signal from the accelerometer is digitized and the magnitude of physical activity is summed over a user-specified time interval. At the end of each interval the summed value or physical activity “count” is stored in the memory of the accelerometer and the integrator is reset once information about physical activity is downloaded to a computer from the accelerometer device itself.

Accelerometers are small devices worn on a hip and account for normal ambulatory movement. This device has the best prediction of energy expenditure when attached by a belt that is worn around the waist (Bouten et al., 1997; Troiano, 2007; Troiano et al., 2008; Troiano, 2009; Troiano & Freedson, 2010; Tudor-Locke et al., 2009). Accelerometers have improved the accuracy of tracking physical activity levels in children compared to direct observation, pedometer use, questionnaires, and heart rate monitoring. Accelerometers have a higher validity and reliability as opposed to the previously mentioned methods because of the advanced electronics used within the mechanics of the accelerometer that is able to track movement not correlated with a physical activity movement (Bouten et al., 1997; Le Masurier & Tudor-Locke, 2003; Troiano, 2006; Troiano et al., 2008). Research has illustrated individual errors in measuring energy expenditure in children when using an accelerometer alone, (Corder, Ekelund, Steele, Wareham, & Brage, 2008; Janz et al., 2005; Puyau et al., 2002; Troiano, 2002) and to overcome this obstacle, investigators have combined physical activity measurement devices together, which

has shown higher validity and reliability in research. (Strath, Bassett, Swartz, & Thompson, 2001).

Using an accelerometer along with a heart rate monitor has proven to be more precise when estimating total energy expenditure than either the heart rate monitor or accelerometer working alone (Johansson, Rossander-Hulthen, Slinde, & Ekblom, 2006; Strath et al., 2001; Zakeri, Adolph, Puyau, Vohra, & Butte, 2008). Heart rate monitors are devices that read and display a person's heart rate either through a strap that is worn around the chest or a watch that has finger touch point sensors. The heart rate monitor can be used to measure the intensity of a workout while being physical. It provides feedback to the individual wearing the heart rate monitor as well as to researchers. There are limitations to wearing only a heart rate monitor in tracking daily physical activity levels because of the differences in biology of individuals and difficulty in discriminating heart rate levels in individuals when low energy expenditure occurs (Guinhouya, Apete, & Hubert, 2009).

Physical activity is defined as “any bodily movement produced by skeletal muscle resulting in energy expenditure” (Caspersen et al., 1985). According to the CDC, the measurement of the number of youth meeting the 60 minute or more standard of daily physical activity at the moderate to vigorous level has been unclear due to small sample sizes and self-reported data validity (Nader, Bradley, Houts, McRitchie, & O'Brien, 2008; Troiano, 2007). To help determine the effectiveness of physical activity intervention programs, such as a morning physical activity club, accurate measurement of daily physical activity is a needed component (Troiano, 2007; Troiano, 2009; US Department of Health and Human Services, 2002). Using

an accelerometer offers potential solutions to problems faced by other unreliable means of tracking physical activity levels (Troiano, 2006; Troiano, 2007; Troiano, 2009).

The accelerometer physical activity measurements can be presented in three ways: 1) mean counts per minute; 2) estimates of the time spent in physical activity according to count thresholds; and 3) an estimate of adherence to physical activity recommendations (Troiano, 2006; Troiano, 2007; Troiano, 2009). Activity count cut points, which translate the time-sampled data information obtained while wearing an accelerometer into estimates of activity duration in specific intensity categories, were developed by Trost and Freedson (Troiano, 2006; Troiano, 2007; Troiano, 2009; Tudor-Locke, Ainsworth, Thompson, & Matthews, 2002b; Tudor-Locke, Williams, Reis, & Pluto, 2002). The defined intensities for the time spent in activity have thresholds for moderate activity of 4 METS and vigorous activity of 7 METS which takes into consideration the children's higher resting energy expenditure rates (Harrell et al., 2005; Trost, McIver, & Pate, 2005). Although the most ideal way to assess physical activity in children is through direct observation, due to the long measurement time periods and personnel constraints, the accelerometer provides a valid alternative to assess amount and intensity of physical activity on a daily basis for children (Sirard, J. 2001). Examples of activities for children to complete to meet the moderate to vigorous physical activity levels can be found in Appendix G.

Although 10,000 steps/day appears to be readily accepted for children by socially accepted standards in meeting the daily physical activity levels, (Dollman, Olds, Esterman, & Kupke, 2010) new data pertaining to children indicate that the

10,000 step/day value is too low to obtain considerable health benefits in the childhood population (Dollman et al., 2010). The President's Challenge Physical Activity and Fitness Awards Program also acknowledges that 10,000 steps/day is too low for physical activity levels of children and recommends girls accumulate at least 11,000 steps/day and boys 13,000 steps/per day, 5 days a week (Dollman et al., 2010; President's Council on Physical Fitness and Sports, 2001). Because of recent research showing evidence of the need to increase the amount of daily steps needed in children, the cut points in this study were set higher than the usual adult values of 3 and 6 METS (Harrell et al., 2005; Roemmich, Clark, Weltman, Veldhuis, & Rogol, 2005). The amount of daily physical inactivity is related to daily sedentary time of children and the amount of daily steps taken influence the activity levels of both areas (Koezuka, N., 2006).

As previously noted, heart rate monitors and accelerometers utilized together show a high validity and reliability level when estimating total daily energy expenditure of an individual (Brage et al., 2004; Brage, Brage, Franks, Ekelund, & Wareham, 2005). Newer technology programs and hardware have been added to physical activity devices to improve reliability and validity as well. The accelerometer physical activity monitoring device has added a more sophisticated analytic approach, such as quadratic discriminate analysis and hidden Markov Modeling, (Poher, Staudenmayer, Raphael, & Freedson, 2006) a two-regression model supported on data variability to improve validity and reliability of physical activity data retrieved from accelerometers (Crouter, Kuffel, Haas, & Bassett, 2010; Kuffel, Crouter, Haas, Frongillo, & Bassett, 2008; Poher et. al., 2006). Accurate

estimations of daily physical activity in children are integral to developing an understanding of physiological, behavioral, and environmental factors that affect the child's overall health. Technological advances have provided researchers various methods to predict activity patterns in a more proficient and precise manner.

Summary

For the last three decades the prevalence of children categorized by the CDC as overweight or obese has continued to rise dramatically (Singhal, Schwenk, & Kumar, 2007a). The relationship between physical activity levels and incidence of obesity is very strong. Increasing children's daily physical activity time will potentially minimize the obesity issue and enable children to develop positive long-term health benefits into adulthood (Centers for Disease Control and Prevention, 2010; Rennie, Johnson, & Jebb, 2005; Rennie, Livingstone, Wells, et. al., 2005). Schools have played a large role in providing physical activity to children for more than a century. However, the 21st century health trends show children with high rates of sedentary time are not taking the initiative to be physically active (Anderson & Butcher, 2006b; Pate et al., 2006; Sallis & Glanz, 2006). The promotion of physical activity in schools needs to expand to a higher engagement level to improve the overall health and physical fitness level of children by offering alternative activity times throughout the school day, as well as before and after the school day to increase daily physical activity (Pate et al., 2006; Stanford Prevention Research Center, 2007). Recess, in-class physical activity time, and physical education classes are excellent starting points to help children decrease their sedentary time and help

fight pediatric obesity (Pate et al., 2006). With high usage levels of technology media by children (American Heart Association & American Stroke Foundation, 2010; Rideout et al., 2010; Roberts et. al., 1999; Roberts & Foehr, 2008), along with their increased interest in technology, the integration of a school-based program and technology media usage is a unique opportunity to improve daily physical activity in a progressive environment for today's children.

CHAPTER 3

METHODOLOGY

Three hundred K-5th grade students from one elementary school in a rural Nebraska town with a population of 40,000 were invited to participate in a cross-sectional study. The investigator used a quantitative method to determine the association between morning physical activity, technology, daily physical activity, cardiorespiratory fitness, and sedentary behaviors in children. The University of Nebraska-Kearney and the University of Nebraska-Lincoln Institutional Review Board approved a document of informed consent to be completed by the parent and child, asset procedures, and questionnaires for the investigation (Appendix B-IRB #030510-2).

Study Overview

The investigator measured the participating children's body weight, height, and cardiovascular fitness levels during physical education classes and throughout the morning physical activity research time. Parent/guardians and participating children were asked to complete a questionnaire assessing video game usage, enjoyment of physical activity, types of activities completed, and average amount of daily sedentary time for descriptive data purposes (CATCH, CAPA, Kaiser Family Foundation, YRBS, Appendix E). Beginning in March 2010, 52 children participated in playing WiiTM *Dance Dance Revolution* and 53 children played WiiTM *Just Dance* video game for seven weeks in the gym at the school. Because of cold weather conditions the running/walking activity began in August.

Beginning in August 2010, a morning physical activity program offering an outdoor running/walking route was offered to children grades K-5 at the school. One hundred and nine children participated in the running/walking club portion for seven weeks. During the seven weeks that children participated in a morning activity either in the March 2010 session or the August 2010 session, children wore an accelerometer mounted on the child's right hip. The accelerometers were set to record activity in 15 s epochs (time sampling interval) during four consecutive days from 7:00 a.m. to 9:00 p.m. while children participated in the *Wii™ Dance Dance Revolution*, *Wii™ Just Dance* activity time, and the running/walking activity (Rowlands, A., 2008). In the months of November and December 2010, 43 students who participated in both the spring and fall morning activities, including *Wii™ Dance Dance Revolution*, *Wii™ Just Dance*, and the running/walking club, wore accelerometers mounted on the right hip, and were set to record activity in 15 s epochs during four consecutive days from 7:00 a.m. to 9:00 p.m. while no morning activities were offered (Rowlands, A., 2008). Throughout each segment the children wore the accelerometer 15 s epoch (time sampling interval) were used to capture the quick changes in activity found in children (Rowland, A. 2006; Trost, S., 2005; Bailey, 1995), and to maximize the accuracy of measurement of activity intensity, while decreasing the likelihood of underestimating vigorous activity (Troiano, R., 2006; Treuth, M., 2004; Rowland, A., 2006).

The purpose of wearing the accelerometer was to collect data on the amount of moderate to vigorous physical activity and sedentary time the child comprised on days the child played *Wii™ Just Dance*, *Wii™ Dance Dance Revolution* or

ran/walked compared to days the child had no morning activity. At the end of each interval of the child wearing the accelerometer, the summed value or activity “count” was stored in the memory of the accelerometer and the information was downloaded onto a computer (Troiano, 2006).

The accelerometer physical activity measurements were presented in three ways: 1) mean counts per minute, 2) estimates of the time spent in physical activity according to count thresholds, and 3) an estimate of adherence to physical activity recommendations (Troiano, 2007). Activity count cut points, which translate the time-sampled data information obtained while wearing an accelerometer into estimates of activity duration in specific intensity categories developed by Trost and Freedson, were used on the data collected (Freedson, Pober, & Janz, 2005; Tudor-Locke, Ainsworth, Thompson, & Matthews, 2002a; Rowland, A. 2006). The classification of each category (sedentary/light, moderate, vigorous, hard vigorous activity) allowed the number of minutes of each type of physical activity or sedentary time to be assessed (Tudor-Locke, C., 2002; Freedson, P., 2005; Rowland, A., 2006; Stone, M., 2008). The defined intensities for the time spent in activity for sedentary time equaled 1 MET (metabolic equivalent of task), or less than 100 counts per minute. Moderate activity (equal to or greater than a brisk walk) levels equaled 4 METS (thresholds greater than 3000 to 3600 ActiGraph counts·min⁻¹), vigorous activity (equal or greater than a light jog) was greater than or equal to 7 METS (thresholds greater than 3600 to 9630 ActiGraph counts·min⁻¹), and hard vigorous activity (equal or greater than fast run) was greater than or equal to 10 METS (9630 ActiGraph counts·min⁻¹) which takes into consideration children’s

higher resting energy expenditure rates (Freedson et al., 2005; Treuth et. al., 2004 July; Strath et al., 2001; Trost et al., 2005).

Along with wearing an accelerometer, the children wore a Bowflex™ 10s strapless heart rate monitor while participating in the *FITNESSGRAM*® PACER (Progressive Aerobic Cardiovascular Endurance Run) during physical education class and throughout the morning activities. According to the manufacturer of the Bowflex™ 10s strapless heart monitor, a strapless heart rate monitor is said to be “ECG accurate,” which means the heart monitor is an electrocardiogram – a measure of the heart’s electrical activity. This illustrates that the exact heart rate of a person can be accurately determined by the use of a strapless heart rate monitor (<http://www.bowflexhomegyms.com>). Research is currently underway to determine the reliability and validity of the strapless heart rate monitor. The primary purpose of wearing the heart rate monitor was to provide descriptive information for the study. The heart rate monitors were used to determine the child’s average heart rate while participating in the morning fitness activities. The secondary purpose was to determine if there was a significant difference between average activity heart rate and moderate to vigorous physical activity levels while participating in the before-school activities.

Selection of Sample

As previously noted, 300 K-5th grade students were invited to participate. The selection of elementary students, as opposed to high school students, was based on research evidence of increased sedentary behavior of children as the child gets

older due to increased amounts of technology media available (Roberts & Foehr, 2008). As well as research indicating that all types of physical activity declines as age and/or grade in school increases and the relationship between low physical activity levels and the frequency of obesity is very strong (Centers for Disease Control and Prevention, 2010; Janz, Dawson, & Mahoney, 2000; National Center for Chronic Disease Prevention and Health Promotion, Division of Adolescent and School Health, 2010).

Out of the 300 possible participants, 100 children volunteered to participate in the study beginning in March 2010, 109 children in August 2010, and 43 children in November 2010. The children were divided into separate categories by gender and were randomly selected to play Wii™ *Dance Dance Revolution* or Wii™ *Just Dance* for seven weeks beginning in March 2010. All children participated in the running component so no randomization was needed. Children selected to wear an accelerometer at the end of November or beginning of December had participated in both the technology, Wii™ *Dance Dance Revolution* or *Just Dance*, and running/walking morning fitness programs.

The children were randomized for the Wii™ *Dance Dance Revolution* and *Just Dance* games by using a two *Excel*™ spreadsheet (one spreadsheet for boys, one for girls) where the cells were highlighted for each selection and the formula =RAND () and hit Ctrl+Enter was entered. The formula was inputted in all cells and copied with Ctrl +c. The special formula values were then pasted into the excel document by using Edit-PasteSpecial-Values-OK. Each of the gender specific spreadsheets was divided randomly into two equal groups by giving each student an

identification number. The children with odd identification numbers were selected to play Wii™ *Dance Dance Revolution* in March 2010. The children with even identification numbers were selected to play Wii™ *Just Dance* in March 2010.

Procedures

Overview:

Children participating in the study completed the *FITNESSGRAM*® (www.fitnessgram.net) PACER test, had their resting heart rate taken by wearing a strapless heart rate monitor, and height and weight determined while in their regular physical education class in the spring and fall of 2010. For the indoor morning activities the children were divided into two groups. This division resulted from the high volume of children and limited available gym space while playing the interactive technology Wii™ video games. During the seven-week timeframe, half of the children reported to the school gymnasium on Mondays and Wednesdays to participate in the Wii™ *Just Dance* interactive video game. The other half of children reported on Tuesdays and Thursdays for that same seven weeks to play the Wii™ *Dance Dance Revolution* interactive video game.

Beginning in August 2010, the children participated in an outdoor running/walking club on Mondays and Wednesdays for seven weeks. Midway through the seven-week sections of the study during spring and fall, a letter was sent home for the parent and child that described the process of wearing an accelerometer for four days (Appendix I). During the midway point of the study, within a two-week time frame, all children wore an accelerometer mounted on the child's right

hip, and set to record activity in 15 s epochs (time sampling interval) during four consecutive days to determine their daily physical activity levels as well as the amount of daily sedentary time (Tudor-Locke, C., 2002; Freedson, P., 2005; Rowland, A., 2006; Stone, M., 2008). Children who participated in both the interactive technology Wii™ video games and running/walking club wore an accelerometer mounted on the child's right hip, and set to record activity in 15 s epochs (time sampling interval) during four consecutive days during a two-week time frame in November when no morning activity transpired.

Initial Screening: Initial information was provided by the investigator(s) to potential participating children's parents where the goals, purposes, and expectations of the research project were covered (Appendix C). Children still willing to participate signed a document of informed consent along with their parents (Appendix D). The parents of the children completed a written medical history as suggested by the American College of Sports Medicine (Appendix F). In addition, the children and parents also completed a lifestyle evaluation to ensure that the child was in good health to participate in exercise testing (Appendix E).

Questionnaires: A parent/child questionnaire was developed and reviewed for content validity and descriptive data information by the investigator. The questionnaires were completed at the beginning of the March 2010 session and again in the August 2010 session. The investigator sent home the parent/child questionnaire through distribution in the regular elementary classroom. Children were required to complete the questionnaire and return it to school prior to being allowed to begin the physical activity morning program. Children interested in

participating but who did not complete the forms were provided another questionnaire to take home to their parents to complete and return. Children were not allowed to begin the program until the proper paperwork was completed and turned into the researcher.

Questions found on the parent/child questionnaires were divided into the following categories: 1) video game usage, 2) enjoyment and types of physical activity, 3) sedentary activities, and 4) environmental factors. Information such as the children's age, sex, race, parent/guardian's current physical activity level, family time spent participating in physical activities and/or video/technology activities were also measured from the questionnaire for descriptive data collection.

Video Game Usage (Appendix E) A parent/child questionnaire was developed about the family and child video game usage. Questions included having the parent and child answer how much time the parent and/or child spent playing a variety of video game devices, the kind of video game console the parent owned, how often and when the parent and/or child played the video games, and if the video games were a family activity.

Enjoyment and Type of Physical Activity (Appendix E) A parent/child questionnaire was developed to understand the type of physical activity children were involved with and which type of physical activities the child enjoyed on a consistent basis. Questions involved asking the parent and child what physical activities the parent and child were involved in, the amount of time per day and week spent doing those activities, as well as the season of the year in which the activities

occurred. Additionally, parents/children were asked to rank a variety of activities from most favorite to least favorite.

Amount of Sedentary Time (Appendix E) A parent and child questionnaire was developed to understand sedentary activities the parent and children participated in which decreased physical activity time. Sample areas discussed within the questions included time spent watching television individually and as a family, time on the computer, employment and sitting time the parent/guardian completed on a daily basis, and participation in sports/or other organized activities.

Accelerometer

Approximately three and a half weeks into the research, participants and parents received a letter explaining the purpose of wearing an accelerometer and the appropriate way to put on the accelerometer (Appendix I). The children were instructed to wear physical activity monitors (MTI Actigraph model #AM7164) for four consecutive days in August 2010 when the running club was offered and in March 2010 when Wii™ *Dance Dance Revolution* and Wii™ *Just Dance* activities were completed. Children who participated in both of the physical activity sessions were also asked to wear the accelerometers for an additional four-day consecutive time frame when no morning activity was occurring in November and December 2010.

Accelerometers are small (5.1 x 3.8 x 1.5 cm), light weight (45g) uniaxial calculators designed to detect vertical acceleration ranging in magnitude from 0.05 to 2.00 G with frequency response of 0.25 to 2.50 Hz. The accelerometer parameters

allow for a high detection of normal human movement and filter out high frequency vibrations such as shaking the monitor. The filtered acceleration signal is digitized and the magnitude is summed over a user-specified time interval. At the end of each interval, the summed value or activity “count” is stored in memory and the integrator is reset. The classification of each category (sedentary/light, moderate, vigorous, hard vigorous activity) allowed the number of minutes of each type of physical activity or sedentary time to be assessed (Tudor-Locke, 2002; Freedson, 2005; Rowland, 2006; Stone, 2008). The defined intensities for the time spent in activity for sedentary time equaled 1 MET, or less than 100 counts per minute. Moderate activity (equal to or greater than a brisk walk) levels equaled 4 METS (thresholds greater than 3000 to 3600 ActiGraph counts·min⁻¹), vigorous activity (equal or greater than a light jog) was greater than or equal to 7 METS (thresholds greater than 3600 to 9630 ActiGraph counts·min⁻¹), and hard vigorous activity (equal or greater than fast run) was greater than or equal to 10 METS (9630 ActiGraph counts·min⁻¹) which takes into consideration children’s higher resting energy expenditure rates (Freedson et al., 2005; Treuth, M., et al., 2004; Strath et al., 2001; Trost et al., 2005).

Accelerometry data was analyzed using a Statistical Analysis System (SAS[®] version 9.1, Cary, N. C.) to determine the amount of total daily sedentary time, and total daily moderate to vigorous physical activity time the participants obtained using calculations found by wearing the accelerometer. The accelerometer was also worn for four consecutive days to determine primarily the difference in amount of sedentary and moderate to vigorous physical activity time between the running activity, Wii[™] *Dance Dance Revolution*, Wii[™] *Just Dance* activity days, and when

no morning physical activity program took place.

Anthropometric Measurement.

Body mass and height were measured using an electric digital scale and stadiometer. Participants were measured using the BMI calculator to determine the child's BMI level which showed the child as being either obese, overweight, normal, or underweight (<http://www.cdc.gov/healthyweight/assessing/bmi/>). BMI is a noninvasive measure calculated by taking an individual's body mass (kg) divided by the square of his or her height in meters (kg/m²). The BMI calculation does not directly measure the amount of fat on a person but it is a reliable indicator of body fatness for children (Singhal, 2007). All children were measured while wearing school clothes and no shoes. Each child's body mass index were determined by the criteria developed by the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2010) (Appendix H).

Heart Rate and Cardiovascular Fitness

Children completed the *FITNESSGRAM*[®] (www.fitnessgram.net) PACER (Appendix J) fitness test in physical education class while the primary investigator was present to collect data in the spring and fall of 2010. The PACER physical fitness test is a multistage fitness test adapted from the 20-meter shuttle run. The PACER test is progressive in intensity, which is easy at the beginning and becomes more difficult as the test continues. An individual begins by lightly jogging and then progresses to increase the speed of the run until they are unable to keep the same

speed with the cadence of the music CD. At this point the participant stops the test and the total number of laps is recorded.

Children were divided by gender to run the PACER test in physical education class. Girls ran first and then the boys ran. The children participating in the study were provided a Bowflex™ 10S Strapless Heart Rate Monitor Watch prior to beginning the PACER in physical education class. The heart rate watch had a quick touch technology that determined heart rate quickly and easily by the child placing his/her thumb and pointer finger on the interface of the watch. The heart rate watch recorded the average and/or maximum heart rate for each child. When the child completed the PACER fitness test the child moved immediately, within a 10 second time frame or less, to the investigator and completed a heart rate check where the results were recorded by the investigator. The physical education teacher provided the number of PACER laps each child completed to the investigator. The heart rate and PACER data collected from the children completing the PACER fitness test in March and August 2010 was used to determine cardiovascular fitness levels of the children and for descriptive data purposes. *FITNESSGRAM*® PACER information was used for descriptive data to find initial physical activity levels of the children for the study.

Prior to completing the morning fitness program, the children had his/her resting heart rate assessed by wearing the strapless heart rate monitor and sitting calmly for five minutes in the gym during the first morning activity time. The researcher had the children complete the procedure to acquire a heart rate from the touch sensors on each child's watch. The heart rate indicator provided the

investigator the initial resting heart rate for each child. Average activity heart rates of the children were also assessed while the children participated in the morning activities. The heart rate averages were collected in the spring and fall activity sessions. The average heart rate data collected were then analyzed comparing the type of physical activity each of the children completed.

Morning Activities

August 2010-Running Activity: All children reported to the school playground at 7:30 a.m. to begin their run/walk on Mondays and Wednesdays. A 400 m specified route was marked with adults at corners to help guide the children through the route of the run. The running route did not cross any street so there were no traffic safety issues. A randomized sample group of children were given a heart rate watch to wear sometime throughout the seven-week run/walk activity timeframe. When the child completed the 400 m-lap track a researcher placed a small dot on his/her hand. Each time the child completed a lap another dot was placed on their hand. At the completion of the third lap, the researcher had children check their heart rate through the use of the touch sensor wristwatch. The researcher recorded the data for each child. At the completion of the thirty-minute physical activity session children were asked to count the number of running laps completed, by counting the dots on their hand, and the researcher recorded the number of dots.

Children were not given a specific pace to follow for the thirty-minute physical activity time. The children were encouraged to acquire the most “dots” on their hand, which represented 400 m or 1 lap around the track. If the children

received enough dots to equal the length of a half marathon (21,097.5 m) the children were recognized at a mid-year school assembly and received a medal. Prior to the start of the running/walking morning activity program, the children's homeroom teachers told children about the incentive.

March and October 2010 - Physically Active Video Gaming: Children reported to the school gymnasium at 7:30 a.m. to begin playing Wii™ *Just Dance* or *Dance Dance Revolution* interactive video games. The children were provided a short instruction session about the use of the specific game the child had been randomly selected to play. The Wii™ version of the game *Dance Dance Revolution: Ultimate Party 2* was played for the *Dance Dance Revolution* game portion and Wii™ *Just Dance* for the other video game component. All children started on the same difficulty level. Data was not collected directly on the video game and/or the particular score when the child played the game due to high variability and the lack of relevance to the current study. The children wore the accelerometer for four consecutive days and the child's physical activity levels were recorded while playing the video game.

Wii™ *Just Dance* play: Fifty-three children participated in playing Wii™ *Just Dance*. One child was randomly selected for each song during the thirty-minute physical activity session. The child was positioned in front of the Wii™ console and held the Wii™ remote in one hand. The remainder of the children, not holding a remote, were scattered around the gym and found their own personal space to view and participate in playing the Wii™ *Just Dance* game projected by an LCD projector onto a wall in the gym. Wii™ *Just Dance* is a music and rhythm video game that

allows an individual to work on dance moves, eye-body coordination, and increase cardiovascular activity. When playing Wii™ *Just Dance*, no dance pad controllers are required. Instead, the player uses the Wii™ remote to follow the moves of a character shown on-screen completing a variety of dance moves. The Wii™ *Just Dance* game requires the child to follow a continuous list of dance moves to the beat provided by the song which is all shown on the video screen. The dance moves ranged from raising an arm above the child's head to boxing moves like "Rocky". A silhouette of a dancer, the actual child playing, was shown on the screen and mimicked the moves the child completed, while a meter scored how well the child matched the moves shown scoring them as: A) great, B) ok, or C) bad. Children were allowed to select a variety of music with different speeds and difficulty levels to play. One child was "scored" on the screen each song. After each song, a new child who was randomly selected had a turn to be "scored" while playing the Wii™ *Just Dance* video game. Every child was the "scored" individual at least twice throughout the seven-week time frame. Children not being "scored" were asked to scatter around the gym and dance to the songs by completing the moves on the screen shown.

The researcher did not record scores completed by any of the children playing the Wii™ *Just Dance* game due to the variability in type of songs and difficulty the children selected and relevance to the current study. Throughout the duration the children wore the accelerometer, the child's physical activity level, not the score of the actual video game were analyzed.

Within the seven-week time frame a random sample of the children wore a

strapless heart rate watch for one entire morning of the physical activity session. While wearing the heart rate watch the child was strongly encouraged to participate in the dance portion the entire time. The investigator recorded the heart rates of the children wearing the watches half way through and at the end of the dancing period to record heart rate data for each child.

Wii™ *Dance Dance Revolution* play: Fifty-two children participated in playing the Wii™ *Dance Dance Revolution* game for seven weeks in the spring of 2010. Children were positioned on a “dance platform” or stage and stepped on arrows laid out in a cross pattern and with their feet moved to musical and visual cues shown on the screen. Pictures of four arrows are printed on the Wii™ *Dance Dance Revolution* mat in a forward, backward, left and right direction. When the game is played a pattern of arrows is shown on the video screen. For example, a picture of an arrow facing forward will show on the video game screen. When the arrow reaches a central location indicated on the video screen the child playing should tap their arrow on the child’s mat, which is facing forward. As the player continues to play various directional arrows will be shown on the screen and the difficulty of the number of arrows and how quick they are presented in the video game increases. The children were judged by how well they timed touching the arrows on their mat to the dance (arrow) patterns presented to them.

Four children were on “active” pads for each song. The other children participating were on practice pads and completed the moves but did not get “scored.” After each song the children on the Wii™ *Dance Dance Revolution* mats had their heart rate taken through the use of the touch sensor wristwatch and the

researcher recorded the heart rate of each child. The children rotated onto the “active” and practice pads after each song ended throughout the morning physical fitness activity by viewing a participation order list on the wall and verbally communicated to the children after each song.

When the children played Wii™ *Dance Dance Revolution*, four dance pads were hooked up to the screen and provided feedback on the child’s individual performance. This research did not record scores of the children participating on the “active” pads. The scope of the research included analyzing heart rate levels and physical activity, not how well the children scored in completing the dance moves determined by the Wii™ *Dance Dance Revolution* video game. Variability and reliability of tracking scores was low as well. Throughout the four-day duration that the children wore the accelerometer, a child’s physical activity level rather than the score of the actual video game were analyzed.

Calculations and Statistics

The primary aim of the study was to determine if a before-school program decreased total daily sedentary time of children, and increased moderate to vigorous physical activity levels. An independent t-test Satterthwaite analysis with unequal variance and alpha level of .05, was used to analyze total daily and only morning activity (7:15 a.m.- 8:15 a.m.) of physical activity time versus total daily and only morning (7:15 a.m.- 8:15 a.m.) of no morning physical activity.

The *Statistical Analysis System*® (SAS® version 9.1, Cary, N. C.) was used for completion of the remainder of the statistics of the current investigation. A one-way

ANOVA and Duncan Post Hoc with an alpha level of 0.05 with repeated measures were used to analyze and provide statistical summary information on the dependent variables of moderate to vigorous physical activity and sedentary levels for total daily amounts and only morning activity (7:15 a.m.- 8:15 a.m.) segments.

A one-way ANOVA and Duncan Post Hoc with an alpha level of 0.05 with repeated measures were used to analyze and provide statistical summary information on the dependent variables of moderate to vigorous physical activity and sedentary levels for total daily amounts and moderate to vigorous physical activity and sedentary levels for only during the morning activity timeframe (7:15 a.m.- 8:15 a.m.).

A one-way ANOVA and Duncan Post Hoc with an alpha level of 0.05 with repeated measures were also used to analyze and provide statistical summary information on the dependent variables of resting heart rate, activity heart rate, *FITNESSGRAM*[®] PACER lap count and PACER heart rate of the participants. A one-way ANOVA and Duncan Post Hoc with an alpha level of 0.05 with repeated measures were completed to determine total daily and only morning activity (7:15 a.m.- 8:15 a.m.) levels comparing independent variables: interactive video games *Wii*[™] *Dance Dance Revolution*, *Just Dance*, a running/walking program, and no physical activity.

Chapter Four

RESULTS

Introduction

The primary purpose for conducting this quantitative investigation was to determine if the use of a physically active video game in a before-school physical activity program could decrease the amount of total daily sedentary time in children. Accelerometer data were collected during four consecutive days from each child who participated in the study. Multiple analyses of variance (ANOVA) were computed to evaluate the effects of the various morning activities that included interactive Wii™ video games *Dance Dance Revolution* and *Just Dance*, a running/walking activity, and no morning physical activity. When a significant omnibus ANOVA result was obtained, the Duncan post-hoc analysis was used to examine pairwise mean differences when more than two means were being compared. Means and standard deviations were calculated for all demographic and physical/sedentary activity information. The level of significance chosen for all statistical analyses was .05.

Demographics

Two hundred seventy-four K-5th grade students from one elementary school participated in the cross-sectional study. Of the 274 children enrolled, 232 had functional accelerometer data equaling an 84.67% participation rate. The number of children with valid data for the study was less than 100% because of incomplete data from some participants. Also, low battery life in some accelerometers precluded

obtaining physical activity time.

Table 4.1 shows the continuous and categorical variables in children ages 6-12 years at one public elementary school who participated in a before-school physical activity program. The number (N) of participants engaged in the activities is listed in the table. The descriptive information for each child included age (yrs), height (cm), mass (kg), and calculated body mass index ($\text{kg}\cdot\text{m}^{-2}$), as well as attendance rate.

Table 4.1 Descriptive information for Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA) Participants

Table 4.1	Total	DDR	JD	Rng/Wlkg	NOPA
N	232	46	53	88	45
Females	118	26	27	41	24
Males	114	20	26	47	21
Age (yrs)	8.1±1.7	8.3±1.7	8.1±1.9	7.9±1.7	8.1±1.3
Mass (kg)	71.6±22.9	71.6±23.7	74.6±26.9	70.2±21.7	71±19.6
Height (cm)	52.9±4.5	53.1±4.9	53.1±5.01	52.6±4.3	52.97±4.1
BMI ($\text{kg}\cdot\text{m}^{-2}$)	17.6±3.2	17.4±3.1	18.0±3.4	17.5±3.3	17.46±2.8
Attendance Rate	75.2±6.6	81.8±5	75.5±10.9	68.6±11.7	

Data are means ± standard deviation

BMI=Body Mass Index

N= number of participants

Results from the descriptive data assessed throughout the morning physical activity period indicated the mean age for the children who participated was 8.1 years, weight was 71.6 kg, and height was 52.9 cm. The mean BMI $\text{kg}\cdot\text{m}^{-2}$ of program participants was $17.6 \text{ kg}\cdot\text{m}^{-2}$. Therefore, according to the BMI graph (Appendix C), the average child in the program was categorized as being borderline healthy to overweight according to CDC norms (CDC, 2010).

Mean Difference in Total Daily Moderate to Vigorous Physical Activity and Total Daily Sedentary Time from Three Physical Morning Activities to No Morning Activity

Data were combined for all three of the active Morning Physical Activities that included Wii™ *Just Dance* (JD), Wii™ *Dance Dance Revolution* (DDR), and the run/walk club. Using these combined data, comparisons of Total Daily Moderate to Vigorous Physical Activity (PA) and Total Daily Sedentary (SED) time for children who participated in all three of the Morning Physical Activities versus participants (N) who completed No Morning Activity were calculated to determine if a before-school program made a significant difference in the amount of the child's day spent in Moderate to Vigorous Physical Activity or Sedentary activity.

Information can be found in Table 4.2.

Table 4.2: Total Daily Moderate to Vigorous Physical Activity (PA) and Total Daily Sedentary Time (SED) during all Morning Activities Combined versus No Morning Activity Participants

	Morning Activity	No Morning Activity	t-statistic	P-value
N	225	49		
PA (min)	106.0±45.1	95.8±35.6	1.71	p= .09
SED (min)	1104±207	1094.3±83.2	0.58	p= .56

Data are means ± standard deviation

N= number of participants

PA= Daily Moderate to Vigorous Physical Activity time

SED= Daily Sedentary Activity time

An independent t-test was used to determine if the difference between the means of the Morning Activity Group (M=106 min.) versus the No Morning Activity Group (M= 95.8 min.) for Daily Moderate to Vigorous Physical Activity

was significant. No significant difference was found. Likewise, an independent t-test was used to determine if the difference between the means of the Morning Activity Group (M=1,104.8 min.) and the No Morning Activity Group (M=1094.3 min.) for Total Daily Sedentary Time was significant. Again, no significant difference was detected between these two means.

Mean Difference in Total Daily Sedentary Time Between All Activities

The results of a one-way ANOVA to determine the effects of the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA) on Total Daily Sedentary activity (SED) time appear in Table 4.3.

Table 4.3 ANOVA Summary Table: Mean Difference in Total Daily Sedentary Activity (SED) Scores

Source	SS	df	MS	F	Prob.
Between	494,535.81	3	164,845.27	4.68*	0.0033
Within Error	9,510,218.80	270	35,223.03		
Total	10,004,754.61	273			

*p ≤.05

The statistical analysis from the Total Daily Sedentary (SED) activity summary ANOVA provides evidence that there were significant differences between means of Total Daily Sedentary time of children who completed a before-school program activity. The Duncan's Multiple Range Test was used to determine if any of the pairwise mean differences for the physical activities offered were significant for Total Daily Sedentary Time.

The mean differences for Total Daily Sedentary Time (SED) and the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity can be found in Table 4.4

Table 4.4 Duncan's Multiple Range Test for Total Daily Sedentary Time (SED)

Group	Mean±Std (min)	DDR (min)	NO PA (min)	Rng (min)	JD (min)
Dance Dance Revolution (DDR)	1,169.4±335.5	-	75*	89*	107*
No Physical Activity (No PA)	1,094.32±83.2		-	32	14
Running/Walking (Rng)	1,080.07±68.4			-	18
Just Dance (JD)	1,062.87±73.3				-

*($p \leq .05$)

Significant differences were found between the mean of the interactive game Wii™ *Dance Dance Revolution* Group (M=1,169) and means of the interactive video game Wii™ *Just Dance* Group (M=1,062), the Running/Walking Group (M=1080), and No Morning Physical Activity Group (M=1,094) for Total Daily Sedentary time (SED).

Mean Difference in Total Daily Moderate to Vigorous Physical Activity Between All Activities

The results of a one-way ANOVA to determine the effects of the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA) on Total Daily Moderate to Vigorous Physical Activity (PA) time appear in Table 4.5.

Table 4.5 ANOVA Summary: Dependent Variable: Mean Difference between Total Daily Moderate to Vigorous Physical Activity (PA) scores

Source of Variance	SS	df	MS	F	Prob.
Between	5,975.42	3	8,658.57	4.73*	0.0031
Within Error	494,174.55	270	1,830.31		
Total	520,149.83	273			

* $p \leq .05$

The statistical analysis from the Total Daily Moderate to Vigorous Physical Activity (PA) summary ANOVA provided evidence that there were significant mean differences in Total Daily Moderate to Vigorous Physical Activity time for the children who participated. The Duncan's Multiple Range Test was used to determine if any of the pairwise mean differences for the physical activities offered were significant for Total Daily Moderate to Vigorous Physical Activity Time.

The mean differences for Total Daily Moderate to Vigorous Physical Activity (PA) and morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity can be found in Table 4.6.

Table 4.6 ANOVA Summary Table: Effects of Exercise on Total Daily Moderate to Vigorous Physical Activity (PA)

Group	Mean±Std (min)	JD (min)	Rng (min)	No PA (min)	DDR (min)
Just Dance (JD)	118.9±43.8	-	13.8	23.1*	24.4*
Running/Walking (Rng)	105.1±39.4		-	9.3	10.6
No Physical Activity (No PA)	95.8±35.6			-	1.3
Dance Dance Revolution (DDR)	94.5±48.9				-

*($p \leq .05$)

Significant mean differences were found between the interactive game Wii™ *Just Dance* Group (M=95.8) and the interactive video game Wii™ *Dance Dance Revolution* Group (M=94.5) and the No Morning Physical Activity Group (M=95.8). No other significant pairwise mean differences were found.

Analysis of Moderate to Vigorous Physical Activity and Sedentary Levels During the Before-School Activity Time Only (7:15 a.m. - 8:15 a.m.)

An independent t-test was used to determine if the mean difference between Moderate to Vigorous Physical Activity (PA) and Sedentary (SED) time for children who participated in the Morning Physical Activities versus participants (N) who completed No Morning Activity was significant. Statistics were calculated to determine if a before-school program made a significant difference in the amount of time spent in Moderate to Vigorous physical activity or Sedentary levels of children during the 7:15 a.m. – 8:15 a.m. program hour. Statistical information can be found in Table 4.7.

Table 4.7 Moderate to Vigorous Physical Activity (PA) and Sedentary Time (SED) for Morning Activity Time for All Activities Combined

	Morning Activity	No Morning Activity	t-statistic	P-Value
N	272	66		
PA (min)	10.7±8.5	5.2±3.7	8.07*	≤.0001
SED (min)	30.9±11.9	40.0±10.5	-6.15*	≤.0001

Data are means ± standard deviation

*($p \leq .05$)

N= number of participants

PA= Daily Moderate to Vigorous Physical Activity time

SED= Daily Sedentary Activity time

The independent t-test revealed a significant difference between the mean of the Morning Activity Group (M=10.7 min.) versus the mean of the No Morning Activity Group (M=5.2 min.) for Moderate to Vigorous Physical Activity completed only during the before-school activity time. Likewise, an independent t-test revealed

a significant difference between the means of the Morning Activity Group (M=30.9 min.) and the No Morning Activity Group (M= 40 min.) completed only during the before-school activity time.

Mean Difference in Sedentary Time Between All Activities

The results of a one-way ANOVA to determine the effects of the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA) on Sedentary (SED) time appear in Table 4.8.

Table 4.8 ANOVA summary: Dependent Variable: Mean Difference in Morning Sedentary Activity Time Only (SED)

Source of Variance	SS	df	MS	F	Prob.
Between	4,705.05	3	1,568.35	11.52*	<.0001
Within Error	45,487.23	334	136.19		
Total	50,192.28	337			

*p ≤.05

The ANOVA provided evidence that there was a significant difference among the Morning Sedentary mean times of children. The Duncan's Multiple Range Test was used to determine if any of the pairwise mean differences for the physical activities offered were significant for Total Daily Sedentary Time.

The difference between means for Sedentary Time (SED) and morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA) was calculated using the Duncan's Multiple Range Test. Results appear in Table 4.9.

Table 4.9 Duncan's Multiple Range Test for Sedentary Time (SED)

Group	Mean±Std (min)	No PA (min)	JD (min)	DDR (min)	Rng (min)
No Physical Activity (No PA)	40.0±10.5	-	8.3*	8.6*	10.8*
Just Dance (JD)	31.7±10.2		-	21.5	31.7
Dance Dance Revolution (DDR)	31.4±13.0			-	2.2
Running/Walking (Rng)	29.2±12.4				-

Data are means ± standard deviation

*($p \leq .05$)

Significant differences were found between the mean of the No Physical Activity Group (M=40.0) and the mean of the interactive game Wii™ *Dance Dance Revolution* Group (M=31.4), the Wii™ *Just Dance* Group (M=31.7), and the Running/Walking Group (M= 29.2). No other significant pairwise mean differences were found.

Mean Difference in Moderate to Vigorous Physical Activity Time Between All Activities

A one-way ANOVA was executed to determine if any mean Sedentary (SED) time differences were found for the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA). See Table 4.10.

Table 4.10 ANOVA Summary: Dependent Variable: Moderate to Vigorous Physical Activity (PA)

Morning Activity	SS	df	MS	F	Prob.
Between	2,291.55	3	763.85	12.88*	<.0001
Within Error	19,813.97	334	59.32		
Total	22,104.52	337			

* $p \leq .05$

The ANOVA provided evidence that there were significant differences among the Sedentary Activity mean times of children involved in Morning Moderate to Vigorous Physical Activity. The Duncan's Multiple Range Test was used to determine if any of the pairwise differences for the groups involved for Total Daily Sedentary Time were significant.

The difference between means for Moderate to Vigorous Physical Activity Time (PA) and the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity were calculated using the Duncan's Multiple Range Test. Results appear in Table 4.11.

Table 4.11 Duncan's Multiple Range Test for Morning Activity Time Only for Moderate to Vigorous Physical Activity Time (PA)

Group	Mean±Std (min)	Rng (min)	JD (min)	DDR (min)	No PA (min)
Running/Walking (Rng)	12.7±11.4	-	3.1*	3.4*	7.5*
Just Dance (JD)	9.6±6.5		-	0.3	4.4*
Dance Dance Revolution (DDR)	9.3±4.6			-	4.1*
No Physical Activity (No PA)	5.2±3.7				-

Data are means ± standard deviation

N=number of participants

*($p \leq .05$)

Significant differences were found between the mean of the Running/Walking Activity Group (M=12.7) the mean of the Interactive Video Game Wii™ *Dance Dance Revolution* Group (M=9.3), the Wii™ *Just Dance* Group (M=9.6), and the No Morning Physical Activity Group (M=5.2) for Moderate to Vigorous Physical Activity completed only during the before-school timeframe. A significant difference between the mean of the No Morning Physical Activity Group (M=5.2) and means of the interactive video game Wii™ *Dance Dance Revolution*

Group (M=9.3), and Wii™ *Just Dance* Group (M=9.6) were also found. No other significant pairwise mean differences were found.

Mean Difference of Activity Heart Rate (Activity HR) for All Morning Activity

Participants

The results of a one-way ANOVA to determine the effects of the morning activities on the Activity Heart Rate (Activity HR) appear in Table 4.12. The No Physical Activity (NoPA) group was not included in this analysis due to the children being inactive and not involved in any organized morning physical activity program where heart rate data would be determined.

Table 4. 12 ANOVA Summary: Dependent Variable: Mean Difference for Activity Heart Rate (Activity HR) of Before-School Program Participants.

Activity Heart Rate (bpm)	SS	df	MS	F	Prob
Between	85,655.61	2	42,827.81	70.91*	<.001
Within Error	64,624.94	107	603.97		
Total	150,280.55	109			
*p≤.05					

The ANOVA revealed a significant difference among the Activity Heart Rate means for Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), and Running/walking (Rng/Wlkg) participants who completed the morning physical activity program.

The difference between means for Activity Heart Rate (Activity HR) and morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), and Running/Walking (Rng/Wlkg) were calculated using the Duncan's Multiple Range Test. Results appear in Table 4.13.

Table 4.13 Duncan's Multiple Range Test for Activity Heart Rate (Activity HR) and All Morning Activities

Group	Mean±Stdv (bpm)	Rng (bpm)	DDR (bpm)	JD (bpm)
Running/Walking (Rng)	175.0±25.92	-	50.85*	57.66*
Dance Dance Revolution (DDR)	124.1±24.27		-	6.81
Just Dance (JD)	117.3±25.06			-

Data are means ± standard deviation

N=number of participants

*($p \leq .05$)

Significant mean differences were found between the Running/Walking Activity Group (M=175) and both the interactive game Wii™ *Dance Dance Revolution* Group (M=124), and the Wii™ *Just Dance* Group (M=117.3). No other significant pairwise mean differences were found.

Mean Difference Between Activity Heart Rate (Activity HR) and Gender

An independent t-test was used to determine the mean difference between Activity Heart Rate (Activity HR) and Gender (F/M) for children who participated in the Morning Physical Activities. Statistics were calculated to determine if Gender significantly affected the average Activity Heart Rate (Activity HR). The No Physical Activity (NOPA) group was not included in this analysis due to the children being inactive and not involved in any organized morning physical activity program where heart rate data would be obtained. Statistical information can be found in Table 4.14.

Table 4.14 Gender and Activity Heart Rate (Activity HR) for Morning Activities

Table 4.14	Male	Female	t-statistic	P-Value
N	51	58		
Activity Heart Rate (bpm)	154.81±35.5	150.50±40.31	-.194	.056

Data are means ± standard deviation

*($p \leq .05$)

N= number of participants

A two-tailed independent t-test was used to determine the difference between Gender and mean Activity Heart Rate (AHR) for the Morning Activity Groups. No significant difference was determined between Activity Heart Rates for Females (M=154.81) and Males (M=150.5).

Mean Difference of Resting Heart Rate (RHR) for All Morning Activity Participants

The results of a one-way ANOVA to determine the effects of the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA) on Resting Heart Rate (RHR) appear in Table 4.17.

Table 4.17 ANOVA Summary: Resting Heart Rate (RHR) of Before-School Program Participants.

Resting Heart Rate	SS	df	MS	F	Prob
Between	193.20	3	64.40	0.251	0.860
Error within	29,466.77	115	256.23		
Total	29,659.97	118			
*p≤.05					

No significant difference was found among the Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/walking (Rng/Wlkg) and No Physical Activity (NOPA) group means.

Mean Difference in FITNESSGRAM® PACER Lap count for All Morning Activity

Participants

Because the mean age of participants was only 8.1 years, data could not be analyzed to determine cardiovascular fitness levels using the *FITNESSGRAM*® PACER standards because that test does not currently have a lap count standard for reaching the healthy fitness zone™ (Appendix J) until the child is 10 years of age. Even though *FITNESSGRAM*® PACER standards could not be used to analyze the data, *FITNESSGRAM*® PACER lap scores were calculated.

The results of a one-way ANOVA was executed to determine the effect of the *FITNESSGRAM*® PACER lap count for the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA). See Table 4.18 for results.

Table 4.18 ANOVA Summary: Dependent Variable: *FITNESSGRAM*® PACER Laps for Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/walking (Rng/Wlkg) and No Physical Activity (NOPA) Participants

PACER	SS	df	MS	F	Prob
Between	772.88	3	257.63	0.52	0.671
Error within	58,778.99	118	498.13		
Total	59,551.88	121			
*p≤.05					

No significant difference was found among the Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg) and No Physical Activity (NOPA) group means.

Mean Difference in FITNESSGRAM® PACER Heart Rate for All Morning Activity

Participants

The effects of the morning activities of Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA) on FITNESSGRAM® PACER Heart Rate (PCRHR) were analyzed with a one-way ANOVA. Results appear in Table 4.19.

Table 4.19 ANOVA Summary: Dependent Variable: FITNESSGRAM® PACER Laps for Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/walking (Rng/Wlkg) and No Physical Activity (NOPA) Participants

FITNESSGRAM® PACER Heart Rate	SS	df	MS	F	Prob
Between	9,266.24	3	3088.747	4.52*	0.005
Error within	83,401.47	122	683.619		
Total	92,667.71	125			
*p≤.05					

A significant mean difference was found among the Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), Running/walking (Rng/Wlkg) and No Physical Activity (NOPA) group means for FITNESSGRAM® PACER Laps.

The difference between means for *FITNESSGRAM*[®] PACER Heart Rate (PCHR) and morning activities of Wii[™] *Dance Dance Revolution* (DDR), Wii[™] *Just Dance* (JD), Running/Walking (Rng/Wlkg), and No Physical Activity (NOPA) were calculated using the Duncan's Multiple Range Test. Results can be found in Table 4.20.

Table 4.20 Duncan's Multiple Range Test for *FITNESSGRAM*[®] PACER Heart Rate and Before-School Program Participants.

Group	Mean (min)	NoPA (min)	Rng (min)	JD (min)	DDR (min)
No Physical Activity (No PA)	180.27±17.6 3	-	.91	15.88*	20.4*
Running/Walking (Rng)	179.36±21.5 3		-	14.97*	19.49 *
Just Dance (JD)	164.39±35.3 5			-	4.52
Dance Dance Revolution (DDR)	159.87±30.5 8				-

Data are means ± standard deviation

N=number of participants

*($p \leq .05$)

Significant mean differences were found between the No Physical Activity Group (M=180.27) and the interactive video games Wii[™] *Dance Dance Revolution* Group (M=159) and Wii[™] *Just Dance* Group (M=164). A significant mean difference was found between the Running/Walking Activity Group (M=179) and the interactive video games Wii[™] *Dance Dance Revolution* Group (M=159) and the Wii[™] *Just Dance* Group (M=164). No other significant pairwise mean differences were found.

Chapter Five

DISCUSSION

Purposes of the Study

The primary purpose for conducting this quantitative investigation was to determine if the use of a physically active video game in a before-school physical activity program could increase the total amount of daily moderate to vigorous physical activity and decrease the amount of total daily sedentary time in children. Findings from the investigation indicated there were no significant differences in total daily sedentary time or total amount of moderate to vigorous physical activity time among children when a before-school physical activity program was implemented. Results can be found in Table 4.2.

The secondary aim was to compare physically active video games including Nintendo Wii™ *Just Dance* and Wii™ *Dance Dance Revolution*, a running/walking activity, and no activity to determine which, if any, of the activities had a greater effect on decreasing total daily sedentary time, and increasing total daily moderate to vigorous physical activity time of children. When comparing the before-school physical activities, findings from the current investigation indicated that there were significant differences in the total daily sedentary and total daily moderate to vigorous physical activity time between the morning activity programs offered. Results can be found in tables 4.2-4.6.

The final purpose was to evaluate the average physical activity heart rate of the children participating in the before-school physical activity program and determine if any significant difference was evident between the activities of Wii™

Dance Dance Revolution, Wii™ *Just Dance*, or a running/walking activity. A significant difference was found (See table 4.12 and 4.13). The investigator also evaluated the mean activity heart rate levels of each activity which included Wii™ *Dance Dance Revolution*, Wii™ *Just Dance*, and a running/walking activity to determine if the activity increased the child's heart rate level up to the CDC standard for moderate to vigorous physical activity. All three morning activities met the CDC moderate to vigorous physical activity standard.

Further statistical analysis was completed after the current investigation provided evidence of no significance differences for total daily sedentary or total daily moderate to vigorous physical activity levels of children when comparing the difference between incorporating any of the before-school activities and no morning physical activity offered. Instead of analyzing daily totals, the additional statistical analysis compared the sedentary and moderate to vigorous physical activity level of each activity offered during only the before-school program session time that was from 7:15 a.m. to 8:15 a.m. This additional investigation data indicated that there were significant differences in both sedentary and moderate to vigorous physical activity levels of children when before-school program session times were assessed alone. Results can be found in Table 4.7-4.11.

Statistical Overview for Total Daily Participant Levels and Impact on Schools

Research pertaining to after-school physical activity programs has been previously discussed as an effective way to decrease total daily sedentary time and body mass, while at the same time improving fitness levels of children (Pate et al., 2006). Children and educators alike have a high interest level in technology media.

The researcher predicted that, by integrating a morning physical activity program along with a technology media component in a school-based program setting, children could improve physical activity levels using an area of interest, in this case technology. However, the current investigation data found there was no significant difference in total daily sedentary levels or total daily moderate to vigorous physical activity time when children played the interactive games *Wii™ Dance Dance Revolution*, *Wii™ Just Dance* or participated in a running/walking activity in a before-school program compared to no morning physical activity offered. These findings mean that although the child participated in a before-school program, the amount of total daily minutes spent in moderate to vigorous or sedentary time did not change.

Although the before-school physical activities did not significantly decrease overall total daily sedentary time of children, when the total daily moderate to vigorous physical activity levels of children were compared between *Wii™ Dance Dance Revolution*, *Wii™ Just Dance*, a running/walking activity, and no morning physical activity, the interactive video game participants who completed *Wii™ Just Dance* significantly increased the total daily amount of moderate to vigorous physical activity levels. This result is congruent with research that interactive video games are useful tools in achieving some increased physical activity levels among children (Andrews, 2007; Höysniemi, 2004; Lanningham-Foster et al., 2006). In contrast, when analyzing the morning timeframe segment only, children who played *Wii™ Dance Dance Revolution* in the mornings significantly increased the amount

of total daily sedentary time when comparing children who played Wii™ *Just Dance*, a running/walking activity, or completed no morning physical activity.

To date, there are no specific research studies conducted on before-school physical activity programs. Therefore, the researcher compared an after-school program study by Dale, Corbin, & Dale (2000). The Dale et. al. study was similarly conducted to the current investigation. The findings from the after-school research study indicated children do not compensate for a sedentary school day by increasing their levels of physical activity after school. The Dale et. al study results are in alignment with the outcomes in the current study and support the conclusion that programs offered before or after-school do not provide the means on their own to improve overall total daily physical activity levels of children.

Because there were no significant changes in total daily sedentary time of children when a before-school physical activity program was solely implemented, schools will need to find alternative activities to incorporate along with a before-school program to meet the NASPE daily recommended physical activity levels of 60 minutes or more of moderate to vigorous physical activity for elementary age children (Department of Health and Human Services, Washington D.C., 2000; National Association of Sport and Physical Education, 2008; National Association of Sport and Physical Education, 2010).

Statistical Overview for Participant Activity and Sedentary Levels for the Before-School Session Time Alone (7:15 a.m. – 8:15 a.m.) and Impact on Schools

The extended current investigation data indicated that a before-school physical activity program did in fact have a significant difference when compared to no before-school physical activity when looking at only the before-school time frame (See Table 4.7). The sedentary and moderate to vigorous physical activity results provided evidence of having a significant difference for the before-school activity time as well (See Table 4.8-4.11). When the morning activities were compared alone, and only during the before-school session time frame, the running/walking activity had a significant difference in the amount of moderate to vigorous physical activity time for children (See Table 4.10 and 4.11). The running/walking activity provided 12.7 minutes within the moderate to vigorous physical activity levels that showed children increased their activity levels during the before-school activity time.

Analysis of the children's moderate to vigorous physical activity levels when participating in the Wii™ *Dance Dance Revolution* or *Just Dance* provided evidence that the interactive video game play was significantly different, during the before-school session time frame only, from children who participated in the running/walking activity and no morning physical activity (See Table 4.10-4.11). However there were no significant differences between moderate to vigorous physical activity levels of children between each of the video games themselves. Wii™ *Just Dance* provided 9.6 minutes of moderate to vigorous physical activity and Wii™ *Dance Dance Revolution* provided 9.3 minutes of physical activity per the

before-school session time frame only, showing only a small difference in moderate to vigorous physical activity time between the two interactive video games.

No Physical Activity

Data showed that participants with no physical activity before-school had no significant difference compared to total daily sedentary and totally daily physical activity levels (See Table 4.2). However, there was a significant difference in the amount of moderate to vigorous activity levels between all other morning activities compared to the no physical activity group (See Table 4.10 and 4.11). Along with the above two findings, children who completed no before-school physical activity averaged only 5.2 minutes of moderate to vigorous physical activity per day compared to the significantly higher activity minutes of the video games and running/walking activity which were 9.3- 9.6 and 12.7 minutes.

Conclusions derived from analyzing the no physical activity group provide evidence that the before-school physical activity program alone does not influence total daily sedentary or moderate to vigorous physical activity levels. However, the before- school program, when evaluated only during the morning timeframe, produced results that indicate higher levels of moderate to vigorous physical activity time compared to no activity in the morning.

Physical Education and Before- School Physical Activity Participants

Physical Education classes are offered at participating school on Wednesdays and Thursdays of each week, and every other Friday. Kindergarten classes are

involved in physical education class for twenty minutes. First and second grade students are in physical education class for 25 minutes and third through fifth grade students have thirty minutes of Physical Education. The amount of time the children spent in physical education class could have impacted the statistical data found for the amount of total daily moderate to vigorous and total daily sedentary time children involved in the current investigation completed. A California study found that the amount of actual moderate to vigorous physical activity time within thirty-minute physical education classes equaled only four minutes (CLA, 2007). Another study found children accrued 4.8 very active and 11.9 moderate physical activity minutes per thirty-three minute physical education class (Nader, 2003). Depending on the duration and engagement level of the child within Physical Education class the amount of sedentary and moderate to vigorous activity time may have impacted results found from the accelerometer data for the current investigation.

The type of activities, difficulty level, and location of the activity the child completed in Physical Education class while wearing the accelerometer may have been influential factors to the results found in the current investigation. The type of physical activity may have influenced the child's level of sedentary and moderate to vigorous activity levels due to enjoyment of the game and types of movements incorporated into the activity. Research has shown that children participate for increased lengths of time and intensity in tasks and activities the child describe as enjoyable, and the child's acuity of their fitness and skill knowledge positively correlates with the child's decision to be physically active (Biddle & Armstrong,

1992; Ennis, 2010; Stuntz & Weiss, 2010; Dishman, Motl, Sallis et al., 2005; Dishman, Motl, Saunders et al., 2005).

Location of activities, indoor or outdoor, is a factor to consider based on research evidence showing that children with larger outdoor play space are more active than when the child has a limited indoor play area. (Louie & Chan, 2003). The reason the location is significant is because the gym is not large, which decreases movement space availability. Physical Education class and physical activity time were not analyzed for the current investigation but could be influential factors which should be analyzed in future research.

Conclusions and Comparison of Total Daily Sedentary and Total Daily Moderate to Vigorous Physical Activity During Only the Before-School Physical Activity from 7:15 a.m. to 8:15 a.m.

Although the number of moderate to vigorous physical activity minutes are higher than the no physical activity morning group, the number of moderate to vigorous physical activity minutes are still low in comparison to the total amount of moderate to vigorous physical activity levels recommended by the NASPE of 60 minutes per day (Centers for Disease Control and Prevention, 2010). Children who participated within the current investigation for a thirty-minute before-school physical activity program obtained 9.3 to 12.7 minutes of moderate to vigorous physical activity. The amount of time is less than the recommended moderate to vigorous physical activity time per day but is more than four minutes of moderate to vigorous physical activity found in thirty minute physical education classes by a

California study (Centers for Disease Control and Prevention, 2010; CLA, 2007).

Thus, children who participated in the before-school physical activity program accumulated more moderate to vigorous physical activity time than in the child's normal physical education class. This is a crucial finding to support the rationale of why a before-school program should be integrated into the school day to help meet the NASPE level of 60 minutes of moderate to vigorous physical activity time.

The statistical information from the current investigation indicated that the before-school physical activity program had a significant difference in decreasing sedentary time of children during the 7:15 a.m. – 8:15 a.m. timeframe. These findings can be compared with research from another after-school program study that determined after-school programs, in this study before-school programs, can enhance physical activity levels and other health-related aspects for all children (Beets, Beighle, Erwin, & Huberty, 2009; Dzewaltowski et al., 2010).

The morning physical activity sessions children decreased their sedentary levels. Throughout the remainder of the day, however, the children engaged in fewer minutes in the range of moderate to vigorous physical activity time which resulted in no significant differences in the overall levels of total daily sedentary time. These findings are congruent with results from a study conducted with third and fourth grade students in which they wore an accelerometer for four days. The researcher concluded that children did not compensate for a sedentary school day by increasing their levels of physical activity after-school (Dale, Corbin, & Dale, 2000). Potential factors that may have produced these outcomes in the before-school program are discussed in the following section.

Possible Factors Influencing Results of the Individual Program Activities

Running/Walking Activity

During the running/walking before-school physical activity such factors as the level of difficulty of the activity, age, gender, weather, and the running/walking course used may have been influential in the results of finding no significant difference in total daily sedentary time. These factors may also have resulted in a significant difference in total daily sedentary time compared to all other before-school physical activities offered and having the highest number of moderate to vigorous physical activity minutes during the before-school time frame. The running/walking activity provided a physical activity option that the children already knew how to perform. Thus, there was nothing new to learn like some children may have had to do with the interactive games the Wii™ *Just Dance* or Wii™ *Dance Dance Revolution*. According to the child questionnaires completed in the Spring, prior to the current investigation, 28% of children had played Wii™ *Just Dance*, and 47% had previously played Wii™ *Dance Dance Revolution* compared to 100% who had run/walked prior to the study. The children could also complete the running/walking course at the child's own pace which provided the children the opportunity to work at the level they selected or were able to handle instead of at the difficulty level and pace set by the interactive video games.

Furthermore, the researcher observed that gender could have influenced total daily sedentary time and the before-school physical activity timeframe only. The males within the study, compared to the female participants, were more aggressive in

attaining a jogging pace. These findings concur with a previous study, which indicated boys produce higher levels of moderate to vigorous levels of physical activity than females (Patnode, et al., 2010). The female participants seemed to be more interested in socializing with their friends rather than the activity itself, which is similar to Kahn et al. findings in 2008 (psycho-social aspects influenced gender physical activity levels). Females would sustain a pace in which all within the child's friendship bases could sustain or females would wait for their friends to catch up with them while on the running/walking course as opposed to individually working toward their best effort as the male participants did.

Finally, the running/walking course itself may have adversely affected the results. While the course was safe and children were able to use sidewalks the entire route, there were parts of the route that were on an incline and parts of the route that were on a decline. The researcher observed that the children had a higher likelihood of running/jogging down the incline and flat portion of the course but lessened their energy exertion when on the incline portion. If the study were done again, perhaps an entirely flat route would be a factor to consider implementing, or varying courses depending on fitness scores found through the *FITNESSGRAM*[®] PACER test.

WiiTM Dance Dance Revolution and WiiTM Just Dance

Factors impacting results found for *WiiTM Dance Dance Revolution* and *WiiTM Just Dance* when comparing total daily amount of sedentary time could have stemmed from the group setting in which the games were played. Groups of 40 to 50 children were playing the same game simultaneously. Therefore, having such a

large group made it challenging to set a difficulty level at which both games could be played in order to accommodate the large age range of participants which varied from 6 to 11 years old.

Another factor may have stemmed from the initial randomization of groups for the Wii™ *Dance Dance Revolution* and Wii™ *Just Dance* that may have had a skewed number of participants with initial high or low physical activity levels because of the order in which the computer randomized the children. The number of children with initial higher levels of total daily sedentary time could have resulted in the significant differences in total daily sedentary and moderate to vigorous physical activity for each game.

The child's initial comfort level in playing the games and ability to complete the Wii™ *Dance Dance Revolution* and the Wii™ *Just Dance* patterns could have also influenced activity intensities and subsequent results. The difficulty level and competence of completing Wii™ *Dance Dance Revolution* are crucial factors in achieving improvement in physical activity elements in children according to research by Höysniemi, 2004 and Lanningham-Foster et al., 2006.

Finally, the child's interest level and enjoyment when playing the interactive video game may have influenced activity time and intensity levels (Dishman, Motl, Sallis et al., 2005; Dishman, Motl, Saunders et al., 2005). Children with low interest and little enjoyment in the video games may have exerted less overall energy resulting in little to no decrease in total daily sedentary time.

When the before-school physical activities were compared during the morning time frame only (7:15 a.m. - 8:15 a.m.), the Wii™ *Dance Dance Revolution*

and Wii™ *Just Dance* analysis provided evidence that the interactive video games were significantly different than the running/walking activity and no morning physical activity, but were found to have no significant difference between each other. These findings show that the type of interactive video game is not influential, but that incorporating technology does impact the child's level of activity. The current investigation findings may have been negatively impacted by the low interest level in technology media of a child, which according to prior research influences activity time and intensity levels when playing interactive video games. (Dishman, Motl, Sallis et al., 2005; Dishman, Motl, Saunders et al., 2005). Children with low interest when playing the interactive video games may have exerted less overall energy resulting in little to no decrease in sedentary time, causing lower moderate to vigorous activity levels than the running/walking activity (12.7 minutes of MVPA compared to 9.6 minutes of MVPA for Wii™ *Just Dance* and 9.3 minutes of MVPA for Wii™ *Dance Dance Revolution*).

When playing the video games, children had to wait to play on the pads with the Wii™ *Dance Dance Revolution* and wait to hold the remote for Wii™ *Just Dance*. This could account for the twenty minutes of the interactive video game participation time that was categorized as sedentary. In addition, only four players at a time could be on the feedback mats for Wii™ *Dance Dance Revolution*. This may have resulted in lack of concentration and lower physical activity movement levels of the children who were not on the dance pads. The same issue was found with Wii™ *Just Dance* because only one controller could be used by a child at a time. However, in Wii™ *Just Dance*, all the children could follow the screen with the

exact moves in which the child with the controller was to imitate, as opposed to Wii™ *Dance Dance Revolution* where children not on the mat really could not participate from the sidelines.

Although specific gender differences were not reviewed from accelerometer data within the current study, an additional factor impacting results of daily physical activity levels could have stemmed from the type of music used when playing the interactive video games Wii™ *Dance Dance Revolution* or Wii™ *Just Dance*. While some songs were playing during the interactive activity time, the researcher heard specific genders identify the song as the opposite gender type of song and then the child would only participate at very low physical activity levels or none at all. The researcher tried to select a majority of gender-neutral songs for the duration of the study to improve the level of physical activity, but identifying the songs as a specific gender were still sometimes developed by the children.

Participation and Attendance Rates

Although there were many variables that may have influenced physical activity levels, there were high participation rates for each before-school physical activity program offered throughout the entire study. The high percentage of attendance, equaling 75.2%, for all before-school activities in the investigation illustrated children participated in the morning program with no variance to the type of physical activity offered; Wii™ *Dance Dance Revolution*, Wii™ *Just Dance*, or running/waking activity.

Factors influencing attendance and participation may have also impacted results, which are similar to variables associated with physical activity levels observed by Kohn et al., 2008. For example, if the child was an early riser or enjoyed morning activities that child may have been more likely to regularly attend. Another factor to consider is whether the parent decided that the child would participate in the program for health reasons, or because the program was viewed as a before-school “day care” provider, but the child really was not interested in attending and participating. Such children may not have exerted as much effort in the program because they were being “forced” to be there. It is also possible that the parent may not have dropped the child off early enough to participate in the program for the accelerometer to count the physical activity time of the participant.

If the child was present for only socialization reasons verses wanting to improve their physical fitness level the results may also have been impacted. Research indicates that the skill knowledge for physical activities and perception of the child’s own ability to be physically active directly affects that child’s motivation level to participate in daily physical activity (Bell, 1997; Ennis, 2010; S. Biddle & Armstrong, 1992; Ennis, 2010; Stuntz & Weiss, 2010). Therefore, if a child perceived him or herself to have a strong physical activity level, then that child may have increased the physical activity level completed during the before-school activity and/or attended the before-school activity on a regular basis.

Although the reasons why a child attended were not addressed in this study, other studies suggest that children who are categorized as overweight felt a sense of belonging, improvement in their health and well-being, and had enhanced school

cohesiveness in a pleasant and non-competitive atmosphere thereby promoting lifelong participation in physical fitness activities (Centers for Disease Control and Prevention, 2010; Gutin, R., Ferguson, & Owens, 1999; Gutin, Y., Humphries, & Barbeau, 2005S. ; R. Daniels et al., 1999). On average, children participating in this study were evaluated as being in the borderline healthy to overweight category according to the CDC BMI (Appendix H) standards so those feeling might have applied here. Enhancing self-concept as a contributing factor relevant to a child's attendance was not directly analyzed within the current investigation. Further research into the relationship between the motivations for the reason in attending and the levels of daily sedentary time should be pursued.

Resting Heart Rate for All Study Participants

Resting heart rates were used as baseline data to determine if any significant differences existed among participants prior to beginning of the research study. There was no significant difference in resting heart rate levels taken before any of the children participated in the before-school physical activities offered; Wii™ *Dance Dance Revolution* (DDR), Wii™ *Just Dance* (JD), running/walking (Rng/Wlkg) and no physical activity (NOPA). Because the findings resulted in no significant differences in the resting heart rate of any participants, the researcher concluded that all children who participated in the study had similar initial heart rate levels and thus, comparable beginning levels of cardiovascular fitness prior to the start of the before-school physical activity program.

Activity Heart Rate and Differences between Gender in Mean Activity Heart Rate of Participants For Morning Activities Completed by Participants

The mean activity heart rate was crucial for the current investigation to determine which physical activity increased the child's heart rate the most and if the activity produced high enough heart rate levels to meet the CDC moderate to vigorous activity heart rate standards shown to help improve cardiovascular fitness of children (Appendix K). A significant difference in mean activity heart rate between the interactive video games, Wii™ *Dance Dance Revolution*, *Just Dance*, and the running/walking activity were evident. However, the running/walking activity participants (M=175) had a significantly higher mean than both Wii™ *Dance Dance Revolution* (M= 124.1) and *Just Dance* (M=117).

The differences between activity heart rate gender were analyzed to determine if gender was a factor that impacted activity heart rate. No significant differences were found between gender and activity heart rate, which corresponds with past studies that found no significant difference in maximal heart rates between genders (Gallahue & Ozmun, 2005; Astrand, 1952).

The activity heart rate can be used to monitor if a child can reach the moderate to vigorous activity level standard (Center for Disease Control and Prevention, 2010). Heart rate monitors along with accelerometers used in the before-school physical activity program provided two different methods to account for physical activity levels achieved by the children. Because of the limitations in the type of heart rate monitor worn, the length of time the child sustained the level of being in the moderate to vigorous heart rate category could not be tracked which was

why the accelerometer was worn. However, the average activity heart rate of the child in the before-school activities could provide immediate feedback results to determine if the child reached the moderate to vigorous physical activity level during the particular day the child had the activity heart rate checked during the before-school activity.

The average child within the current investigation was 8.1 years old. According to the CDC moderate to vigorous physical activity level standards found in Appendix K, a child 8 years old should obtain a heart rate between 106-180 bpm to be considered to have a heart working at the moderate to intense physical activity level. From the current investigation results, the average activity heart rate for the running/walking activity was 175 bpm, Wii™ *Dance Dance Revolution* was 124 bpm, and the Wii™ *Just Dance* was 117 bpm which all meet the CDC moderate to vigorous physical activity level standard. These findings are parallel with the accelerometer results that found that all before-school physical activities provided the children the opportunity to be physically active at a moderate to vigorous physical activity level.

Impact of Before-School Physical Activity Programs on FITNESSGRAM® PACER

The *FITNESSGRAM®* PACER and ending PACER heart rate are evaluating tools used to determine the level of exertion a child sustains while completing the *FITNESSGRAM®* PACER test. The PACER test shows the degree of effort and fitness level the child was able to deliver in comparison to the *FITNESSGRAM®* standards for ages 9 and up found in Appendix J, as well as CDC moderate to

vigorous target heart rate standards found in Appendix K (Center for Disease Control and Prevention, 2010).

The statistical findings of the research study indicated that implementing an interactive video game or running/walking before-school physical activity program will not significantly change *FITNESSGRAM*[®] PACER lap count scores. As previously stated, the average age of participants was 8.1 years so data was not analyzed using the *FITNESSGRAM*[®] PACER standards because the current *FITNESSGRAM*[®] PACER test does not have a lap count standard for reaching the healthy fitness zone[™] until the child is 9 years of age as shown in Appendix J (Human Kinetics, 2011). However, the *FITNESSGRAM*[®] PACER lap scores of each before-school physical activity that the child completed were calculated because of the positive correlation between the number of PACER laps completed and aerobic fitness levels, impact on school attendance, and academic performance (Cooper Institute, 2011, Morrow et. al, 2010; Wittberg et al., 2009, Welk, et al. 2011). According to the current investigation there was no significant difference in the number of *FITNESSGRAM*[®] PACER laps the children within the study completed when participating in a before-school physical activity program which indicates the children did not improve their cardiovascular fitness levels as a result of participating.

A significant difference was evident in the mean between the *FITNESSGRAM*[®] PACER test heart rate scores and the interactive video games, running/walking, and no physical activity before-school physical activity programs for all children. A significant difference was found between the fall and spring

before-school physical activities offered. There was also a significant difference of means between the running/walking activity and the interactive video games Wii™ *Just Dance* and Wii™ *Dance Dance Revolution*. A significant difference was also found between the means of the no running/walking activity group and the interactive video games Wii™ *Just Dance* and Wii™ *Dance Dance Revolution*. Initial resting heart rate levels indicated no significant difference between any of the morning activity groups, which provides evidence that a relationship between types of activity completed in the morning and PACER heart rate could possibly exist (Results found in Table 4.17). This may stem from the current study results, which indicated that children who completed the running/walking activity (M= 175) had a significant difference in mean between the interactive video games Wii™ *Just Dance* (M= 117) and Wii™ *Dance Dance Revolution* (M= 124) for activity heart rate. Another factor which may have made a significant difference in the PACER heart rate results, was the time of year in which the test was completed. According to Carrel, et. al., 2007, physical fitness levels in children are reduced during summer vacation time which could explain the significant difference in PACER scores between fall and spring participants.

Limitations and Delimitations

Limitations of the study derive from a variety of components. First, limited research resources and safety considerations impacted the study due to the high level of participation. Next, the variance between the time of year and difference in weather temperature in which the interactive video game segment was completed,

Spring 2010, and the running/walking and no physical activity program that were completed in the Fall 2010, may have been another limitation to the study. Other limitations may have stemmed from the wide age span of participants, thereby impacting the difficulty level at which activities could be completed and the use of the same participants in other activity groups.

First, the before-school physical activities could not be offered at the same time due to gym space, personnel, the number of working accelerometers, heart rate watches, and the large group of participants. Small gym space did not provide a safe environment to accommodate one hundred plus children on a consistent basis for a before-school physical activity program. The average physical education class at the elementary school ranges from 20-22 children for which the gym space is adequate. The available certified personnel to help with the program were limited as well. The participating district requires a ratio of less than thirty children to one supervisor. In order to provide a safe environment for the students, the number of children in attendance for each of the physical activity sessions needed to be less than one hundred. Therefore, due to the large numbers of participants, the before-school session activities had to be divided into smaller groups.

Technology was an influential factor as well. Seventeen of the accelerometers used were older and battery life could not be retained for the allotted time. Because only fifty heart rate watches were available for the study, the number of watches was not sufficient to record heart rate data on the activities *Wii™ Just Dance* and *Wii™ Dance Dance Revolution*, and the running/walking activity at the same time for all participants. By splitting the before-school activities, it provided

the majority of children who participated in Wii™ *Just Dance* and Wii™ *Dance Dance Revolution* with a heart rate monitor, and half of the running club participants per attendance time.

The next limitation was the time of year and weather temperatures. The local weather plays a role in the opportunity for outdoor daily physical activities for children (Belanger, Gray-Donald, O'Loughlin, Paradis, & Hanley, 2009; Rosenberg & Wood, 2010). The school policy for the weather temperature to allow students outdoors to complete physical activity at the participating school is 32 degrees Fahrenheit. Low morning temperatures in the Spring, which averaged 30.8 degrees Fahrenheit, were not high enough to consistently have a group of children outdoors in the morning running/walking (National Weather Service, 2011). When the child wore the accelerometer, the temperature of the weather could have influenced the child's activity level as well. The average temperature throughout the day during the spring session was 48 degrees Fahrenheit and fall session was 56 degrees Fahrenheit (National Weather Service, 2011). Differences in weather conditions and activities offered for children of this age at the time of wearing the accelerometer may have influenced the results.

Finally, the investigation findings that a before-school program provided 9.3 to 12.7 minutes of moderate to vigorous physical activity, which helps to meet, but, does not solely cover the NASPE and CDC 60 minutes a day activity level may have stemmed from the wide age span of participants and the difficulty level at which activities could be completed. The age span for children participating in the study ranged from 6-11 years. Endurance, and ability to comprehend are different between

a kindergartener and a fifth grade student. Because of the wide age span, the difficulty level of the interactive video games had to be kept at an easy to moderate level. If the study could have focused on a specific age, the difficulty of the physical activity could have been modified. Studies have indicated interactive video games provide a positive effect on increasing energy expenditure when playing the interactive game Wii™ *Dance Dance Revolution* (Höysniemi, 2004; Lanningham-Foster et al., 2006). Both of the studies completed by Höysniemi, and Lanningham-Foster were completed in a smaller group setting. The large group setting may have contributed to less engagement time of the children.

Incomplete data from children who did not wear the accelerometer the entire allotted time was also an influential factor on the ending results. Children who showed only one recorded day of data were not used in the investigation due to reliability. Studies have shown accelerometers need to be worn at least three to four days to find valid and reliable data (Trost et. al., 2000). Children may have also worn the accelerometer during school, but when the child arrived at home, the child took off the monitor. Results may have stemmed from the type of activities in which children were active in, which the accelerometer could not be worn due to safety and/or the accelerometer was not waterproof. Some examples of physical activities that could not be accounted for by the accelerometer included any physical activity in the water and wrestling.

Delimitations of the study included the great support from the participating school and the willingness of both the principal and parents to incorporate a before-school physical activity program. The children understood the routine to attend and

order was kept in completing the activities throughout the duration of the study.

Volunteer support from the University of Nebraska-Kearney Physical Education Department was beneficial to keep children on task and involved in the activities by completing the activities with the elementary children. Utilizing the accelerometers for the study was also beneficial to accurately count total daily sedentary, total daily moderate to vigorous physical activity and sedentary, and moderate to vigorous physical activity levels during the before-school activity time alone, in a non-invasive, technologically advanced manner.

Chapter Six

CONCLUSION

This investigation was designed to examine before-school physical activities and determine if the activities completed provided a significant means to decreasing total daily sedentary time and improving children's fitness levels. The findings from the investigation indicate that the before-school physical activity program carried out in this study did not provide a significant decrease in total daily sedentary time.

However, conclusions from the extended portion of the study, which analyzed sedentary and moderate to vigorous physical activity levels during the before-school physical activity time only (7:15 a.m. - 8:15 a.m.), found the morning program session did in fact provide a significant difference in sedentary and moderate to vigorous physical activity. These findings are noteworthy in providing evidence that a before-school physical activity program could be considered a foundation point to decrease total daily sedentary time, but should not be the only accountable factor used by schools to reach the 60 minute a day, 5 days a week daily physical activity recommendation by the NASPE (Department of Health and Human Services, Washington D.C., 2000; National Association of Sport and Physical Education, 2008; National Association of Sport and Physical Education, 2010).

Future Research and Recommendations

The results of the investigation provide insight into one alternative physical activity opportunity throughout a school day that was hypothesized to decrease total daily sedentary time and improve a child's physical activity level of this study. The

following recommendations for dissemination of the findings and further studies are deemed appropriate:

1. The statistical data collected from the current investigation could serve as a basis for future correlation studies between sedentary time, moderate to vigorous physical activity, activity heart rate, and difficulty level when engaged in playing Wii™ interactive video games *Dance Dance Revolution*, *Just Dance*, and Xbox 360™ Kinect™ *Dance Paradise* and *Dance Central*.
2. The data collected in the current investigation could serve as a basis for future research comparing age, difficulty level, and population size used when playing Wii™ interactive video games *Dance Dance Revolution*, *Just Dance* and changes in sedentary/moderate to vigorous physical activity time.
3. The data collected in the investigation could serve as a basis for a future longitudinal study to determine changes in daily sedentary and physical activity levels by grade level and gender throughout the child's elementary and middle school careers.
4. The descriptive and collected data from the current investigation could be used as a baseline investigation to find the relationship between the reason(s) the child participated in the before-school physical activity program, the time the child woke up for the day, and the child's daily sedentary levels.
5. The descriptive and statistical data from the current investigation could be

a baseline for future investigations to determine perceived physical activity levels by children and the actual completed physical activity levels achieved in a before-school physical activity compared to Physical Education class.

6. The statistical data collected from the current investigation could serve as a base to future comparative research between sedentary levels of children wearing only an accelerometer versus wearing an accelerometer and pedometer in which immediate feedback of physical activity “steps” could be evaluated by the child.

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APPENDICES

APPENDIX A

Kearney Public School Project Approval Letter



Copy

February 23, 2010

Dear Megan Adkins-Gangwish,

I am writing in support of your research proposal of instigating morning physical activity programs for elementary schools from the Health, Physical Education, and Recreation Department at UNK. This would include measurement of physical activity prior to the school day beginning by means of accelerometry, observation, heart rate levels and PACER physical fitness test through the use of Dance Dance Revolution and the morning fit (running) club.

The Kearney Public School system is supportive of these projects as they will aid in the evaluation of morning physical activity programs offered in the school district. The research project has good intentions, will not be disruptive or detrimental to students or the Kearney Public School routine, and will most likely be well received by volunteer students and therefore is welcome within the schools.

The proposed project is important for the evaluation component of morning activities in Kearney Public Schools, and therefore intends to support efforts of bringing quality physical activity to our schools through fully supporting the collection of data within the programs.

Sincerely,

Carol Renner

Carol Renner, PhD
Associate Superintendent
Kearney Public Schools.

APPENDIX B

UNL AND UNK IRB Approval Letter

**Message**

* Indicates Required Fields

Printer Friendly Version

Sent By: IRB NUgrant System
Sent On: 09/08/2010 02:40 pm
Reference: IRBProjectForm - 14552
Subject: Official Approval Letter for IRB project #10957
Message: August 23, 2010

Megan Adkins
Teaching, Learning and Teacher Education
530 E 47th St Kearney, NE 68847

David Brooks
Teaching, Learning and Teacher Education
123A HENZ, UNL, 68588-0355

IRB Number: 20100710957COLL
Project ID: 10957
Project Title: Energy expenditures (use) in elementary students while playing Dance
Dance Revolution or Wii Just Dance in a before school program.

Dear Megan:

The Institutional Review Board for the Protection of Human Subjects has completed its review of the Request for Change in Protocol submitted to the IRB.

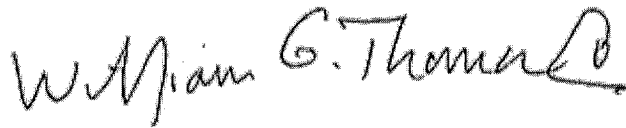
We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

- * Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
- * Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
- * Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
- * Any breach in confidentiality or compromise in data privacy related to the subject or others; or
- * Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This letter constitutes official notification of the approval of the protocol change. You are therefore authorized to implement this change accordingly.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,



William Thomas, Ph.D.
Chair for the IRB



Close

Attachments:

March 24, 2010

Megan Adkins
Department of Health, Physical Education, Recreation and Leisure Studies
University of Nebraska at Kearney

IRB #030510-2

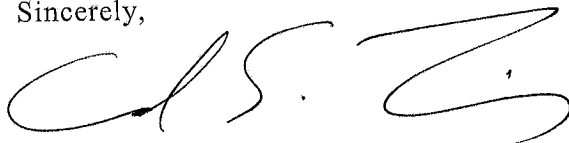
TITLE OF PROPOSAL: Energy Expenditures (Use) and Daily Physical Activity Changes in Elementary Students while Playing Dance Dance Revolution or Wii Just Dance in a Morning Fitness Program

Dear Ms. Adkins:

The Institutional Review Board (IRB) for the Protection of Human Subjects has completed its review of your revised research proposal. The Board concludes that you are in compliance with all applicable federal regulations, and you have provided adequate safeguards for protecting the rights and welfare of the subjects to be involved in this study. The IRB, therefore, approves your research project. This letter constitutes official notification of the approval and release of your project by the IRB, and you are authorized to implement this study accordingly.

We wish to remind you that, under the provisions of the General Assurance from the University of Nebraska to HHS on the Protection of Human Subjects, the principal investigator is directly responsible for insuring prompt reporting to the IRB of proposed changes in the research. In addition, any unanticipated problems involving risk to the subject or others must be reported in writing immediately. This project is subject to periodic review and surveillance by the Board and, as part of their surveillance, the Board may request periodic reports of progress and results. For projects that continue beyond one year from the starting date, it is also the responsibility of the principal investigator to initiate a request to the Board for annual review and update of the research project.

Sincerely,



Carol S. Lomicky, Ph. D.
Director, IRB

cs1/js

APPENDIX C

Study Overview Information to Parents and Students

UNK Research Project for **Children Ages 6-11**

to Determine Physical Activity Levels and Daily Sedentary Time while Participating in a Morning Fitness Program

Wii™ *Just Dance* and

Dance Dance Revolution, and a Run/Walk Activities

The University of Nebraska at Kearney-Health, Physical Education, Recreation and Leisure Studies Department is conducting a research project to determine the daily physical activity levels and daily sedentary time while participating in a morning **Run/Walk club** and playing Wii™ ***Dance Dance Revolution and Just Dance***.

We would like to invite your children to participate in our study.

- ❖ If you choose to participate, your children(ren) will need to be at school by 7:30-8:00am two days a week (Monday and Wednesday) starting date until date (7 weeks)
- ❖ During your child's normal Physical Education class time and during the beginning day of the program the following items will be measured:
 - We will measure body fat using height/weight:
 - We will measure aerobic fitness levels by using the following techniques:
 - Your children will complete the PACER test during their normal physical education class. (Progressive Aerobic Cardiovascular Endurance Run). The PACER test is a multistage fitness test adapted from the 20-m shuttle run. It is progressive in intensity-it is easy at the beginning and gets harder as an individual stays within the test longer.
 - Your children will wear a strapless heart rate monitor watch (See attached for information)

Throughout the rest of the 7 weeks your children will be active

Running/walking and playing Interactive Video Games

We will measure the level of physical activity for four days within the study during the running portion and again while playing Wii™ *Dance Dance Revolution* or *Just Dance* using the following techniques:

- Accelerometer. (4 days only) Your child will wear an accelerometer, which is a small (5.1 X3.8 X 1.5 cm), light weight (45g) plastic device worn on the hip. The accelerometer detects movement by the body, and depending on the amount and force of movement the physical activity can be classified as light, moderate, or vigorous.

Lastly, your child will be asked to complete a short questionnaire about video game and physical activity play. Parents will be asked to complete a short lifestyle and family questionnaire.

This information is important to understanding the level of physical activity in young children. If you are interested in participating, please complete the forms provided distributed by the homeroom teacher to your child or contact Megan Adkins, PROJECT COORDINATOR (308) 865-8727 or Greg Brown (865-8333).

APPENDIX D

Instructional Packet covering the Parental/Children Permission/Consent and Medical
Consent with Liability Release and Children Assent

Instructions & Checklist
Parental/Children Permission/Consent and Medical Consent with
Liability Release and Children Assent

PARENTAL/GUARDIAN CONSENT FORM

CONSENT FOR RESEARCH

IRB Protocol Number: #030510-2

AN EXAMINATION OF CHANGES IN SEDENTARY TIME WITH THE
 INTEGRATION OF TECHNOLOGY FOR CHILDREN PARTICIPATING IN A
 MORNING FITNESS PROGRAM

TITLE: *An Examination of Changes in Sedentary Time with the Integration of Technology for Children participating in a Morning Fitness Program.*

The Department of Health, Physical Education, Recreation and Leisure Studies at the University of Nebraska at Kearney would like to invite your son or daughter to participate in this research study. The following information is provided in order to help you to make an informed decision about whether or not you wish for your children to participate. You should be aware that even if you agree to allow your children to participate, you or your children are free to withdraw at any time without penalty.

PURPOSE OF STUDY. The purpose of the proposed research project is to determine if the “Physically Active” video game, *Dance Dance Revolution or Just Dance* or a running/walking club can provide adequate increases in heart rate and movement to be considered beneficial to improving fitness levels in children, and decreasing daily sedentary time of children.

INVITATION TO PARTICIPATE AND PROCEDURES. Your children are invited to participate in the following research study if your child is between the ages of 6-11 years of age.

Participation in this study will require your child to be present at Park Elementary School by **7:30 a.m. only on Monday and Wednesdays** from **date**. (7 weeks for the running club and 7 weeks for the interactive video games)

You and your children will need to complete the following forms and return to the front office secretary at Park before or on **date** to be able to participate in the activity.

- 1) Medical health history questionnaire for your children and family
 - a. The questionnaire attached will ask if your child is allergic to anything, under doctors care, have any illnesses or injuries that should be noted, and/or any physical or mental disabilities.

- 2) Short Lifestyle Evaluation & Parent/Guardian Information
 - a. The lifestyle questionnaire asks about your child's and family television watch time, and video game play, as well as involvement in physical activities outside of school.
 - b. The Parent/Guardian information asks basic questions such as, the number of children at home, rate your current level of physical activity, your video game play time.

All questionnaires are voluntary to answer. They are developed to help the researcher understand all aspects and contributing factors, which may play into the results, found. Your participation is solicited although strictly voluntary. We assure you neither your name, nor your children's name, will be associated in any way with the research findings.

IMPORTANT: MUST BE COMPLETED

Child and Parent Consent, Assent Forms

All parents/guardians will need to initial each page and sign the parental consent form on the last page that is attached. The child involved in the study will also need to sign the child consent form, which is also attached.

Participation in the study will include measurement of aerobic fitness, body composition, and physical activity. Below is a description of each measurement. Many of these measurements are routinely taken during physical education class and present minimal risk. In the absence of a parent/guardian, a child advocate that is independent of the study (a teacher) will be available and accessible for the participant during the research procedures.

On **date** of the activity, the students will participate in the following health and physical fitness testing at **Park Elementary at 7:30 A.M:**

- 1) **Measurement of your child's body height & weight**
 - a. Body weight and composition. Body height and weight will be measured using a standard scale. Your child's body composition will be measured using a body mass index calculation chart.
- 2) **Aerobic fitness**
 - a. Aerobic Fitness Testing: We will measure aerobic fitness level by running the Pacer (Progressive Aerobic Cardiovascular Endurance Run). The PACER test is a multistage fitness test adapted from the 20-m shuttle run. It is progressive in intensity-it is easy at the beginning and gets more difficult as an individual runs longer. An individual begins by lightly jogging and then progresses to increase the speed of the run until they are unable to keep the speed going with the cadence of the CD, and then the individual stops the test.
 - i. Heart Rate Monitor: While completing the PACER all children will wear a strapless heart rate monitor (Bowflex OS Strapless Heart Rate Monitor Watch with Calorie and

Pedometer Counter). Consists of a watch that straps around the participants wrist. The watch has a quick touch technology that determines heart rate quickly and easily by the subject placing their thumb and pointer finger on the interface of the watch. It records average and/or maximum heart rate; target zone indicator. Inside the watch a small electronic device in the middle of the interface counts the number of beats a person's heart takes through the fingers pressing down on the watch. The electronic device then transfers the calculated heartbeats to the wristwatch. The wristwatch shows the calculated heart rate for the individual. Prior to completing the PACER the subjects will have their resting heart rate assessed by wearing a heart rate monitor and sitting calmly for five minutes. The researchers will read the heart rate indicator watch to find the initial resting heart rate. The researchers will read the heart rate indicator watch to find the initial resting heart rate.

- ii. The students will wear a Bowflex™ strapless hear rate monitor while completing the PACER fitness test and while participating in the morning activity to monitor cardiovascular changes and document the change in the heart rate from the beginning of the PACER to the end. Use of the heart rate monitors will be done exactly the same on dates

- 3) **Child Questionnaire:** Participating subjects will be asked to complete a small series of questions about their video game knowledge, and their physical activity levels on.

For the duration of the 7 weeks in the fall your children will participate in a run/walk activity, for the next 7 weeks they will play the game *Just Dance* or *Dance Dance Revolution* at 7:30 am at Park Elementary on Monday and Wednesdays.

Running Activity: When all fitness assessments have been completed, children will report to the playground at Park Elementary at 7:30am to begin their run. A specified route will be marked with adults at corners to help guide the students as to where they need to travel. The route will not go by any street so there will be no safety issues. When the students complete the 1/4 lap track a researcher will place a small dot on their hand. Each time the student completes a lap another dot will be placed on their hand. At the end of the running time, the researcher will have the subjects take their heart rate and count the number of laps completed by each student and record that data.

Active Game Play: On date your child will play Wii™ *Dance Dance Revolution* or *Just Dance* two times (Mon/Wed) a week in the Park Elementary gym beginning at 7:30 a.m.

- Placement of students in Wii™ *Dance Dance Revolution* or *Just Dance* activities will be randomly selected.
- Subjects will play for 30 minutes, alternating between practices and scoring components.

Wii™ *Dance Dance Revolution* play: Players stand on a “dance platform” or stage and hit arrows laid out in a cross with their feet to musical and visual cues. Players are judged by how well they time their dance to the patterns presented to them and are allowed to choose more music, at different speeds and difficulty levels. Four students will be on the “active” pads for each song. Other students involved will be on practice pads and complete the moves but will not be “scored.” After each song the students will rotate onto the “active” and practice pads.

Wii™ *Just Dance* play: Players stand in front of the Wii™ console and hold a Wii™ remote in one hand. Up to four players can be “scored” the rest of the students will complete the dance moves shown on the screen without being scored. *Just Dance* is a music and rhythm video game that allows an individual to work on dance moves, eye-body coordination, and increase cardiovascular activity. Players with a remote are judged by how well they time their dance moves to the patterns presented to them. The player is allowed to choose a variety of music, at different speeds and difficulty levels to play.

Physical Activity Measurement. We will measure the level of physical activity for four days in mid-fall and mid-winter of the study by using an accelerometer. (better grade pedometer) An accelerometer is a small (5.1 X3.8 X 1.5 cm), light weight (45g) plastic device worn on the hip. The accelerometer detects movement by the body, and depending on the amount and force of movement the physical activity can be classified as light, moderate, or vigorous. From the data collected from the three days your children wears the accelerometer we will download the information into a program that determines the amount of physical activity performed by each student per day. The accelerometer will tell the researcher the time of day the students were most active, what classification of exercise it would be considered.

POTENTIAL RISKS AND DISCOMFORTS.

Your child will be exposed to some minimal risk while participating in the running/walking activities and playing the game Wii™ *Just Dance* or *Dance Dance Revolution*. While running participants are outside so they need to wear appropriate clothing for temperature differences. They also need to be aware of uneven surfaces on sidewalks. Both games require the student to move their body in all directions (left, right, diagonal etc) While participating in Wii™ *Dance Dance Revolution* students will be using leg movement at a slow speed and as improvement and skill improve, the movements will get faster. To reduce risk, if a student feels they

cannot go the fast pace the screen will be divided into two sections and the student can follow the slower paced arrows. Students participating in *Wii™ Just Dance* will use leg and arm moves through dance forms. The individual will use high, medium, and low levels of space, as well as a variety of flowing arm and leg moves. To reduce the risk, students not able to participate in the dance will be able to modify as needed by help through college student helpers in the class. Subjects may also experience some mild muscle soreness from the aerobic fitness testing as well as from the active game play. To help minimize the soreness students will have complete access to the water fountain. They will also complete a small stretching routine conducted by physical education college student pre and post game play. A certified medical aid will be present at the school during the time of the activity as well.

POTENTIAL BENEFITS TO THE SUBJECT.

The running/walking club and *Wii™ Just Dance* and *Wii™ Dance Dance Revolution* used in a before- school program could potentially provide a means to increase cardiovascular activity and make an impact upon childhood obesity due to more energy exertion during physical activity. Due to the ever-increasing amount of television and sedentary video game time, research is needed to determine whether or not a running club, *Wii™ Just Dance* and/or *Dance Dance Revolution* can be used as a contributing benefit for schools to build healthier lifestyles.

ALTERNATIVES TO PARTICIPATION. The alternative to participation is not to participate.

ASSURANCE OF CONFIDENTIALITY. Your participation is requested, although strictly voluntary. We assure you neither your name, nor your child's name, will be associated in any way with the research findings. The information obtained in this study may be published in scientific journals and presented at professional meetings, but only as aggregated data. Your child's information will be identified only by a code number and will be kept secure in the Health, Physical Education, Recreation and Leisure Studies Department at the University of Nebraska at Kearney.

COMPENSATION FOR PARTICIPATION. Your child will be recognized at an assembly for participation in the study and being active.

IN CASE OF EMERGENCY CONTACT PROCEDURE. In the event of a research related injury or adverse reaction, please immediately contact one of the investigators listed at the end of this consent form.

EMERGENCY CARE AND COMPENSATION IN CASE OF INJURY. In the unlikely event that your child should suffer an injury as a direct consequence of the research procedures described above, the emergency medical care required to treat

the injury will be provided by the University of Nebraska at Kearney at no expense to you, providing that the cost of such medical care is not reimbursable through your health insurance. However, no additional compensation for physical care, hospitalization, loss of income, pain, suffering, or any other form of compensation will be provided. None of the above shall be construed as a waiver of any legal rights or redress you may have.

RIGHTS OF RESEARCH SUBJECTS. Your child's rights as a research subject have been explained to you. If you have any additional questions concerning your rights, you may contact the Institutional Review Board (IRB) of the University of Nebraska at Kearney, telephone (308) 865-8235.

VOLUNTARY PARTICIPATION AND WITHDRAWAL. Your child is free to decide not to enroll in this study or to withdraw at any time without adversely affecting your relationship or your child's relationship with the investigators, or the University of Nebraska at Kearney-Health, Physical Education, Recreation and Leisure Studies Department. Your child's decision will not result in any loss of benefits to which he/she is otherwise entitled. If any additional information develops or changes occur during the course of this study that may affect your child's ability to continue participating you will be informed immediately.

DOCUMENTATION OF INFORMED CONSENT. You are voluntarily making a decision whether or not to allow your child to participate in the research study. Your signature certifies that the content and meaning of the information on this consent has been fully explained to you and that you have decided to allow your child to participate having read and understood the information presented. Your signature also certifies that you have had your questions answered to your satisfaction. If you think of any additional questions during the study, please contact the investigators.

Printed Name of Parent

Signature of Parent

Date

Printed Name of Children

Signature of Children

Date

Signature of investigator

Date

If you have questions, please contact:

PROJECT COORDINATOR/PRINCIPAL INVESTIGATOR

Megan Adkins, MS University of Nebraska at Kearney 865-8727

SECONDARY INVESTIGATORS

Greg Brown, PhD University of Nebraska at Kearney 865-8333

Child Consent Form

Thank you for showing interest in our study: Please review this form and sign at the bottom if you agree to participate in the study. If you choose to participate, details of the study are outlined below. It's strictly your choice to participate.

- The **first day of the activity**, (date)
 - We will record your height and weight.
 - You will hand in the completed questionnaire about your video game experience and physical activity levels
 - You will run the PACER test during Physical Education Class and wear a heart rate monitor.
 - The heart rate monitor is watch that goes around your wrist and counts the beats of your heart and shows it on a watch that you will wear.
- **ONLY Two days a week (Monday and Wednesday) from 7:30-8:00 am** you will report to the playground and participate in a run/walk activity. For 7 weeks after the running club you will report to Park Gym and participate in the Wii™ *Just Dance* or *Dance Dance Revolution* . You will only play one of these games for 7 weeks.
 - Each activity will last for a ½ hour
 - For four days in mid fall and again mid-winter, you will wear an accelerometer (more expensive pedometer-counts your steps and figures out how active you are) to calculate at your daily physical activity levels.
 - If, at any time during the testing you want to stop, just tell us know.
 - At the end of the testing, the participants will be recognized at an assembly at school for your involvement.

By signing this you agree that you have read this sheet and agree to the terms of this study:

Signature: _____

Date: _____

Printed Name: _____

***TURN in with Parent Consent and Questionnaire form Please**

Child Assent Procedures.

The child will report to the gymnasium at 7:30am-8:00am on Monday and Wednesdays ONLY. A teacher from the school, whom is not connected to the current project, will be available and accessible during the testing procedures. If he/she is not accessible, an alternative person will be selected. The following protocol will be followed for all participants:

CONFIDENTIALITY: It is easier, and less prone to error, to refer to subjects by their names during data collection. So, during the stages of the study in which the investigators and subjects are in contact, subjects and their associated data will be referred to by the subject's name. However, once the data has been collected, the subject's name will be removed from all data and a randomly generated subject number will be used throughout data analysis and manuscript preparation. The number will be a randomly generated number created with the Random number feature of Excel.

Participation in the activity:

- a. Upon the first protest by the child the testing procedure will be terminated. The child will be calmly asked about their concerns and comforted by staff member in attendance and/or advocate.
- b. The procedure will be further explained and the child will be asked whether or not they wish to participate.
- c. If the child wishes not to participate, they will receive the intended incentive and be thanked for their time. No further testing will be completed.
- d. If the child wishes to participate, testing will be continued. Researchers will monitor the participants to check if they look comfortable throughout the testing procedure. Upon any protest, the above procedure will be followed.
- e. The research team will assure the child that there are no hard feelings and the research team appreciates their efforts.

APPENDIX E

Parent/Child Questionnaire

Parent/Child Questionnaire

PARENT

LIFESTYLE EVALUATION

INSTRUCTIONS: The questions in this section are about your television and video game usage. Please circle your answer for each question.

- 1) **During the week, how many hours per day do you usually spend watching TV shows or videos?**
 - a. I don't watch TV or videos
 - b. Less than 1 hour a day
 - c. 1-2 hours a day
 - d. 3-4 hours a day
 - e. more than 4 hours a day

- 2) **During the week, how many TV shows or videos do you usually watch each day?**
 - a. I don't watch TV or videos
 - b. 1
 - c. 2
 - d. 3 or more

- 3) **During the weekend, how many hours per day do you usually spend watching TV shows or videos?**
 - a. I don't watch TV or videos
 - b. Less than 1 hour a day
 - c. 1-2 hours a day
 - d. 3-4 hours a day
 - e. more than 4 hours a day

- 4) **During the weekend, how many TV shows or videos do you usually watch each day?**
 - a. I don't watch TV or videos
 - b. 1
 - c. 2
 - d. 3 or more

- 5) **During the week, how many hours per day do you usually play video games like Wii™, Nintendo™, XBox™, games at the arcade, or use the computer to surf the Internet?**
 - a. I don't play video games or use the computer
 - b. Less than 1 hour a day
 - c. 1-2 hours a day
 - d. 3-4 hours a day
 - e. More than 4 hours a day

- 6) **During the weekend, how many hours per day do you usually play video games like Wii™, Nintendo™, Xbox™, , games at the arcade, or use the computer to surf the Internet?**
- I don't play video games or use the computer
 - Less than 1 hour a day
 - 1-2 hours a day
 - 3-4 hours a day
 - More than 4 hours a day
- 7) **Do you play video games with your children? No ____ Yes ____**
- If yes, think about only yesterday, about how much time did you spend playing video games? Circle one.**
 - None
 - 5 minutes
 - 15 minutes
 - 30 minutes
 - 45 minutes
 - hour
 - over an hour
 - If yes, think about only yesterday, what type of video games did you play? Circle all that apply**
 - Action/combat/Adventure (example: Doom, Duke Nukem) (tomb raider, titanic etc.)
 - Classic games or puzzles or logic (word grid, battle chess, solitaire)
 - Interactive- whole body movement games (*Just Dance, Dance Dance Revolution, Wii™* or *Kinect™* Games)
- 8) **On average how much television does your children watch on a daily basis?**
- I don't watch TV or videos
 - Less than 1 hour a day
 - 1-2 hours a day
 - 3-4 hours a day
 - more than 4 hours a day
- 9) **On average how much TV does your family watch together daily?**
-
- I don't watch TV or videos
 - Less than 1 hour a day
 - 1-2 hours a day
 - 3-4 hours a day

e. more than 4 hours a day

10) Does your child play video games? No ____ Yes ____
a. If yes, think about only yesterday, about how much time did they spend playing video games? Circle one.

- i. None
- ii. 5 minutes
- iii. 15 minutes
- iv. 30 minutes
- v. 45 minutes
- vi. hour
- vii. over an hour

b. If yes, think about only yesterday, what type of video games did your child play? Circle all that apply

- i. Action/combat/Adventure (example: Doom, Duke Nukem) (tomb raider, titanic etc.)
- ii. Classic games or puzzles or logic (word grid, battle chess, solitaire)
- iii. Interactive- whole body movement games (*Just Dance, Dance Dance Revolution, Wii™ or Kinect™ Games*)

11) Is your child physically activity outside of school? No ____ Yes ____

If yes, what type of activities do they participate in? (Circle all that apply)

Organized Sports Playing with Friends Playing by Self

12) How likely is your child to be physically active 3-5 times a week

- a. Not likely
- b. Likely
- c. Very likely

13) What activities do your children like to do after-school?

- a. Bike
- b. Dance
- c. Trampoline
- d. Play sports
- e. Play video games (sitting ones)
- f. Play video games (you are moving)
- g. Other: _____

14) Are you currently involved in regular exercise program?

- a. No ____ Yes ____
- i. If yes, how often do you exercise? _____

- ii. Average duration? _____
 - iii. What type of activities do you participate in.
-

15) **Are you physically active with your children?** No ____ Yes ____
 i. **If yes, what activities do you like to do together?**

ii. **If yes, how much time on a weekly basis?**

- i. 30 minutes
- ii. 45 minutes
- iii. hour
- iv. hour in a half
- v. two hours or more

CHILD QUESTIONNAIRE –Please have your Child fill this portion out.

INSTRUCTIONS: The questions in this section ask how likely you are to be physically active. Please circle your answer for each question.

1) **I enjoy exercise a lot**

- a. Yes
- b. No

2) **I think exercise is important to my health**

- a. Yes
- b. No

3) **I have more fun playing outdoor games and sports than anything else.**

- a. Yes
- b. No

4) **Yesterday, did you exercise or participate in sports activities that made your heart beat fast and made you breathe hard for at least 20 minutes. (For example: basketball, jogging, skating, fast dancing, swimming laps, tennis, fast bicycling, or aerobics)?**

- b. Yes
- c. No

5) **How likely are you to be physically active 3-5 times a week**

- a. Not likely
- b. Likely
- c. Very likely

- 6) **How likely you to exercise and keep moving after-school?**
- Not likely
 - Likely
 - Very likely
- 7) **What activities do you like to do after-school?**
- Bike
 - Dance
 - Trampoline
 - Play sports
 - Play video games (sitting ones)
 - Play video games (you are moving)
 - Other: _____
- 8) **How likely are you to run or bike 3-5 times a week?**
- Not likely
 - Likely
 - Very likely
- 9) **How likely are you to keep up a steady pace without stopping for 15-20 minutes when you are physically active?**
- Not likely
 - Likely
 - Very likely
- 10) **During the week, how many hours per day do you usually spend watching TV shows or videos?**
- I don't watch TV or videos
 - Less than 1 hour a day
 - 1-2 hours a day
 - 3-4 hours a day
 - more than 4 hours a day
- 11) **During the week, how many TV shows or videos do you usually watch each day?**
- I don't watch TV or videos
 - 1
 - 2
 - 3 or more

- 12) **During the weekend, how many hours per day do you usually spend watching TV shows or videos?**
- I don't watch TV or videos
 - Less than 1 hour a day
 - 1-2 hours a day
 - 3-4 hours a day
 - more than 4 hours a day
- 13) **During the weekend, how many TV shows or videos do you usually watch each day?**
- I don't watch TV or videos
 - 1
 - 2
 - 3 or more
- 14) **During the week, how many hours per day do you usually play video games like Nintendo, Sega, games at the arcade, or use the computer to surf the Internet?**
- I don't play video games or use the computer
 - Less than 1 hour a day
 - 1-2 hours a day
 - 3-4 hours a day
 - More than 4 hours a day
- 15) **During the weekend, how many hours per day do you usually play video games like (*Just Dance, Dance Dance Revolution, Wii™* or *Kinect™ Games*) games at the arcade, or use the computer to surf the Internet?**
- I don't play video games or use the computer
 - Less than 1 hour a day
 - 1-2 hours a day
 - 3-4 hours a day
 - More than 4 hours a day

- 16) **Do you play video games? No ____ Yes ____**
- a. **If yes, think about only yesterday, about how much time did you spend playing video games? Circle one.**
- i. None
 - ii. 5 minutes
 - iii. 15 minutes
 - iv. 30 minutes
 - v. 45 minutes
 - vi. hour
 - vii. over an hour
- b. **If yes, think about only yesterday, what type of video games did you play? Circle all that apply**
- i. Action/combat/Adventure (example: Doom, Duke Nukem) (tomb raider, titanic etc.)
 - ii. Classic games or puzzles or logic (word grid, battle chess, solitaire)
 - iii. Interactive- whole body movement games ((*Just Dance*, *Dance Dance Revolution*, Wii™ or Kinect™ Games)
- 17) **Did you participate in the morning fitness (running) club in the fall? No ____ Yes ____**
- a. **If yes, would you rather run or play active video games in the morning?**
- CIRCLE ONE**
- i. Run/Walk
 - ii. Play Active Video Games
- 18) **Have you ever played *Dance Dance Revolution*? No __ Yes __**
- a. **If yes, on average how often do you play? CIRCLE ONE**
- i. Daily
 - ii. Couple times a week
 - iii. Couple times a month
- b. **If yes, on a scale of 1 being best and 5 being the worst, how well do you think you play the game? CIRCLE ONE**
- 1 2 3 4 5
- 19) **Have you ever played *Just Dance*? No ____ Yes ____**
- a. **If yes, on average how often do you play? CIRCLE ONE**
- i. Daily
 - ii. Couple times a week
 - iii. Couple times a month
- b. **If yes, on a scale of 1 being best and 5 being the worst, how well do you think you play the game? CIRCLE ONE**
- 1 2 3 4 5

***Please fill out all forms and bring back with the consent forms on date or before.**

Sources: Children's Attraction to Physical Activity; CATCH; Kaiser Family Foundation, 2010; Television Bureau of Advertising

- http://researchonline.nd.edu.au/cgi/viewcontent.cgi?article=1017&context=health_article
- <http://www.nhlbi.nih.gov/health/public/heart/obesity/wecan/downloads/CKC-questionnaire.pdf>
- <http://www.kff.org/entmedia/upload/Appendices.pdf>
- <http://www.tvb.org>

APPENDIX F

Liability Release

Child Medical History Background

Instructions & Checklist
Parental/Children Permission/Consent and Medical Consent with
Liability Release and Children Assent

- This packet contains a (1) Parental Permission/Consent and Medical Consent with Liability Release. (2) Child consent form. (3) Child Assent. (4) Child Questionnaire.
- Either one or both Parents/Guardians can sign the Parental Permission/Consent and Medical Consent with Liability Release forms. The child participating must sign the Child Consent form and fill out the child questionnaire.
- The original forms need to be given to the secretary in the front office of Park **before** or by **date** to be eligible to participate. Your child will not be able to participate in any activity until all forms are signed.

These forms are not intended for any other use than for this research project.

*Parental, Child Permission/Consent, Medical Consent with Liability Release, and
Child Assent*

It sometimes is necessary for parents to give their permission so that the child can participate in some form of organized activity and to release the organizer of the activity from liability.

A “Parental Permission and Medical Consent with Liability Release” form allows parents to give consent for their child to participate in a specified activity as defined in the form.

By having this type of document available the organizers of the activity will be able to better deal with any types of emergency involving the child and can avoid potential problems. All activities will be conducted at Park Elementary so staff will be available if an emergency takes place with your children.

The Liability Release Form releases the organizer of the activity from any liability, holds them harmless and indemnifies them in the event of injury or damage.

**PARENTAL PERMISSION/CONSENT AND MEDICAL CONSENT
WITH LIABILITY RELEASE**

NAME of participant: (please print)

DATE OF BIRTH: _____ **AGE:** _____ **GRADE:** _____

TEACHER: _____

ADDRESS:

PARENT/GUARDIAN NAME:

ADDRESS:

CONTACT PHONE NUMBER: _____

circle one

(CELL \ WORK \ HOME)

MEDICAL HISTORY:

1) Is the child allergic to anything? No ___ Yes ___ If yes, what?

2) Is the child currently under a doctor's care? No ___ Yes ___ If yes, what?

3) Is the child on any continuous medications? No ___ Yes ___ If yes, what?

4) Is the child had any recent illnesses No ___ Yes ___ If yes, what?

5) Any previous hospitalizations or operations? No ___ Yes ___ If yes, what?

6) Any history of significant previous diseases or recurrent illness in the family?

No _____ Yes _____:

a. Diabetes- No _____ Yes _____

b. Convulsions-No _____ Yes _____

c. Heart issues- No _____ Yes _____ If yes, what? _____

d. Others-

7) Does the children have any physical disabilities or injuries? No___ Yes ____
If yes, please describe?

8) Does your children have any mental disabilities? No___ Yes ____ If yes,
please describe?

9) Other information we need to know:

APPENDIX G

Definition and Examples of Light, Moderate, Vigorous Physical Activity, and
Sedentary Time Count Cut Points

Definition of Moderate/Vigorous Physical Activity and Sedentary Time

According to the CDC, American College of Sports Medicine, GetActive
Public Health Agency

- The ratio of exercise metabolic rate. One MET is defined as the energy expenditure for sitting quietly, which, for the average adult, approximates 3.5 ml of oxygen uptake per kilogram of body weight per minute (1.2 kcal/min for a 70-kg individual). For example, a 2-MET activity requires two times the metabolic energy expenditure of sitting quietly.
- The defined intensities for the time spent in activity for
 - Sedentary time equaled 1 MET (metabolic equivalent of task), or less than 100 counts per minute.
 - Moderate activity (equal to or greater than a brisk walk) levels equal 4 METS (thresholds greater than 3000 to 3600 ActiGraph counts·min⁻¹).
 - Vigorous activity (equal or greater than a light jog) is greater than or equal to 7 METS (thresholds greater than 3600 to 9630 ActiGraph counts·min⁻¹)

which takes into consideration children's higher resting energy expenditure rates (Freedson et al., 2005; Treuth, M. S., et al., 2004 July; Strath et al., 2001; Trost et al., 2005).

Example Moderate/Vigorous Physical Activities for Children

Type of physical activity	Activity example
Moderate, aerobic	Walking to school Skateboarding Gentle bike ride
Vigorous, aerobic	Active games involving running and chasing, such as tag Fast bike riding Skipping Running Sports such as football or basketball
Muscle strengthening	Rope or tree climbing Swinging on play equipment such as 'monkey' bars Gymnastics
Bone strengthening	Games such as hopscotch Skipping Running Sports such as gymnastics or basketball

Source: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity. *Promoting physical activity: a guide for community action*. Champaign, IL: Human Kinetics, 1999. (Table adapted from Ainsworth BE, Haskell WL, Leon AS, et al. Compendium of physical activities: classification of energy costs of human physical activities. *Medicine and Science in Sports and Exercise* 1993;25(1):71-80. Adapted with technical assistance from Dr. Barbara Ainsworth.)

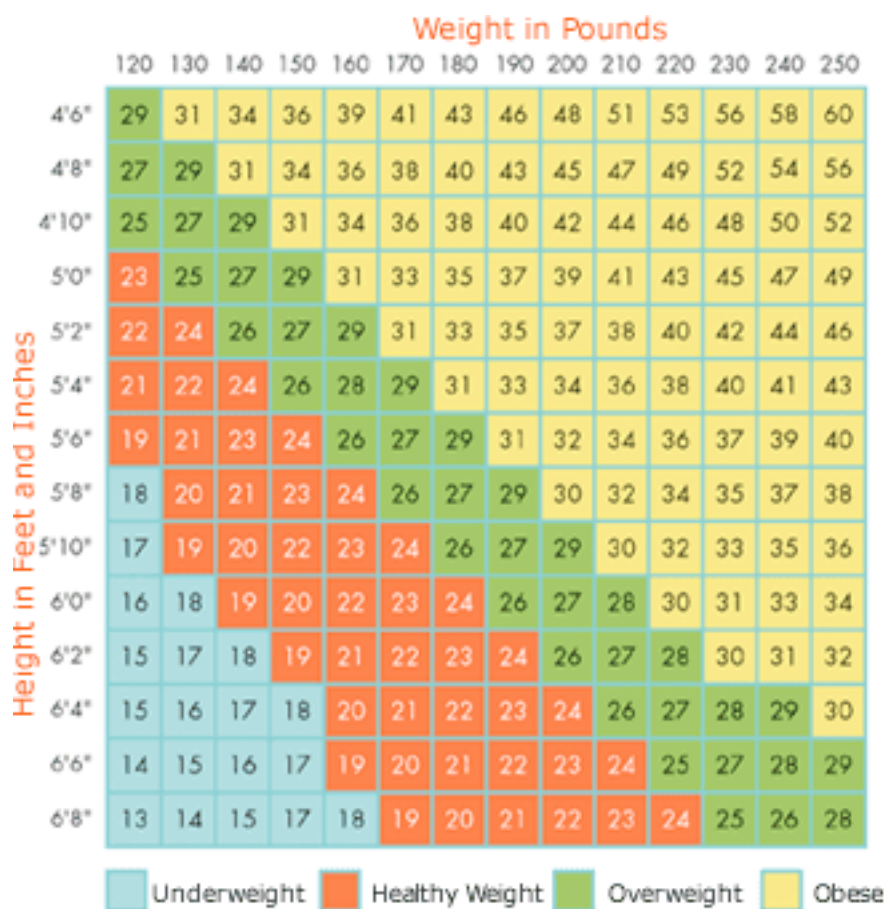
GetaLifeGetActive, Public Health Agency, 2009

- <http://getalifegetactive.com/active-families/how-much-activity-do-children-need/how-much-activity-do-children-need>
- http://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA_Intensity_table_2_1.pdf

APPENDIX H

Body Mass Index Chart for Children

Body Mass Index Chart for Children



Source: Center for Disease Control and Prevention, 2011
http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html

APPENDIX I

Park Morning Fit Club Accelerometer Letter to Parents and Children



PARK MORNING FIT CLUB



Dear Morning Fitness Activity Participant,

As you may remember, part of the morning fitness program, we would like to measure your child's physical activity level for 4 full days. To do this, we ask them to wear a small motion sensor, which is on a belt, around their waist. We have been doing this for years and most children are very excited to wear these physical activity monitors. Your child has been selected to wear the physical activity monitor from **Monday, date** to **Friday, date**.

In order to get the physical activity monitor on your child right away Monday morning, we are asking that your child to be at Park Elementary by **7:15 am on Monday date** if you attend the **Monday/Wednesday** Session. If you participant on the **Tuesday/Thursday** schedule, please have your child come to Park **MONDAY at 7:45 am**. Please have your child come directly to the gym to meet us.

To pick up the monitor, we will be at Park on **Friday date BEFORE SCHOOL**. Your child may come directly to the gym between 7:45 and 8:00am.

Instructions: For the use of the Physical Activity Monitor.

- 1) The monitor belt should be worn around the waist with the monitor in line with their right knee.
- 2) The monitor should be worn so the arrow points up.
- 3) Ideally we want the monitor worn from the time they wake up, until the time they go to bed. Please take off while sleeping.
- 4) Please take off the monitor while in water; bathing, swimming, etc.

If you have any questions regarding the use of the physical activity monitor, please call the Human Performance Lab at 865-8336.

Thank you for your time and involvement.

IRB #030510-2

APPENDIX J

FITNESSGRAM[®] Standards Chart

TABLE 9.1 FITNESSGRAM Standards for Healthy Fitness Zone

BOYS														
Age	VO ₂ max (ml · kg ⁻¹ · min ⁻¹)		PACER (no. of laps)		One-mile run (min:sec)		Walk test (VO ₂ max)		Percent fat		Body mass index		Curl-up (no. completed)	
5			Participation in run. Lap count standards not recommended.		Completion of distance. Time standards not recommended.				25	10	20	14.7	2	10
6									25	10	20	14.7	2	10
7									25	10	20	14.9	4	14
8									25	10	20	15.1	6	20
9									25	10	20	15.2	9	24
10	42	52	23	61	11:30	9:00			25	10	21	15.3	12	24
11	42	52	23	72	11:00	8:30			25	10	21	15.8	15	28
12	42	52	32	72	10:30	8:00			25	10	22	16.0	18	36
13	42	52	41	72	10:00	7:30	42	52	25	10	23	16.6	21	40
14	42	52	41	83	9:30	7:00	42	52	25	10	24.5	17.5	24	45
15	42	52	51	94	9:00	7:00	42	52	25	10	25	18.1	24	47
16	42	52	61	94	8:30	7:00	42	52	25	10	26.5	18.5	24	47
17	42	52	61	94	8:30	7:00	42	52	25	10	27	18.8	24	47
17+	42	52	61	94	8:30	7:00	42	52	25	10	27.8	19.0	24	47

Age	Trunk lift (inches)		90° push-up (no. completed)		Modified pull-up (no. completed)		Pull-up (no. completed)		Flexed arm hang (seconds)		Back-saver sit and reach* (inches)	Shoulder stretch
5	6	12	3	8	2	7	1	2	2	8	8	Healthy Fitness Zone = touching fingertips together behind the back on both the right and left sides.
6	6	12	3	8	2	7	1	2	2	8	8	
7	6	12	4	10	3	9	1	2	3	8	8	
8	6	12	5	13	4	11	1	2	3	8	8	
9	6	12	6	15	5	11	1	2	4	10	8	
10	9	12	7	20	5	15	1	2	4	10	8	
11	9	12	8	20	6	17	1	3	6	13	8	
12	9	12	10	20	7	20	1	3	6	13	8	
13	9	12	12	25	8	22	1	4	12	17	8	
14	9	12	14	30	9	25	2	5	15	20	8	
15	9	12	16	35	10	27	3	7	15	20	8	
16	9	12	18	35	12	30	5	8	15	20	8	
17	9	12	18	35	14	30	5	8	15	20	8	
17+	9	12	18	35	14	30	5	8	15	20	8	

Number on left is lower end of HFZ; number on right is upper end of HFZ.

*Test scored Pass/Fail; must reach this distance to pass.

© 1992, 1999, 2004 The Cooper Institute, Dallas, Texas.

Source: Cooper Institute, 2010

<http://www.cooperinstitute.org/documents/StandardsTable.pdf>

APPENDIX K

Target Heart Rate for Moderate/Vigorous Physical Activity Intensity

Target Heart Rate for Moderate/Vigorous Physical Activity Levels

For moderate-intensity physical activity, a person's target heart rate should be 50 to 70% of his or her maximum heart rate. This maximum rate is based on the person's age. An estimate of a person's maximum age-related heart rate can be obtained by subtracting the person's age from 220. For example, for a 50-year-old person, the estimated maximum age-related heart rate would be calculated as $220 - 50 \text{ years} = 170 \text{ beats per minute (bpm)}$. The 50% and 70% levels would be:

50% level: $170 \times 0.50 = 85 \text{ bpm}$, and

70% level: $170 \times 0.70 = 119 \text{ bpm}$

Thus, moderate-intensity physical activity for a 50-year-old person will require that the heart rate remain between 85 and 119 bpm during physical activity.

For vigorous-intensity physical activity, a person's target heart rate should be 70 to 85% of his or her maximum heart rate. To calculate this range, follow the same formula as used above, except change "50 and 70%" to "70 and 85%". For example, for a 35-year-old person, the estimated maximum age-related heart rate would be calculated as $220 - 35 \text{ years} = 185 \text{ beats per minute (bpm)}$. The 70% and 85% levels would be:

70% level: $185 \times 0.70 = 130 \text{ bpm}$, and

85% level: $185 \times 0.85 = 157 \text{ bpm}$

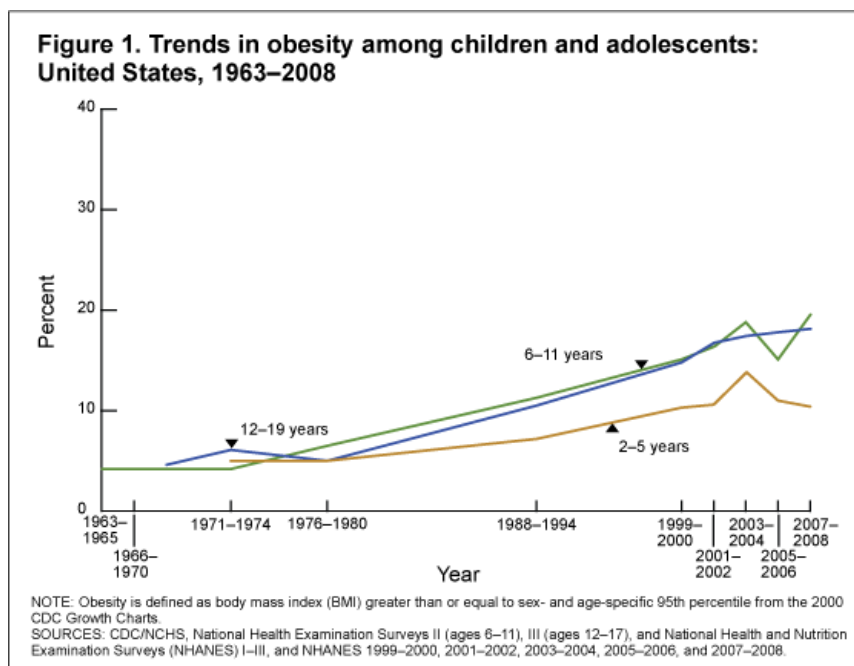
Thus, vigorous-intensity physical activity for a 35-year-old person will require that the heart rate remain between 130 and 157 bpm during physical activity.

Source: Center for Disease Control and Prevention:

<http://www.cdc.gov/physicalactivity/everyone/measuring/hearttrate.html>

APPENDIX L

Obesity trends of Children through the Past Decades



Prevalence of obesity among U.S. children and adolescents aged 2-19, for selected years 1963-1965 through 2007-2008

Age (in years) ¹	NHA NES 1963-1965	NHA NES 1971	NHA NES 1976	NHA NES 1988	NHA NES 1999	NHA NES 2001	NHA NES 2003	NHA NES 2005-2006	NHA NES 2007-2008
Total	(3)	5.0	5.5	10.0	13.9	15.4	17.1	15.5	16.9
2-5	(3)	5.0	5.0	7.2	10.3	10.6	13.9	11.0	10.4
6-11	4.2	4.0	6.5	11.3	15.1	16.3	18.8	15.1	19.6
12-19	4.6	6.1	5.0	10.5	14.8	16.7	17.4	17.8	18.1

1 Excludes pregnant women starting with 1971-1974. Pregnancy status not available for 1963-1965 and 1966-1970.

2 Data for 1963-1965 are for children aged 6-11; data for 1966-1970 are for adolescents aged 12-17, not 12-19 years.

3 Children aged 2-5 were not included in the surveys undertaken in the 1960s.

NOTE: Obesity defined as body mass index (BMI) greater than or equal to sex- and age-specific 95th percentile from the 2000 CDC Growth Charts.

Source: National Center for Health Statistics;

http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm#table1