Acute effects of teacher-implemented physical activity breaks on preschooler's physical activity participation and academic time on-task

by

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Abstract

Physical activity participation is a crucial component to a child's healthy development. Although various benefits and positive correlations exist from adequate amounts of physical activity participation, a majority of preschool-age children do not participate in recommended amounts of activity. Schools have been found to be an appropriate area to address these physical activity needs and potentially deter the rapid onset of the current childhood obesity epidemic. The purpose of this intervention was to examine the acute effects of teacher-implemented classroom based physical activity breaks on physical activity participation and academic time on-task for a preschool-age population. Motor skill competency and weight classification status were also examined to determine if classroom-based physical activity breaks could equally influence moderate-to-vigorous physical activity (MVPA).

118 (*M* age = 3.7966 ± 0.69 years) preschoolers from one Head Start center in the southeastern region of the United States participated in this within-subjects experiment. Teachers' implemented ten-minute classroom based physical activity breaks into their classroom. Students' physical activity was assessed with accelerometers; on-task behavior was coded prior to and following the activity breaks. The Test of Gross Motor Development – 2nd edition (TGMD-2) and body mass index (BMI) percentiles were used

to examine the effect of motor skill competency and weight on physical activity behaviors during the activity breaks.

Results found no significant difference between conditions (i.e. activity break, typical instruction) in terms of percentage of school day physical activity participation (i.e. light, moderate, or vigorous physical activity; $F_{1, 117} = 1.059$, $p = 0.315$). The same was observed for sedentary behaviors ($t_{117} = -1.244$, $p = .216$). The activity break time period did have more MVPA compared to the control time period ($t_{116} = 18.083$, $p < .001$). However, it appears compensation did occur following the implementation of an activity break, students were significantly more sedentary ($t_{117} = -2.6$, $p = .011$) and less active in light ($t_{117} = 2.653$, $p = .009$) and moderate ($t_{117} = 2.250$, $p = .026$) physical activity compared to the typical instruction days. Physical activity breaks did promote more on-task behavior immediately following an in-class break ($F_{1,117} = 18.857$, $p < .001$). There was no significant correlation between weight status and MVPA participation during the breaks ($r = -.028$, $p = .385$); however, higher motor skill competency appeared to have been moderately related to MVPA participation ($r = 0.366$, $p < .001$).

The findings of this acute intervention indicate that with an increased bout of physical activity in the classroom, teachers' may adequately improve time on-task post-break for the preschool-age population. Additionally, classroom based physical activity breaks can increase MVPA, however these effects don't appear to carry over into the rest of the school day. One potential explanation may be compensation of more sedentary behavior and less physical activity after the activity break; further investigation into the cause may be necessary, such as low cardiorespiratory endurance levels. Activity breaks may be an appropriate way to elicit activity in overweight or obese students and increase physical activity participation. Motor skill competency, specifically locomotor scores, did predict activity, more emphasis may need to be placed on improving fundamental motor skills along with increasing physical activity in this age population.

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Chapter 1

Introduction

The prevalence of obesity in preschool children has doubled since 1980 (Ogden & Carroll, 2010). The World Health Organization (WHO; 2010) estimated that over 40 million children worldwide are overweight under the age of five. Further evidence shows that 21.2% and 10.4% of 2-5 year old children are overweight and obese, respectively (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Obesity stems from a variety of sources where biological, genetic, social, and environmental influences all contribute to the overall problem, but physical activity is a modifiable risk factor that comes with a large number of positive outcomes including healthy weight management. Although the exact etiology of the increase in obesity has not been established, physical inactivity has been implicated (Hedley et al., 2004). High amounts of inactivity have been associated with an increased risk of being overweight or obese (Reilly, 2008), while increased physical activity is associated with a reduced risk (Centers for Disease Control and Prevention; CDC, 2006). In addition, physical activity decreases the likelihood of developing cardiovascular disease risk factors, hypertension, and type 2 diabetes, along with improving bone health and reducing psychosocial factors like stress and anxiety (Daniels, 2006; Strong et al., 2005).

Despite the numerous documented benefits of regular physical activity, a majority of children do not meet national recommendations (CDC, 2003). According to the Active Start guidelines (2nd edition), preschoolers should engage in at least 60 minutes of structured (planned) physical activity and up to several hours of unstructured (unplanned) play each day (National Association for Sport and Physical Education; NASPE, 2009). A review on physical activity participation concluded that only 23% of preschoolers, between the ages of 2 – 5 years, engage in the recommended 120 minutes of daily physical activity (Tucker, 2008). In a study of over 400 children in 24 preschools, only 3.3% of time is spent in moderate-to-vigorous physical activity (MVPA) during the school day (Pate, McIver, Dowda, Brown, & Addy, 2008). Furthermore, longitudinal data suggest that physical activity levels decline between the ages of 3 and 5 years (Taylor et al., 2009), and that physical activity levels established during the preschool years are similar to physical activity levels during the childhood years (Pate, Baranowski, Dowda, & Trost, 1996). Physical activity levels remain relatively consistent through adolescence and into adulthood (Kelder, Perry, Klepp & Lytle, 1994; Pate et al., 1996). Thus, it is imperative that research focus upon effective strategies to encourage preschoolers to establish and maintain adequate amounts of physical activity. Particularly when research has found that preschool-age children are more likely than older children to modify their lifestyle behaviors (CDC, 2001) and this can deter accelerated weight gain in this young population (Klesges, Klesges, Eck, & Shelton, 1994).

High amounts of inactivity have been associated with an increased risk of being overweight or obese (Dietz, 1997; Janz, Dawson, & Mahoney, 2002; Reilly, 2008; Trost, Sirard, Dowda, Pfeiffer, & Pate, 2003), while increased physical activity is associated with a reduced risk of being overweight or obese (CDC, 2006; Reilly et al., 2003). Evidence shows that greater participation in physical activity is associated with a healthy body weight in preschoolers (Trost et al., 2003). Conversely stated, Bayer and colleagues (2008) found that preschool children who are the most physically active are less likely to be overweight or obese. Fit Kids Australia (2010) describes this "inactivity cycle" as a dangerous association between children who are overweight being less likely to participate in physical activities. This may translate to tracking studies that support the consistency of physical activity levels from childhood to adulthood (Kelder et al., 1994; Pate et al., 1996). Although this is not always the case, the increase in obesity among children points to inactivity as a major component of the problem.

The NASPE (2009) guidelines also promote that preschooler's should not be sedentary for more than one hour at a time. Preschoolers tend to exhibit high levels of sedentary behaviors especially in preschool settings. Studies have found that students are sedentary for 80-85% of the time while at preschool (Cardon & de Bourdeaudhuij, 2008; Pate et al., 2008). Another detrimental effect of prolonged sedentary activity may be found in the classroom environment. Jarrett and colleagues (1998) observed classroom behavior and discovered that children who have prolonged periods of academic instruction often exhibit an increase in fidgety behaviors by 6% and tend to become more off-task by at least 4%. Thus, long periods of instructional time without a break may be counterproductive to academic behaviors (Jarrett et al., 1998; Pellegrini & Davis, 1993). This has important implications for classroom teachers to implement some sort of activity break to maximize student learning.

An emerging approach to increase daily physical activity participation in school is the implementation of structured, classroom-based physical activity breaks. A typical break consists of ten to fifteen minutes of activities designed to promote MVPA. This strategy is effective in significantly increasing physical activity levels of school-age children (Ernst & Pangrazi, 1999; Mahar et al., 2006; Scruggs, Beveridge, & Watson, 2003). A specific program designed to increase physical activity in the classroom is the Take 10! program that integrates physical activity into the elementary school curriculum. In a recent review, Kibbe et al. (2011) provides consistent evidence that the Take 10! program is effective in increasing physical activity levels in children enrolled in kindergarten through fifth grade in a variety of samples in different countries. The findings emphasize the effectiveness and feasibility of providing classroom-based, structured opportunities for physical activity for a school-age population.

For classroom-based physical activity participation to become a priority of early childhood curriculum and policy, it is also important to provide research-based evidence that physical activity breaks do not negatively dissuade from academic behaviors. Although the importance of physical activity for overall health is well known, the positive impacts of physical activity on increasing concentration, mental cognition, and academic performance, as well as reducing self-stimulatory behaviors (e.g. fidgeting) and school-related stress are not as well understood. The CDC (2010) reviewed studies that examined the association between classroom-based physical activity and academic performance in elementary school-age children. Results indicated that eight of nine published studies found positive effects of physical activity on outcomes such as academic achievement and classroom behavior. An additional review by Donnelly & Lambourne (2011) provides further support of the link between physical activity and positive cognitive and academic outcomes in elementary school-age children. One behavioral outcome that has received empirical consideration is the effect of physical activity on attention (i.e. on-task behavior) in the classroom. Studies in elementary school-age children have found an increase in on-task behavior in the classroom after participation in a physical activity break (Grieco, Bartholomew, & Jowers, 2009; Jarrett et al., 1998; Mahar et al., 2006; Mahar, 2011). However, the effect and benefits of classroom based physical breaks in the preschool population have not been thoroughly investigated.

One concern about the implementation of physical activity into the school day may be compensation. Originally found in psychological literature, the term compensation refers to certain behaviors that may be transferred to another behavior (Barnett & Ceci, 2002). This has been adapted in health literature to discuss the phenomenon of the transference of a healthy behavior to an unhealthy substitute to understand failures in behavior change modifications (Väth, Amato, & Nigg, 2012). For example, when physical activity participation was increased, so did the intake of dietary fat, essentially negating efforts to increase physical activity levels for weight loss (Dutton, Napolitano, Whiteley, & Marcus, 2008). Contradictory findings were reported by Dale, Corbin, & Dale (2000) involving children's physical activity behavior, they found children are more sedentary throughout the entire day if physical activity opportunities are diminished at school, and total day activity is increased on days opportunities are present. This may indicate that implementing physical activity into the classroom may increase activity later on in the day, and deter the potential negative effect of compensation.

A factor associated with participation in physical activity is a child's level of motor skill competency; additionally, inactivity may also be associated with children who exhibit motor delays. Fundamental motor skills (FMS; i.e. gross motor skills) require the activation of large muscle groups and are typically classified as either object control or locomotor skills (Haywood & Getchell, 2009). Object control skills involve the transporting, intercepting, or projecting objects such as throwing, catching, and striking. Locomotor skills include running, jumping, and hopping; they involve different movements to transport the body from one location to another (Ulrich, 2000). FMS are the building blocks for more advanced movements (Clark & Metcalfe, 2002) and enable children to participate in sports and games during the school-age years and throughout the lifespan (Clark, 1994). The preschool years are a critical time for FMS development. Research indicates an association between level of motor skill competence and engagement in MVPA in preschool children (Cliff, Okely, Smith, & McKeen, 2009; Robinson, Wadsworth, & Peoples, 2012; Sääkslahti et al., 1999; Williams et al., 2008). Additional studies show that preschool children that demonstrate higher motor skill competence are the most physically active (Fisher et al., 2005; Graf et al., 2004; Robinson et al., 2012) compared to their less skilled peers. Findings from these studies highlight the relationship between FMS and physical activity engagement, along with the potential for development of FMS through increased physical activity opportunities for young children.

In order to investigate some of these key questions discovered in the literature review, pilot data assessed the effects of researcher implemented activity breaks on MVPA levels and time on-task in preschoolers (Logan, Wadsworth, Robinson, & Webster, in review). Results found that within the two centers examined, there was a 69% and 90% increase of daily MVPA participation from the activity breaks (Logan et al., in review; Wadsworth, Robinson, Beckham, & Webster, 2012). Additionally, tests indicated that on-task behavior after the break was not significantly higher compared to the control condition, however, it appears there is an improvement (non-significant) in the time on-task following the activity break pre-test to post-test versus control condition (Logan et al., in review). Lastly, activity breaks were able to influence MVPA levels across various levels of motor skill competency (Logan et al., in review). This is a positive finding considering children with lower levels of motor skill competency may be less likely to engage in physical activity, insinuating that activity breaks may be an effective method for increasing physical activity participation equally.

There were several strengths to this pilot work, including finding significance in improving MVPA in this age group with such a small sample. Additionally, positive results were found for time on-task, although significance was not reached. Furthermore, two very different preschool centers were used and positive results occurred in both environments. The use of a researcher to implement breaks was a limitation; however, it was imperative for this pilot work to discover if activity breaks were effective in the preschool population. It is difficult to determine the feasibility of the program from the pilot data due to the inaccessibility of a researcher conducting programs at every preschool on a daily basis. Therefore, future research may be needed to look at the use of teachers implementing this type of program and include larger sample sizes to fully understand the effect of preschool physical activity breaks on physical activity participation and time on-task.

Statement of Purpose

The purpose of this study is to determine the acute effects of teacher implemented classroom-based physical activity breaks on preschooler's in-school physical activity participation and time spent on-task in a classroom academic setting. Additionally, this study will examine whether or not motor skill competency and weight classification status affect preschoolers' physical activity participation during these physical activity break periods. This study will inform early childhood education policy makers with recommendations for preschool curriculum to enhance movement and physical activity programs. It could also provide teachers with a viable solution to increase preschoolers' physical activity participation and improve classroom behavior and attention.

Research Questions and Hypotheses

Research Question #1

What is the effect of classroom-based physical activity breaks on a preschooler's school-day physical activity participation?

Hypothesis #1a

Preschooler's will participate in more physical activity throughout the day on days classroom-based physical activity breaks are implemented compared to typical instruction days.

Hypothesis #1b

Preschooler's will participate in more MVPA during the classroom-based physical activity breaks compared to the control condition setting.

Hypothesis #1c

Sedentary activity for preschoolers' will be lower on days that breaks are implemented (i.e. compensation will not occur) compared to the typical instruction days.

Research Questions #2

What is the acute effect of classroom-based physical activity breaks on time on-task?

Hypothesis #2

Preschoolers' time on-task will be greater following the activity breaks than the time immediately preceding the break time, as well as, on typical instruction days.

Research Question #3

Does motor skill competence have an effect on MVPA participation during classroom physical activity breaks?

Hypothesis #3

Motor skill competency will not have an effect on preschoolers' MVPA participation during classroom physical activity breaks.

Research Question #4

Does weight classification have an effect on MVPA participation during classroom based physical activity breaks?

Hypothesis #4

Weight classification status will not have an effect on preschoolers' MVPA participation during classroom physical activity breaks.

Definition of Terms

- **School-day physical activity**: Amount of physical activity a child will participate in throughout the school day (i.e. approximately 4 hours), measured by accelerometry, indicating the time and intensity of activity.
- **Time in moderate-to-vigorous physical activity (MVPA)**: As determined by accelerometry counts, moderate activity is classified as exceeding or equal to 715 counts/15 seconds up until vigorous activity, which is classified as exceeding or equal to 1411 counts/15 seconds (cut points established by Pfeiffer, McIver, Dowda, Almeida, & Pate, 2006).
- **Sedentary activity:** Seen in accelerometry counts as the equivalent of being at-rest, this would be less than 200 counts/15 seconds.
- **Compensation:** Change in one health behavior leads to negative effect in another health behavior (Väth et al., 2012). For example, an individual may increase their physical activity by running, but may compensate for this activity by being more sedentary later on.

- **Time on-task**: The amount of time spent participating in on-task behavior, specific to a classroom setting. On-task behavior is defined as verbal or motor behavior that follows class rules and is appropriate to the learning situation.
- **Motor skill competence**: proficient functioning in fundamental motor skills (Stodden et al., 2008).
- **Weight classification status:** Body mass index (BMI) is the measure used to determine a child's weight classification based on their height and weight compared to nationally representative data from their age and gender.
    - **Overweight:** A child would be classified as overweight if their body mass index identified them higher than the 85^{th} percentile, but lower than the 95^{th} percentile compared to children of their same age and gender according to the CDC growth charts (CDC, 2011).
    - **Obese:** A child would be classified as obese if their body mass index identified them above the 95^{th} percentile compared to children of their same age and gender according to the CDC growth charts (CDC, 2011).
    - **Normal weight:** A child would be classified as normal weight if their body mass index identifyed them below the 85th percentile, but above the 5th percentile, compared to children of their same age and gender according to the CDC growth charts (CDC, 2011).
    - **Underweight:** A child would be classified as underweight if their body mass index identified them below the 5th percentile compared to children of their same age and gender according to the CDC growth charts (CDC, 2011).

Limitations

The limitations associated with this study included:

1. The intervention was implemented at only one preschool Head Start center. Thus, characteristics of the school may have influenced results. However, it has been shown that the environment at a childcare center influences approximately 46% of the variance in activity, therefore control of the extraneous variable was necessary (Finn, Johannsen, & Specker, 2002; Pate, Pfeiffer, Trost, Ziegler, & Dowda, 2004).

2. The within-subject experimental design does not provide a true comparison group, but this also eliminates variability due to individual differences as subjects serve as their own control.

3. Children's physical activity participation outside of school was not assessed.

Delimitations

The delimitation associated with this study were:

1. Participants of this study were preschool school-aged children enrolled at a Head Start center located in a rural, southeast town in the United States. Children were primarily African-American.

Chapter II

Review of Literature

The purpose of this intervention was to examine the acute effects of teacher-implemented classroom based physical activity breaks on physical activity participation and academic time on-task for a preschool-age population. Motor skill competency and weight classification status were also examined to determine if classroom-based physical activity breaks could equally influence MVPA participation. Therefore, this literature review will cover topics that are most relevant to these specific research questions and include: the childhood obesity epidemic, physical activity behaviors in preschoolers, the motor skill competency relationship with physical activity, the connection between physical activity and academic performance, and school-based interventions.

Early Childhood Development

Early childhood is a critical time where children are rapidly developing physically, cognitively, socially, and emotionally. The preschool years are typically identified between two and five years of age and are noteworthy in the development of a child's self-sufficiency, school-readiness preparation and social growth (Santrock, 2009). At this time, children are thought to exemplify symbolic thought, a characteristic of Piaget's preoperational stage of development, where children are able to mentally represent an object that is not there. This is an important component that can lead to imaginative and pretend play, and the beginnings of cooperative play in social groups. Children at this age also begin to be more inquisitive of their surroundings and typically establish more abstract reasoning. Additionally, preschool-age children are rapidly developing language, it is estimated that between the ages of one and six, a child may learn five to eight new words a day (Santrock, 2009). This rapid increase in language development does occur in a social context; this is particularly important in terms of children coming from an impoverished environment. A study by Becker (1977) identified that children that are raised in a low socioeconomic family are less prepared in vocabulary in preschool and this achievement gap persists as children age, compared to children from middle class families.

There are a variety of child care options available for the preschool-age population in the United States. Approximately 61% of preschool-age children have some form of prearranged child care established outside the home (Laughlin, 2013). This influx of outside the home care is primarily cited to be the result of the weakened economy where parents' (especially the mother) are more likely to be working (Story, Kaphingst, & French, 2006). Larger, more organized child care facilities account for approximately one-quarter of the preschool population in child care (Laughlin, 2013). There are several different types of these care facilities, including private or public: child care, day care, preschool, pre-Kindergarten, nursery school, or early education. These facilities may vary in setting (e.g. business, home-based, church-based) and on average children spend 33 hours weekly at these sites (Laughlin, 2013). An educational facility, compared to a care facility, targets cognitive, physical, and socio-emotional development in an enriched environment (Early Education for All, 2006). Additionally, these educational facilities have curriculum quality standards carried out by qualified professionals in an organized and structured manner (Early Education for All, 2006).

Quality educational care during this rapid developmental time period is an important component for healthy growth. Head Start was created to address the "cycle of poverty" for young children who could not afford access to quality educational facilities (Story et al., 2006). Genetics and the environment both donate influences towards maturation in early childhood, however a child growing up in an impoverished environment may contribute to detriments that include inhibiting brain development, academic performance and social competence (Jensen, 2009). Head Start is federally funded program that provides comprehensive services to approximately one million children and their families each year and focuses on a child's: language and literacy, cognition and general knowledge, physical development and health, social and environmental development, and approaches to learning (Administration for Children & Families; ACF, n.d.). The Head Start program has served approximately 30 million children and families since its inception in 1965, with the primary goal of "enriching the quality of early childhood development for the nation's most vulnerable children" (ACF, n.d.).

Overweight and Obesity

According to the American Academy of Pediatrics (2012), "obesity is an excess percentage of body weight due to fat that puts people at risk for many health problems." Excess weight normally occurs when individuals have a large amount of adipose tissue relative to lean tissue. The body mass index (BMI) is one measure used to determine an individuals' weight classification based on their height and weight. Adult and children's BMI are determined differently due to the fact that children vary in body fat composition depending on their stage of development and gender. However, BMI does not measure body fat directly and thus is not a diagnostic tool, but it is an inexpensive alternative to quickly screen a large number of people. There are a number of validated forms for determining body fat more accurately, these include: underwater weighing, dual energy x-ray absorptiometry (DXA), Bod Pod, doubly labeled water or skinfold measurements. These alternate techniques are more expensive and often more difficult and timely to conduct, therefore BMI scales have been created from nationally representative data to quickly screen and assess children and adults. BMI has been accepted as a reliable indicator for body fatness by comparison of underwater weighing and DXA reports (CDC, 2011). For adults, a BMI ranging from 25-29.9 indicates an individual is overweight, a BMI over 30 indicates the individual is obese. For children, age and sex specific percentiles are used to determine a child's body mass index and consequently their weight status based on their height and weight (CDC, 2012). These percentiles are determined from CDC growth charts, based on nationally representative data. According to the CDC growth charts, a child would be classified as normal weight if their BMI was between the 5^{th} and 84.9^{th} percentile, overweight if their BMI was higher than the 85^{th} percentile, but lower than the 94.9^{th} percentile and obese if their BMI was above the 95^{th} percentile compared to children of their same age and gender and underweight children would be found to be below the 5^{th} percentile (CDC, 2011). CDC growth charts can be found in Appendix A.

Obesity has become a global epidemic that affects millions of individuals and carries with it a plethora of health complications and disparities. Recent evidence shows that over two-thirds of adults in the United States are overweight (68%) and 35% are obese (Flegal, Carroll, Ogden, & Curtin, 2010; Ogden, Carroll, Kit, & Flegal, 2012). Alabama boasts similar rates to the rest of the country; with 66.8% of adults overweight and 32% are obese (Trust for America's Health, 2012). Obesity rates in adults are projected to rise, the CDC (2012) estimates that by 2030 over 42% of the adult population in the United States will be obese and the current rate of severely obese adults will nearly double to 11%. Other research estimates that in twenty years obesity rates will exceed 60% of adults in 13 states, and will reach 44% in the remainder of the United States (Trust for America's Health, 2012). This is estimated to cause an influx in obesity-related health care costs to an amount over $550 billion dollars (CDC, 2012). Research indicates that obesity found in adults often originated in childhood (Troiano, Flegal, Kuczmarski, & Johnson, 1995). Additionally, obesity trends have been found to track from childhood into adulthood (Serdula et al., 1993; Whitaker, Wright, Pepe, Seidel, & Dietz, 1997), and if a child is overweight, then obesity in adulthood is usually more severe (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001). Therefore, overweight and obese children are at a greater risk for maintaining an unhealthy weight status throughout the life span (Nader et al., 2006).

Obesity rates in children have doubled or tripled over the past few decades in most industrialized nations, as well as several low-income countries (Wang & Lobstein, 2006). According to the most recent data for the National Health and Nutrition Examination Survey (NHANES), 31.7% of children are overweight, specifically 16.9% are obese between the ages of 2-19 (Ogden et al., 2010). That means over 23 million children in the United States are overweight. Additionally, waist circumference measurements have increased substantially, boys have seen a 65% increase in abdominal obesity and girls have increased 69% over the past decade according to NHANES surveys (Li, Ford, Mokdad, & Cook, 2006); this is a serious concern due to the health implications associated with abdominal fat including cardiovascular disease and type 2 diabetes (Adair, 2008). The state of Alabama has the 6th highest ranking of childhood obesity with 36.1% of children aged 10-17 being overweight or obese (Trust for America's Health, 2012). Nine out of the ten states with the highest childhood obesity rankings are located in the South (Trust for America's Health, 2012). Additionally, Wang & Beydoun (2007) found that minority children are disproportionately affected by childhood obesity with prevalence rates from the 2007 NHANES data being: 28.2% among Caucasian youth, while 35.4% of African American youth and 39.9% Hispanic youth are obese. Disproportionate statistics are noted for children that come from lower socioeconomic status who have higher BMI incidence compared to medium or high-socioeconomic groups (Wang & Beydoun, 2007).

The prevalence of obesity in preschool children has doubled since 1980 (Ogden & Carroll, 2010). Current rates show that 21.2% and 10.4% of 2-5 year old children are overweight and obese, respectively (Ogden et al., 2010). The WHO estimated that over 43 million children worldwide are overweight under the age of five (de Onis, Blössner, & Borghi, 2010). Additionally, these weight disparities disproportionately affect individuals from minority groups and those from low socioeconomic status (Healthy Study Group, 2009). Obesity trends are higher for African-American and Hispanic children than for Caucasian preschoolers (Ogden et al, 2012). Trust for America's Health (2012) reported that American Indian and Alaskan Native children, and Latino preschoolers seem to have the highest obesity rates at 21.1% and 17.6% respectively. Additionally, one in seven preschool-age children from low-income families are obese (CDC, n.d.) compared to the 10.4% national average. Thirty-one percent of preschoolers from low-income families are overweight or obese (CDC, 2010). In Alabama, 14.1% of low-income children aged 2-5 are obese (Trust for America's Health, 2012) based on information from the Pediatric Nutrition Surveillance Survey (PedNSS).

The rise in obesity has been linked to poor dietary habits, increases in technology, energy-dense food, portion control, cutbacks in leisure time activities, poor motor skills, physical activity enjoyment and low amounts of energy required for daily living (Gill, King, & Webb, 2005). Genetics is also a factor in obesity. Han, Lawlor, & Kim (2010) estimate that "the obesity epidemic is probably the result of evolutionary legacy interacting with our technologically advanced and consumerist society." Regardless of the cause, obesity is associated with a plethora of health disparities that have deemed this influx an epidemic.

There are a multitude of negative health conditions associated with overweight and obesity. Most alarming is that with the prevalence of childhood overweight and obesity there is an increased likelihood of chronic health conditions. An excess of weight has serious health consequences in pediatric populations, such as: high blood pressure, type 2 diabetes, high cholesterol, hypertension, depression, poor self-esteem, stress, anxiety, endocrine abnormalities, asthma, fatty liver disease, gallstones, gastro-esophageal reflux, and sleep disturbances (American Academy of Pediatrics, 2012; Daniels, 2006; Dietz, 1998; Han et al., 2010; Strong et al., 2005; Whitlock, Williams, Gold, Smith & Shipman, 2005). Also, children that develop type 2 diabetes are more at-risk for health complications when they are adults, such as retinopathy, neuropathy, and cardiovascular and renal disease (Healthy Study Group, 2010). Even prior to the rapid influx of childhood obesity in the United States, Rose (1973) found that children as young as two years of age had coronary heart disease risk factors such as hypertension and elevated serum cholesterol being identified due to obesity. Freedman and colleagues (2007) found in the Bogalusa Heart Study that 70% of children who were obese had exhibited at least one cardiovascular disease risk factor and approximately 39% had two or more. Additionally, psychological and social concerns may coincide with pediatric overweight, such as bullying, teasing, negative stereotypes, and discrimination (American Academy of Pediatrics, 2012; Trust for America's Health, 2012). Other areas, such as economics, play a concerning role in this obesity epidemic.

Economically speaking, obesity is an expensive, preventable disease that could be remedied by lifestyle modifications. Currently, obesity-related illnesses cost an estimated $147 billion dollars each year in the United States (Cawley & Meyerhoefer, 2012). Childhood obesity alone has reached $14.1 billion dollars in direct costs (Trasande & Chatterjee, 2009). If you are obese, you are more likely to spend 42% more on health care compared to a normal-weight individual (Cawley & Meyerhoefer, 2012). Money is also lost in America due to obesity-related illnesses causing absences at work, this is guesstimated to be near $4.3 billion dollars (Cawley, Rizzo, & Haas, 2007). Also, United States military officials have also cited that the influx in childhood obesity will proportionately affect the applicable pool of those able to serve in the military in a few years due to obesity-related illnesses tracked into adulthood (Glickman, Parker, Sim, Cook, & Miller, 2012). This provides clear evidence that steps need to be taken to curb this issue and work towards treatment, or more importantly, prevention of this epidemic.

For modifiable behaviors it appears early intervention may be an effective way of preventing obesity. The CDC (2001) stated that preschool-age children are more likely than older children to modify lifestyle behaviors; with early intervention deterring accelerated weight gain in this young population (Klesges et al., 1994). Early adoption of healthy behaviors has also shown to carry out throughout the lifespan from childhood to adulthood (Janz et al., 2002; Kemper, Post, Twisk, & van Mechelen, 1999; Pate et al., 1996; Telama, Yang, Laakso, & Viikari, 1997). Indicating that early intervention is an effective prevention strategy. Early prevention and intervention programs have found some success, exemplifying that efforts can provide hope for communities attempting to change. For example, in the state of Mississippi, 43% of elementary schools students in 2005 were found to be obese; these rates have dropped to 37.3% in 2011 after implementation of specific policies to address modifiable risk factors for obesity (Center for Mississippi Health Policy, 2012). Similar programs have shown decreases in childhood obesity in California by 1.1% (Babey, Wolstein, Diamant, Bloom, & Goldstein, 2011) and New York City by 5.5% (Benson, Larkin, & Saha, 2011).

Physical Activity

Physical activity is defined as any form of muscular activity; this may include activities of daily living or planned movements. Participation in regular physical activity has positive health benefits including improved bone and joint health, increased muscular strength and endurance, and reduced risk of developing chronic diseases. Additionally, positive psychological health outcomes include improved self-esteem and confidence, and reduced stress and anxiety (Daniels, 2006; Physical Activity Guidelines Advisory

Committee, 2008; Strong et al., 2005). Children that are physically active may be less likely to develop chronic disease risk factors comparative to inactive youth (Strong et al., 2005).

Obesity stems from a variety of sources where biological, genetic, social, and environmental influences all contribute to the overall problem, but physical activity is a modifiable risk factor that comes with a large number of positive outcomes. Although the exact etiology of the increase in obesity has not been established, physical inactivity in children has been implicated (Hedley et al., 2004). High amounts of inactivity have been associated with an increased risk of being overweight or obese (Dietz, 1997; Janz et al., 2002; Reilly, 2008; Trost et al., 2003), while increased physical activity is associated with a reduced risk of being overweight or obese (CDC, 2006; Reilly et al., 2003). Evidence shows that greater participation in physical activity is associated with a healthy body weight in preschoolers (Trost et al., 2003). Conversely stated, Bayer and colleagues (2008) found that preschool children who are the most physically active are less likely to be overweight or obese.

Children who are overweight or obese are less likely to voluntarily participate in physical activities and gain these benefits. Fit Kids Australia (2010) describes this "inactivity cycle" as a dangerous association between children who are overweight being less likely to participate in physical activities. It is described as a child attempting an activity, not being successful at that activity (e.g. low FMS competence necessary to complete the activity) and therefore in the future avoid participation due to lack of success and thereby creating inactive opportunities more enjoyable (Fit Kids Australia, 2010). This may translate into tracking studies that indicate activity levels remain consistent from childhood to adulthood (Kelder et al., 1994; Pate et al., 1996). Although this is not always the case, the increase in obesity levels among children points to inactivity as a major component of the problem. Longitudinal data suggest that physical activity levels decline between the ages of 3 and 5 years (Taylor et al., 2009). Additionally, physical activity levels established during the preschool years are similar to physical activity levels during the childhood years (Pate et al., 1996). These behaviors have been found to remain relatively consistent through adolescence (Malina, 1996) and into adulthood (Kelder et al., 1994; Pate et al., 1996). Therefore, starting healthy habits at a young age may set a solid foundation for a healthy and active life.

In the United States, the NASPE (2009) Active Start guidelines (2nd edition) recommend 60 minutes of structured (planned) activity and an additional 60 minutes of unstructured (free play) activity for preschoolers. Also, 60 of these minutes should be of MVPA intensity and include bone strengthening and motor skill development opportunities. This is perceived as conservative compared to countries such as the United Kingdom, Australia, and Canada, who have recently increased the amount of activity they prescribe for preschoolers to 180 minutes of daily activity, regardless of the intensity level (Department of Health and Ageing, 2010; Start Active, Stay Active, 2011; Tremblay et al., 2012).

Despite the numerous documented benefits of regular physical activity, a majority of children do not meet national recommendations (CDC, 2003). A review on physical activity participation concluded that only 23% of preschoolers, between the ages of 2 – 5 years, engage in the recommended 120 minutes of daily physical activity (Tucker, 2008). Another study found with the use of accelerometers that 7% of children reached the

MVPA standard on weekdays and 8% on weekend days, but 27% achieved the 120 minutes standard of light to vigorous activity (Cardon & de Bourdeaudhuij, 2008).

There is a common misconception that children in this age group are highly active and constantly moving (Tucker, 2008). This misconception of activity may be one reason why caregivers do not place increasing activity as a priority. Movement descriptions for preschoolers often cite short bursts of omnidirectional movements that sporadically occur and are characterized by frequent bouts and transitions from high to low intensity (Bailey et al., 1995). Research has indicated that this age group elicits high amounts of sedentary behavior and low amounts of MVPA.

In terms of MVPA, research has indicated that preschool children spend a small amount of their time engaging in this intensity of physical activity. Pate and colleagues (2008) found that preschool children engaged in MVPA 3.3% of their time in a preschool setting. Another study found that children only engaged in MVPA 5% of monitored time (Cardon & de Bourdeaudhuij, 2008). Reilly et al. (2004) reported that 3 year olds only engaged in 2% of MVPA, while 5 year olds engaged in 4% over the time observed. Gilliam and colleagues (1981) found that activity during the day was only high enough for cardiovascular benefit 2% of the time; 80% of the time was spent in light activity. Others have found similar numbers, Kelly and colleagues (2005) reported 3% of the time was spent in MVPA for 4 and 5 year olds, but they were using 1-minute epoch lengths with accelerometers. One-minute epoch lengths have thought to be too high of a threshold for preschoolers since their activity is so short and sporadic. Studies have also shown that preschoolers’ not only have low levels of physical activity, but also specifically exhibit low levels of vigorous physical activity (Shen et al., 2012).

Conversely, while preschoolers typically engage in low amounts of MVPA they typically acquire high amounts of sedentary behaviors. The NASPE (2009) guidelines indicate that preschooler's should not be sedentary for more than one hour at a time (except while sleeping). Obviously, the more amount of time spent in sedentary pursuits draws away availability for physical activity participation. In a study of over 400 children in 24 preschools, results indicated that over 80% of the day is spent in sedentary activity (Pate et al., 2008). Another study by Cardon & de Bourdeaudhuij (2008) found that preschoolers spent 85% of their time during the school day in sedentary activities measured by accelerometers. Others have found similar results reporting high levels of sedentary behavior in preschool settings and additionally low levels of MVPA (Fisher et al., 2005; Reilly et al., 2004). This is supported by earlier reports from this age group, which indicate that children in day care settings do not engage in the recommended amounts of activity (Seefeldt, 1980).

One study examined outdoor playtime (i.e. recess) and indicated that 89% of the time was spent in sedentary pursuits, a time period where educators and teachers expect children to acquire physical activity during the day and only 3% was spent in MVPA (Brown et al., 2009). Low intensity of physical activity is not a characteristic solely exemplified in preschoolers, Bailey and colleagues (1995) found similar results in 8 year olds using direct observation. They found students engaged in an average of 22 minutes of vigorous activity in twelve hours, 95% of this activity was in bouts less than 15-seconds (Bailey et al., 1995).

With the increase in children's time spent watching television and playing computer and video games, the rise of obesity is not farfetched. The CDC (2003) reported that 22.6% of children in the United States do not engage in physical activity at all in their leisure time. One study found that less than 1% of preschoolers' were meeting Australia's physical activity guidelines but were engaging in excessive amounts of screen-time activity (approximately 113 minutes daily; Hinkley, Salmon, Okely, Crawford, & Hesketh, 2012). Burdette & Whitaker (2005) found that American preschool children watch an average of 190 and 191 minutes of television on week days and weekends, respectively. Another study out of Australia found a positive correlation with the amount of time spent watching television, calories consumed during viewing and weight status in preschoolers (Cox et al., 2012). Similar results were found in the United States over a three-year period, finding a positive correlation between TV viewing and BMI and a negative correlation between physical activity behaviors and BMI in preschoolers (Jago, Baranowski, Baranowski, Thompson, & Greaves, 2005). Parental constraints primarily from work obligations, safety concerns, amount of time spent in daycare and fewer siblings for children to play with have also been cited as additional reasons for the decrease in activity (Boreham & Riddoch, 2001; Davies, Gregory, & White, 1995; Poest, Williams, Witt, & Atwood, 1989; Salbe, Fontvieille, Harper, & Ravussin, 1997). With physical activity interventions, a concern may be compensation of physical activity behaviors.

One concern that researchers may have with the issue of inactivity in overweight children is the concept known as compensation. Originally found in psychological literature, the term compensation indicates that the certain behaviors may be transferred to another behavior (Barnett & Ceci, 2002). This has been adapted in health literature to discuss the phenomenon of the transference of a healthy behavior to an unhealthy substitute to understand failures in behavior change modifications (Väth et al., 2012). For example, when physical activity participation was increased, so did the intake of dietary fat (Dutton et al., 2008). This could essentially negate efforts to increase physical activity levels. Contradictory findings were reported by Dale et al. (2000) involving children's physical activity behavior, they found children are more sedentary throughout the entire day if physical activity opportunities are diminished at school, and total day activity is increased on days opportunities are present. This may indicate that implementing physical activity into the school and/or classroom may increase activity later on in the day, and deter the potential effect of compensation.

Determinants of physical activity

Several determinants have been noted to describe the variations in preschooler's physical activity levels. Research has shown that there are a variety of influences that may contribute to a preschooler's physical activity or inactivity levels. These include the child care center attended, day of the week, gender, age, or time of the year.

Research has shown that a large source of variability in physical activity levels is dependent on the preschool center (Finn et al., 2002; Pate et al., 2004). Finn et al. (2002) reported that 46% of variability in a child's physical activity patterns might be indicative of the preschool center they attend.

It has been suggested that simply being outdoors in a space available for activity may elicit physical activity in preschoolers (Boldemann et al., 2006). Numerous studies found that physical activity among preschoolers is correlated with outdoor playtime (Baranowski, Thompson, DuRant, Baranowski, & Puhl, 1993; Burdette, Whitaker, &

Daniels, 2004; Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008; McKenzie, Sallis, Nader, Broyles, & Nelson, 1992; Tucker, 2008). Some research contraindicates this statement stating that even a suitable environment may not be enough to elicit activity in this group (Kelly, Reilly, Grant, & Paton, 2005). McKenzie et al. (1997) found that preschool-age children are more sedentary during recess (i.e. outdoor play time).

Evidence has found that weekdays had significantly greater activity than on weekends (Benham-Deal, 2005; Cardon & de Bourdeaudhuij, 2008). Jackson et al. (2003) found no differences between the two; however, they noted that children also spent a larger amount of time in sedentary activity on weekdays as well. Burdette & Whitaker (2005) reported activity on weekdays averaged 156 minutes of playtime and 226 minutes on the weekends.

Seasonality has also been a question for source of activity, to see if certain times of the year may elicit more activity than others. Fisher et al. (2005) found that preschoolers had slightly more activity in the summer (826 cpm) versus the springtime (701 cpm) in 209 students over 3-6 days. This may indicate that the seasonality plays a limited role in physical activity behavior.

Another potential influence for preschoolers' physical activity is gender. The current opinion is that boys are more active than girls (Baranowski et al., 1993; Cardon & de Bourdeaudhuij, 2008; Durant et al., 1993; Finn et al., 2002; Hinkley et al., 2008). A group of 60 preschoolers in Scotland were found to have an average of 777 counts per minute (cpm) in boys and 657 cpm in girls, averaged over two weekdays and one weekend day in 3- and 4- year olds (Jackson et al., 2003). Similar results were found with

Kelly et al. (2005) where boys reported a slightly higher average counts at 834 cpm, while girls had 628 cpm. Although, Cardon & de Bourdeaudhuij (2008) found no differences in counts per minute between boys and girls, they did found a higher amount of moderate activity in boys.

Lastly, other items that may potentially influence activity may be that active parents tend to have more active children (Hinkley et al., 2008) and preschool teachers with a college degree generally spend more time and effort involved in the promotion of healthy activities in the classroom (Poest et al., 1989). One study examined the differences in ages and found that 3 year olds had an average of 692 cpm of activity (n = 78), while 5 year olds reported an average of 818 cpm (n = 72; Reilly et al., 2004).

Physical activity assessment

There are several methods available to determine preschoolers' physical activity levels. These may be divided into objective and subjective categories. Traditional objective measures for this population may include pedometers, accelerometers, or heart rate monitors. Direct observation and questionnaires/diaries are subjective measurements currently used in this population.

Direct observation is a very useful tool that is comprehensive and practical. Short time intervals have been suggested for evaluation of this population (Bailey et al., 1995; Fox & Riddoch, 2000; Oliver, Schofield, & Kolt, 2007; Sirard & Pate, 2001). There are various measurement tools that could be used to assess physical activity behaviors via direct observations such as: System for Observing Fitness Instruction Time (SOFIT; McKenzie, 2009), Observation System for Recording Activity in Preschoolers (OSRAP;

a modification of the Children's Activity Recording Scales), CARS, (Puhl, Greaves, Hoyt, & Baranowski, 1990) and Behaviors of Eating and Activity for Children's Health: Evaluation System (BEACHES; McKenzie et al., 1991).

Strengths of direct observation are the amount and quality of information that can be gathered in a short time period (e.g. environment, interactions, and location). Additionally, limited equipment is needed for this data collection process, recall or opinions from teachers/parents are not necessary, and it is a relatively unobtrusive process. Bailey et al. (1995) noted direct observation was advantageous particularly when it comes to observing activity in a social context. Although strict researcher training and protocols may elicit some to believe direct observation is more of an objective measurement, human observation, interpretation of behavior, and recording inherently make this a subjective technique. Other disadvantages include researcher training can be time consuming, extended periods of observation are not practical, and time sampling procedures may miss behaviors due to the non-continuous nature of observations (Oliver et al., 2007). Also, psychological paradigms like the Hawthorne effect may be an issue with researchers observing participant's behavior on-site.

The other subjective technique is recall or questionnaires that would primarily be completed by proxy report by teachers or parents in this population. Recall is certainly a subjective method that is highly influenced by perception of activity. Additionally, there is no standardized questionnaire to measure physical activity in this population (Oliver et al., 2007). Questionnaires are inexpensive, non-invasive and have shown to provide some valid information when paired with an objective measurement tool to indicate context and better explain activity.

Objective measurements are free from experimenter bias, elicit lower levels of participant and researcher burden, and they have the ability of quantifying activity over longer periods of time (Oliver et al., 2007). Popular objective methods for this population are pedometers and accelerometers, heart rate monitors tend to record lots of variability in this young age group that may not be physical activity, including crying, tantrums, or anxiety, and are less often used.

Pedometers are popular in physical activity data collection, as they are affordable, objective measurements that are non-intrusive and easy to understand. They are mechanical or electric sensors that count accumulated steps over time. However, the nature of preschool-age children's movements is sporadic and omnidirectional with frequent short bursts of activity. This is often cited as an issue with accurate measurement techniques to assess and describe this group's physical activity behaviors. Additionally, pedometers do not indicate intensity and a monitor that is more sensitive may be more appropriate for this population (i.e. accelerometers).

An accelerometer measures acceleration in all directions via an omnidirectional sensor, detecting activity in one to three planes (depending on the model). Accelerometers are a popular method to assess physical activity in this population as valuable information about amount, duration, and intensity of activity may be detected over long periods of time. The monitors are non-intrusive and may gather information on a large number of students simultaneously. Although accelerometers are expensive and give limited information by themselves without validated cut points, their usage is predominant in the preschool literature. Another disadvantage may be dependent on where the accelerometer is placed (e.g. hip, wrist, ankle) upper-body exercises may be not be evaluated accurately by accelerometers and pedometers, alike.

Accelerometry is validated for use in the preschool population (Pfeiffer et al., 2006). Epoch lengths are recommended to be set at 15-seconds for the preschool population (Cliff, Reilly, & Okely, 2009) to give a more accurate assessment of preschooler's activity, which tends to be sporadic and omnidirectional. Several groups have used accelerometers to examine activity levels in this population. Studies reporting counts per minute (cpm) have been able to differentiate between males' and females' activity, age differences in activity, seasonality effects and weekend or weekday differences, although reporting in this manner does not detect intensity. For example, Kelly and colleagues (2005) examined seven days of activity in 41 preschoolers with the use of an accelerometer in 4- and 5- year old children, finding an average of 725 cpm.

These studies reporting mean total activity counts give little information of the physiological meaning. Therefore, cut points for the accelerometer data has been set into place to differentiate between intensities based on comparisons from direct observation. Epoch, or time cutoffs of when to record data, has been a point of contention when dealing with this young of a population due to the sporadic nature of their movements. The commonly used epoch of one minute in older populations appears to not be sensitive enough to record data for this young group. Therefore, shorter epochs (i.e. 15 seconds) have been used in order to detect more minor changes and accurately describe short bursts of activity (Nilsson, Ekelund, Yngve, & Sjöström, 2002; Trost, McIver, & Pate, 2005). Pfeiffer and colleagues (2006) set cut points specific for the use of 15 second epoch lengths in preschoolers where 715 counts/15 seconds indicates moderate and 1411 counts/15 seconds for vigorous physical activity for the Actical monitor. Pfeiffer and colleagues (2006) determined these count points by using the formula, VO_2 = counts x 15 s^{-1}(0.01437) + 9.73, and using field measures to determine age appropriate activity levels. Using age validated cut points allows researchers to describe the actual behavior and indicate intensity level of activity.

Physical activity and Fundamental Motor Skills

Fundamental motor skills are basic movement skills that are believed to be "building blocks" for more advanced movements (Clark & Metcalfe, 2002; NASPE, 2009; Robinson & Goodway, 2009; Seefeldt, 1980). The development of FMS is achieved in early childhood (Clark, 2007; Clark & Metcalfe, 2002). These skills contribute to a child's ability to function independently in their surrounding environment and contribute to their cognitive, motor, social and physical growth and it is considered a prerequisite to daily living and participating in later physical and sport-specific activities (Clark, 1994; Clark, 2007; Clark & Metcalfe, 2002; Cools, Martelaer, Samaey & Andries, 2008). Research has shown that mastering FMS is correlated with higher levels of physical activity in school-aged (Okely & Booth, 2000; Wrotniak, Epstein, Dorn, Jones, & Kondilis, 2006) and preschool-age (Robinson et al., 2012) children. Low motor skill competence is associated with a higher BMI in preschool children (Logan, Scrabis-Fletcher, Modlesky, & Getchell, 2013). Barnett and colleagues (2008) reported similar findings that found in an eight-year follow-up childhood object control skills could significantly predict adolescent fitness levels ($P = .0012$), as well as, have a higher likelihood of participating in vigorous activity (Barnett, van Beurden, Morgan, Brooks, & Beard, 2009). Low motor competence appears to have implications for future activity. Hands (2008) found that after five years children with low motor competence performed worse on fitness and motor skill activities than children with high motor competence. Recent research has also indicated that interventions that target specific FMS (i.e. locomotor skills) may significantly decrease the amount of sedentary behavior that preschoolers' participate in daily (Alhassan et al., 2012).

Inadequate development of these FMS early in life may negatively influence physical activity later in life (Gilliam, Freedson, Geene, & Shahraray, 1981; Goodway, Crowe & Ward, 2003; Seefeldt, 1980). This is particularly relevant due to the findings that motor skill competency levels appear to be consistent throughout childhood (Branta, Haubenstricker, & Seefeldt, 1984). FMS appear to have a large impact on physical activity participation and fitness levels.

Competence in motor skills is defined as proficient functioning in these FMS, and is associated with children's activity levels being dependent on their competency as they age (Stodden et al, 2008). If competency in FMS were not achieved, children would not be able to break through what Seefeldt (1980) describes as a "proficiency barrier" and would therefore be unable to participate in games and sports that are related to FMS. FMS (i.e. gross motor skills) require the activation of large muscle groups and are typically classified as object control and locomotor skills (Haywood & Getchell, 2009). Object control skills involve the transporting, intercepting, or projecting objects such as throwing, catching, and striking. Locomotor skills include running, jumping, and hopping as different movements to transport the body from one location to another (Ulrich, 2000).

The importance of developing these skills is reflected in the NASPE (2009) Active Start guidelines (2nd edition), which promote children to have a solid base that improves the acquisition of FMS and increases a child's capability to engage in appropriate movement patterns. The preschool years are a critical time for FMS development. Research indicates an association between level of motor skill competence and engagement in MVPA in preschool children (Cliff, Okely, et al., 2009; Robinson and Goodway, 2009; Robinson et al., 2012; Sääkslahti et al., 1999; Williams et al., 2008). Preschool children that demonstrate higher motor skill competence are the most physically active compared to their less skilled peers (Fisher et al., 2005; Graf et al., 2004; Robinson et al., 2012). Overweight and obesity may significantly impair certain motor skills in preschool children (e.g. jumping), by being unable to navigate their increased body weight potentially leading to detriments down the road (Castlebon & Andreyeva, 2012). This relationship has been speculated to be stronger in overweight or obese preschool boys (Cawley & Spiess, 2008). Conversely, locomotor skills are positively correlated with physical activity in preschoolers (Hardy, King, Farrell, Macniven & Howlett, 2010). Findings from these studies highlight the importance of identifying methods for children to be more physically active throughout the school day. Inactivity may be associated with children who exhibit motor delays. One-way to detect these motor delays are by assessments developed specifically to examine competency levels in children.

Physical activity and Cognition

Recent research has examined the physiological and learning responses of physical activity. Hillman and colleagues (2005) found that regular participation in physical activity is linked to improved cognition and brain function. In addition, Ratey & Hagerman (2008) describe other physiological outcomes that may improve cognition such as strengthening long-term potentiation, increased amounts of brain-derived neurotrophic factors (BDNF) that bolster synaptic plasticity, and an increase in neurotransmitters such as epinephrine, norepinephrine and serotonin. Other physiological factors include increased blood flow and oxygen to the brain and improved executive function. These benefits that manifest physiologically, may directly benefit academic outcomes.

Physical activity and fitness have been associated with a lot of positive relationships in the cognitive domain including enhanced learning outcomes such as standardized and subject test scores, increased concentration and attention, less fidgeting, overall better classroom behavior and time on-task. A positive association between physical activity and cognitive functioning in children has been found in several studies (Coe, Pivarnik, Womack, Reeves, & Malina, 2006; Shephard, 1997), systematic reviews (CDC, 2010; Singh, Uijtdewilligen, Twisk, van Mechelen, & Chinapaw, 2012), and meta-analyses (Erwin, Fedewa, Beighle, & Ahn, 2012; Sibley & Etnier, 2003). The CDC (2010) found that 50.5% of studies had positive associations between academics and school-based physical activity, while less than 1.5% had a negative association (the rest were found to be non-significant). This is a good indication that not only can schools increase amounts of physical activity, but also positive, or at the least non-detrimental, effects to academics.

Physical fitness has been found to be positively related to academic achievement (Castelli, Hillman, Buck, & Erwin, 2008; Chomitz et al., 2009; California Department of Education, 2001) with results indicating that children who were the most fit are more likely to perform better on standardized tests. Jarrett and colleagues (1998) observed classroom behavior and discovered that children who have prolonged periods of academic instruction often exhibit an increase in fidgety behaviors by 6% and tend to become more off-task by at least 4%. Thus, long periods of instructional time without a break may be counterproductive to academic behaviors (Jarrett et al., 1998; Pellegrini & Davis, 1993). Mahar et al. (2006) found that the introduction of a 10-minute classroom physical activity break improved time on-task immediately by 8%. Lastly, a study with 8 and 9 year old children found that with any amount of recess (above 15 minutes), classroom teachers' reported overall better behavior in the classroom compared to no recess conditions (Barros, Silver, & Stein, 2009). With the increased amount of literature on the positive influence of physical activity and academic achievement it is surprising to see that opportunities for activity are still declining in schools.

Despite the connections between physical activity and cognition, in the United States physical activity opportunities and participation in the school systems have declined drastically. Schools cite that increased pressure to improve standardized testing scores, along with budgetary constraints have been the primary reasons why physical activity is suffering at these venues (Trost, 2007). Additionally, federal legislation such as "No Child Left Behind" did not specify when outlining curriculum standards the inclusion of physical education. Therefore, physical education time or programs are being cut. It has been reported that less than five percent of elementary schools provide daily physical education in the United States (3.8%; Trost, 2007). Theoretically, this is supposed to improve academics by increasing the time spent in the classroom. This has been contraindicated by research like the Coe and colleagues (2006) study which showed that students who had almost an hour of physical education a day had similar grades and test scores than students that did not have any. Other research has shown there is a positive relationship for students who are more physically fit and having higher standardized test scores. This was also shown by the California Department of Education (2001) who found that 9th grade students who had higher fitness assessment scores also had higher SAT scores. Absenteeism from school has also been significantly linked with childhood overweight and obesity, despite being adjusted for age, ethnicity and gender, indicating that obesity may be contributing to student's not even being exposed to certain academic lessons (Geier et al., 2007).

Siedentop (2009) argues that although it is not the school's sole responsibility to reverse the obesity epidemic that is unlikely for this trend to change without their assistance in programs and policies. Preschool centers are an ideal venue for implementation of healthy behaviors because they serve nearly 56% of preschool age children (between the ages of 3-5) in the United States (Federal Interagency Forum on Child and Family Statistics, 2001) and already have the access, personnel, equipment and space to implement physical activity. Eighty-percent of children who have working mothers attend preschools for approximately 40 hours per week (ECPP-NHES, 2006). Since preschoolers' spend a large amount of time in school (Dowda et al., 2004; Pate et al., 1996), it is apparent that schools or centers are an excellent venue to incorporate more physical activity. Additionally, research has indicated that interventions conducted by teachers are more likely to induce change in MVPA behaviors when compared to parents in the home environment (Tucker, in press). Schools could potentially influence the physical activity behaviors of their students through various opportunities (e.g., physical education programs, recess periods, physical education/school policies; van Landeghem, 2003). A meta-analysis examining the preschool population found that in general, physical activity interventions are a feasible option to increase moderate levels of MVPA in this age group (Tucker, in press). Mahar (2011) states that children's physical activity levels are directly related to the opportunities they have to be active. Schools have ample opportunity and a captive audience to address this need. Also, current health organizations are indicating that schools and early learning centers should be given more attention and support to curb this obesity epidemic (Glickman et al., 2012). Implementation of more active opportunities will be vital, but research has indicated the need for more structured activities in this young population. A study conducted by Alhassan and colleagues (2007) found that by increasing the amount of time available for recess daily (i.e. an hour more of recess play) resulted in no increase in physical activity for preschoolers, indicating that structured programs may be necessary to evoke changes in physical activity.

Classroom-based physical activity breaks

A recent strategy to increase daily physical activity participation is the implementation of structured, classroom-based physical activity breaks. A typical break consists of ten to fifteen minutes of activities designed to promote MVPA. Breaks have also been incorporated into curriculum content to reinforce teaching concepts such as science and math. Incorporating physical activity into the classroom is effective in significantly increasing physical activity levels of school-age children (Ernst & Pangrazi, 1999; Mahar et al., 2006; Scruggs et al., 2003). Additionally, sustained breaks have also been shown to decrease BMI in students over a period of two years (Donnelly et al., 2009).

A specific program designed to increase physical activity in the classroom is the Take 10! program that integrates physical activity into elementary school curriculum. Kibbe et al. (2011) provides consistent evidence that the Take 10! program is effective in increasing physical activity levels in children enrolled in kindergarten through fifth grade in a variety of samples in different countries. The implementation of short physical activity breaks has been associated with increases in academic areas, for example reading and math test scores (Erwin, Fedewa, & Ahn, 2012). One study found that by including language skills into physical activities in a preschool population, these language skills improved along with improving motor skill development (Connor-Kuntz & Dummer, 1996). Mahar and colleagues (2006) found that with the implementation of ten-minute physical activity breaks, "Energizers", students increased their time on-task while averaging approximately 782 more steps in a day ($p <. 05$). Another program, Texas I-CAN!, helped teachers incorporate physical activity into the school day by modifying curriculum items in a teacher's lesson plans to more active activities, which increased MVPA by 1000 steps per day (Bartholomew & Jowers, 2011). This project also found these curriculum-based activities improved time on-task immediately following activity breaks, especially in children that were overweight; these students went from being on-task 58% of the time for typical instruction days, to being on task 93% of the time after movement breaks (Grieco et al., 2009). These findings emphasize the effectiveness and feasibility of providing classroom-based, structured opportunities for physical activity. Breaks in the classroom provide an additional opportunity for physical activity throughout the school day with minimal planning, no equipment, short amount of time required and potential to integrate learning opportunities for students.

For classroom-based physical activity participation to become a priority of early childhood curriculum, it is also important to provide research-based evidence that physical activity breaks do not negatively dissuade from academic behaviors. Although the importance of physical activity for overall health is well known, the positive impacts of physical activity on increasing concentration, mental cognition, and academic performance, as well as on reducing self-stimulatory behaviors (e.g. fidgeting) and school-related stress are not as well understood. The CDC (2010) reviewed studies that examined the association between classroom-based physical activity and academic performance in elementary school-age children. Results indicated that eight of nine published studies found positive effects of physical activity on outcomes such as academic achievement and classroom behavior. The one study that found no relationship found that the implementation of activity breaks did not dissuade from academic performance and increased daily activity levels (Ahamed et al., 2007). An additional review by Donnelly & Lambourne (2011) provides further support of the link between physical activity and positive cognitive and academic outcomes in elementary school-age children.

One behavioral outcome that has received empirical attention is the effect of physical activity on attention (i.e. on-task behavior) in the classroom. Studies in elementary school-age children have found an increase in on-task behavior in the classroom after participation in a physical activity break (Jarrett et al., 1998; Mahar et al., 2006; Mahar, 2011). For example, Mahar and colleagues (2006) found that time on-task increased by 8% ($p < .017$) with the implementation of a ten-minute break. They also found that the 20% of students who were off-task the most, benefitted the most from the activity breaks for improvements on time on-task (Mahar et al., 2006). On-task behavior is defined as verbal or motor behavior that follows class rules and is appropriate to the learning situation. It is classified as an academic behavior, which includes a range of behaviors that may have an impact on students' performance. Common examples include: on-task behavior, organization, planning, attendance, scheduling, and impulse control Similar results were found in Georgia where fourth graders exhibited significantly less fidgeting behaviors and significantly more on-task behaviors on days where activity breaks were conducted (Jarrett et al., 1998). Pellegrini & Davis (1993) found similar results and added that reduced concentration was also a result of prolonged instructional time without a break. An additional meta-analysis by Erwin, Fedewa, Beighle, & Ahn (2012) provides further research on classroom-based breaks with physical activity, health outcomes and learning outcomes and found that breaks do increase the frequency of physical activity behaviors and had positive learning outcomes. However, the effect and benefits of classroom based physical breaks in preschool populations have not been thoroughly investigated.

Pilot Data

In order to investigate some of these key questions discovered in the literature review, pilot data was gathered to assess the effects of researcher implemented activity breaks on MVPA levels and time on-task in preschoolers. Motor skill competence was also evaluated to determine whether or not activity breaks might influence children equally among various levels of motor skill competency. Two small preschool classes were used, one was a federally funded program for low-income families (*n* = 9) and the other was a university-based preschool center (*n* = 12). Four days were observed in each classroom, breaks were implemented on two days and typical instruction was carried out on two days. Over this time period, we observed physical activity participation with accelerometers and coded for on-task behavior before and after the activity break time or the control condition of normal class time.

A trained researcher who was an expert in pediatric motor development and had experience in implementing movement programs conducted activity breaks. Results found there was a 69% and 90% increase of daily MVPA participation from the activity breaks at each center, respectively (Logan et al., in review; Wadsworth et al., 2012). While examining on-task behaviors, results were combined from the two centers in order to test for significance. Children were found to be on-task 62.3% (*SD* = 7.8) of the time after the control condition (no activity break) and were on-task 77.7% (*SD* = 5.03) after the activity break condition, tests indicated that this was not significant (Logan et al., in review). Although it appears there is an improvement in the time on-task following the activity break versus control condition, perhaps the sample size was too small to indicate significance at this time. Lastly, in evaluating whether activity breaks were able to influence MVPA levels across various levels of motor skill competence, this pilot program found there to be no significance between competency and MVPA (Logan et al., in review). This is a positive finding considering children with lower levels of motor skill competency may be less likely to engage in physical activity, insinuating that activity breaks may be an effective method for increasing physical activity participation equally.

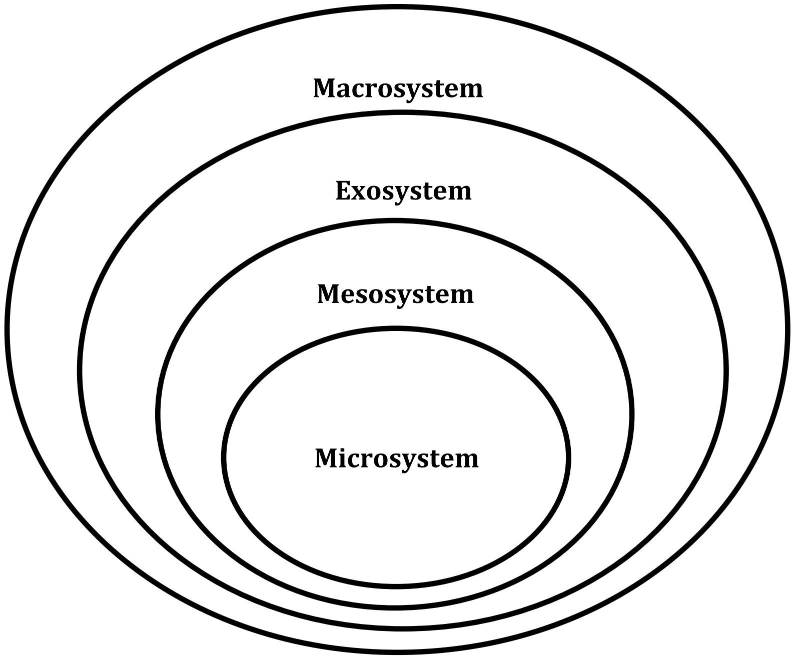
There were several strengths to this pilot work, including finding significance in improving MVPA in this age group with such a small sample. Additionally, positive results were found for time on-task, although significance was not reached. The use of two diverse preschool centers and populations was another strength. The subsidized preschool had primarily African American students from a low-socioeconomic status, while the university center was comprised of primarily White or Asian-decent students from middle to high socioeconomic status; showing the potential to deliver the breaks in multiple types of preschool centers. A limitation for this project was the use of a researcher to implement activity breaks. The use of a researcher to implement breaks was imperative for this pilot work to discover if activity breaks were effective in the preschool population, however, it is hard to determine if this is a feasible program to promote due to the inaccessibility of a researcher conducting programs at every preschool.

Therefore, future research needs to investigate the use of teachers implementing this type of program. An increased sample size would be beneficial in determining a true effect to the research questions at hand. Other research may be imperative to examine physical activity patterns in this age group, particularly in regards to incorporating more activity into the school day. Also, determining whether activity breaks may be an effective method of increasing activity in students who are traditionally not as active in this population, such as students with low levels of motor skill competency or higher weight classification statuses.

Theoretical Approach

The theoretical framework that was used for this dissertation is the Socio-ecological Model, sometimes referred to as the Social Ecological Model, which aims to better understand the complex interconnections of behavioral changes within an individual and their surroundings. This model suggests that multiple levels of interactions and contexts create a larger picture for behavior and that interventions are most effective in implementing change when targeting several levels of influence. The various levels that could influence behavior include: the microsystem, mesosystem, exosystem, and macrosystem. The microsystem consists of individual factors relevant to the specific person. Mesosystem is the interpersonal environment that includes relationships with the individual. The exosystem is comprised of the physical and built environment around the individual. Lastly, the macrosystem is the rules and policies that influence an individual's behavior.

Figure 1: Socio-ecological model depiction derived from Brofenbrenner (1977)



This model was largely adapted from Brofenbrenner's work on the "Ecological Systems Theory" which suggested that each individual is significantly affected by the interactions of a number of overlapping influences (Brofenbrenner 1977, 1979). This was expanded by McLeroy, Bibeau, Steckler, & Glanz (1988) and then tailored to health behaviors by Stokols (2001, 2003). The latest version provides assumptions that could assist in the implementation of this theory into a behavioral intervention context. These assumptions or core principles include: multiple factors influence behavior, environments are multidimensional, interactions could be described at varying levels of organization, and there is a dynamic and reciprocal relationship between an individual and the environment.

This study examined the relationship between the individual factors of the preschoolers (microsystem), including in-school physical activity behaviors and time on-task. The mesosystem was targeted through classroom-based activity breaks conducted by the classroom teachers. Additionally, potential policy changes were examined by the requirement of activity breaks to be conducted on specific testing days to determine if they are a feasible option for increasing activity. Hopefully, the implementation of these activity breaks will work to influence various levels of behavior surrounding this preschool population in order to successfully incorporate more physical activity regardless of certain components that have been shown to deter activity.

One potential result of this study was to examine the feasibility of this type of intervention to be integrated in a national preschool center being carried out by teachers to examine the effectiveness of increasing physical activity and improving academic behaviors. One area to focus on in promoting policy change is providing evidence about the effectiveness of a program. Thereby decreasing uncertainty in the probable effects of adopting particular programs. Additionally, since a large amount of variability may be present differing by individual teachers and classrooms, the goal of this project is to target a wide spectrum of variation and still provide positive results to help create a well-rounded program.

Chapter III

Methods

The purpose of this intervention was to examine the acute effects of teacher-implemented classroom based physical activity breaks on physical activity participation and academic time on-task for a preschool-age population. Motor skill competency and weight classification status were also examined to determine if classroom-based physical activity breaks could equally influence MVPA participation. This chapter presents the methodology for the study including an overview of research design, participant recruitment and inclusion criteria, instrumentation for data collection, research procedures, and data analysis.

Participants and setting

This program was implemented in one large Head Start preschool center in a rural area in the southeastern region of the United States. The Head Start Program is a federally funded early childhood development center aimed to assist lower-income families. This particular center conducts a curriculum-based program in the morning and then students depart for childcare or day care services in the afternoon. Prior to data collection Institutional Review Board approval from Auburn University (10-217 MR 1009) as well as, parental consent and child assent was obtained (Appendix B). Only students whose parents/guardians signed a consent form were included in the research component of this project. However, all students in each classroom received the activity breaks. All teachers agreed to participate in this research study.

The center serves approximately 196 preschool students, between 11 classrooms for this age group. All 11 classrooms participated in this study. From this particular center, 139 preschool students consented to participate in this study (70.92% consent rate). A total of 118 preschoolers completed all assessments and were included in the analysis for this research project (*M* age = 3.7966 ± 0.69 years). Examining the demographics of those who participated in this study, 46.6% of students were male and the racial makeup consisted of: 83.1% African American, 8.5% Caucasian, 5.1% Hispanic, and 3.4% from mixed racial background.

Instrumentation

Demographic and Anthropometric

Descriptive and anthropometric measures were assessed. Race, birthdate and sex were collected from the parents and school. Height and weight were measured on site. Height and weight was measured without shoes, coats, and other heavy outerwear. Height was measured to the nearest 0.1 centimeter using Digital Medical Scales (Seca Floor Scale 769, SECA Corporation Hanover, MD). Children were instructed to keep their shoulders in a relaxed position, allow their arms to hang freely and their head aligned in the Frankfurt plane. Weight was measured to the nearest 0.1 lb using the same scale, with the same protocol of arms hanging freely from the child's side and shoulders back in a relaxed position.

Physical activity participation

Physical activity was measured with the Actical accelerometer (Mini-Mitter Co., Inc. Bend, OR, USA). The Actical is a small (28x27x10 mm) and light weight (17g) device that measures acceleration in all directions via an omnidirectional sensor and is validated for use in the preschool population (Pfeiffer et al., 2006). Accelerometers were calibrated for each child based on height, weight, sex, and age according to the Actical manual guidelines. Children wore the accelerometers on the right hip (anterior to the iliac crest) and were secured with an elastic belt worn around the waist. The epoch length was set to 15-second intervals, a time that is recommended for use in preschool children (Cliff, Okely, et al., 2009). Specifically, the accelerometers were placed on the student upon arrival to the classroom setting (approximately 8:00 am) and were worn for the duration of the school day until the student departed (approximately 1:00 pm). Arrival and departure times were noted for each student. To be included in data analysis the student needed to have worn the accelerometer for 2/3rd of the school day (approximately 3.3 hours) and be present during the on-task observation period (32-minutes before and after the physical activity break was implemented or during typical instruction time). Cut points were set at 715 counts/15 seconds for moderate and 1411 counts/15 seconds for vigorous physical activity (Pfeiffer, McIver, Dowda, Almeida, & Pate, 2006). Additionally, sedentary behavior was identified as less than 200 counts/15 seconds; this was extrapolated from the formula used by the Pfeiffer et al. (2006) moderate and vigorous cut points. Light behavior was classified as behaviors between sedentary and light (i.e., 201 counts/15 seconds – 714 counts/15 seconds). These age-validated cut points allow researchers to describe the actual behavior and indicate intensity level of activity, especially since preschooler's activity tends to be sporadic and omnidirectional.

On-task behavior

On-task behavior was assessed by direct observation, recorded live by two trained observers using a momentary time sampling protocol originally developed by Shimabukuro, Prater, Jenkins, & Edelen-Smith (1999) and modified by Mahar and colleagues (2006). Each researcher was randomly assigned eight students prior to data collection and was assigned an equal number of males and females, gender was counterbalanced based on the students who consented and were present for each day. Researchers' listened to a pre-recorded audio file that prompted them to systematically observe behavior for a 10-second interval and then record behavior during a 5-second interval using a pre-recorded audio file. This protocol yielded four observations per minute. After each minute, the researcher began observation on the next randomly selected child. This process continued for eight minutes until the researcher coded eight children for one minute each. The observation cycle was repeated for four cycles (32 minutes; see Table 1 for an example of timing for two students during an observation). In total, each child was observed for four minutes prior to the activity break time and four minutes following, so each child was coded for eight minutes each day. This order was the same prior to and following the activity break. The modification from Mahar and colleague's (2006) protocol was to allow each child to be observed for on-task behavior versus using a random selection of children to be representative of the entire class. This enabled an individual analysis of on-task behavior and was compared to accelerometer counts. There were no more than two observers present in one classroom at a time to avoid burdening the classroom teacher.

Table 1: Example of on-task coding timing

Observations	Total Time	Example: Student A coding times	Example: Student B
First set of pre-break observations	10:40 - 10:48 am	10:40-10:41 am	10:41–10:42 am
Second set of pre-break observations	10:48 – 10:56 am	10:48–10:49 am	10:49-10:50 am
Third set of pre-break observations	10:56 – 11:04 am	10:56–10:57 am	10:57-10:58 am
Fourth set of pre-break observations	11:04 – 11:12 am	11:04–11:05 am	11:05-11:06 am
Activity Break	**11:15 – 11: 25 am**		
First set of post-break observations	11:28 – 11:36 am	11:28–11:29 am	11:29-11:30 am
Second set of post-break observations	11:36 – 11:44 am	11:36–11:37 am	11:37-11:38 am
Third set of post-break observations	11:44 – 11:52 am	11:44–11:45 am	11:45-11:46 am
Fourth set of post-break observations	11:52 am – 12:00 pm	11:52–11:53 am	11:53-11:54 am
Total Number of observations for Example Student A & B		8 minutes (32 total observations for each child)	8 minutes (32 total observations for each child)

Observations took place immediately before and following the time allotted for the classroom-based physical activity break. Observations were made regardless if it were an experimental or control day, at the same time of day to control for variations in class scheduling. Children's behavior was recorded on an observation sheet (see Appendix C) as one of the following: on-task, motor off-task, noise off-task, or passive/other off-task. On-task behavior is defined as verbal or motor behavior that follows the class rules and is appropriate to the learning situation. Off-task behavior is any behavior that is not on-task and is coded as motor off-task, noise off-task, or passive/other off-task. The three off-task behaviors are then grouped together for one measure. A definition and example of each on/off-task category may be found in Table 2.

Table 2. On/off-task coding definitions and examples

Code	Definition	Example
On-task	Verbal or motor behavior that follows the class rules AND is appropriate to the learning situation.	Sitting down and actively listening to the teacher read a book during reading time.
Off-task – motor	Motor behavior that does not follow the class rules or is not appropriate to the learning situation.	Walking around the room when the teacher has indicated that students should be sitting
Off-task – noise	Noise behavior that does not follow the class rules or is not appropriate to the learning situation.	Talking or creating noises when the teacher has indicated that students are not supposed to be talking
Off-task – passive/other	Passive or other behavior that does not follow the class rules or is not appropriate to the learning situation.	Being non-responsive when asked to do a task or partaking in an activity that is not what the class is supposed to be doing.

The observers were trained to use this protocol prior to data collection by video review and field practice in the classrooms. Practice with discussion took place so that observers were more acclimated to using the coding system terminology and recording sheet. Expert and trainees watched approximately two hours of classroom video of preschoolers from a previous study who did not attend this same center and coded live, without discussion, and then compared results. Training continued until all observers reached 90% agreement with the expert in this protocol. Field training also took place to ensure that observers were able to sit in a live classroom and code behavior with student and teacher distractions. An expert in the protocol was present to answer any questions prior to data collection. Field training continued until all observers reached 90% agreement with the expert in this protocol.

Motor skill competence

Prior to the start of the study, preschoolers' motor skill competence was assessed using the Test of Gross Motor Development-2nd edition (TGMD-2; Ulrich, 2000). It is a quantitative assessment that qualitatively measures criterion elements of fundamental motor-skill competence in children. The TGMD-2 assesses 12 motor skills separated into two subscales: object control (striking, throwing, catching, kicking, dribbling, and underhand rolling a ball) and locomotor skills (running, galloping, sliding, leaping, hopping, and jumping). A researcher demonstrated the proper execution of the skill and children completed one practice and two formal trials. An expert in this protocol conducted all tests for consistency in carrying out this assessment. All trials of the TGMD-2 were videotaped and coded through video analysis by two coders independently. Intra-rater reliability (>90%) was established between two researchers. Additionally, coders coded 25% of the same tapes to ensure that at least 90% accuracy was being maintained throughout the scoring procedure for this study.

Each skill is evaluated on three to five performance criteria (Appendix D). A score of zero is given for each trial if a criterion was not performed. A score of one is given for each trial if a criterion was performed. Both subscales' raw score can range from 0-48, the higher score indicating a higher competency in motor skills. Each subscale yields a raw score that was converted to a standard score. The standard scores from both subscales were then summed and converted to a percentile score that indicated overall performance on the TGMD-2. The TGMD-2 assessment was used to identify children with reduced capacity for motor skills. Children scoring lower than the 30^{th} percentile on the TGMD-2 are classified with motor delays demonstrating a reduced capacity for executing the FMS. Previous studies have found that approximately 20% of preschool children exhibit motor delays (Individuals with Disabilities Education Improvement Act of 2004, 2004).

Classroom-based physical activity breaks

The physical activity breaks lasted approximately ten minutes and was integrated into the daily schedule in each classroom. The center used three separate schedules for classes; therefore breaks were scheduled to accommodate the Head Start centers' required "plan, do, and recall" block. All breaks centered around the same activities such as read aloud and large group time (detailed schedules can be found in Appendix E). The break included age-appropriate activities and did not require any equipment. The classroom teacher implemented the breaks in their own classroom. The physical activity breaks consisted of a warm-up (1 minute), structured movement activities focused on MVPA and gross motor skills (8 minutes), and cool-down activity (1 minute). Typical coding schedule may be seen in Table 3. The structured movement activities were four activities that were carried out for 30 seconds each, and rotated through four times to equal eight minutes of activity. Movement skills interchanged between moderate and vigorous activity intensity levels. Each classroom teacher was provided with two routines that all teachers used for coding purposes (See Appendix F). This was designed to ensure that all breaks were similar in content for accelerometer and on-task coding purposes.

Table 3: Data collection schedules for on-task coding

Data Collection for Schedule 1

Activity	**Time**	**Length**
Arrive at center, ready for students to arrive to place on accelorometers	7:30 – 8:15 am	45 min
Begin coding for on-task behavior	10:40 - 11:12 am	32 min
Activity Break or Typical Instruction Teacher Fidelity Check	**11:15 -11:25 am**	**10 min**
Begin coding for on-task behavior	11:28 – 12:00 pm	32 min
Remove accelerometers prior to students departing	12:50 pm	Until done

Data Collection for Schedule 2

Activity	**Time**	**Length**
Arrive at center, ready for students to arrive to place on accelorometers	7:30 – 8:15 am	45 min
Begin coding for on-task behavior	10:15 – 10:47 am	32 min
Activity Break or Typical Instruction Teacher Fidelity Check	**10:50 -11:00 am**	**10 min**
Begin coding for on-task behavior	11:03 – 11:35 am	32 min
Remove accelerometers prior to students departing	12:50 pm	Until done

Data Collection for Schedule 3

Activity	**Time**	**Length**
Arrive at center, ready for students to arrive to place on accelorometers	7:30 – 8:15 am	45 min
Begin coding for on-task behavior	9:30 – 10:02 am	32 min
Activity Break or Typical Instruction Teacher Fidelity Check	**10:05 -10:15 am**	**10 min**
Begin coding for on-task behavior	10:18 – 10:50 am	32 min
Remove accelerometers prior to students departing	12:50 pm	Until done

Procedure

Researcher Training

Prior to data collection, each researcher involved in the project went through a training program in order to be familiar with the protocols that were evaluated for this project along with gaining reliability for measures. Each researcher also completed the CITI training program to ensure that they understood the nature of collecting data using human subjects and was familiar with the information provided in the Belmont Report about ethical principles in conducting research. Protocols were reviewed and practiced for each assessment so that accuracy and consistency would be met.

Teacher training

Training for teachers took place during an hour and a half training session scheduled jointly by the researchers and the preschool center. At this training day, teachers received information packets that included: general information about the project, procedures that would take place while we were collecting data, and their role in conducting the activity breaks (this can be found in Appendix G). The teachers were also given an instructor booklet which included movement activity descriptions, and resources for them to be able to conduct activity breaks in their classroom, general information about the project, projected schedule changes, two pre-determined activity breaks (that all teachers would use), management techniques, and a large list of movement activities that they could use in their classrooms that included a picture, cue words, descriptions, and contraindications (if necessary). At this training session, teachers were shown how to implement breaks and strategies on how to prompt activity from students and how to deal with disciplinary issues. While in training, teachers were asked to brainstorm potential barriers that may impede their ability to conduct activity breaks, so that these may be addressed and overcome prior to the start of the project. Also, details about activity break fidelity checklists were discussed so teachers knew what would be asked of them and an explanation of classroom procedures during the data collection week.

Teachers were scheduled for a week of data collection and also informed that the week prior to data collection we would be gathering anthropometric data and conducting TGMD-2 tests on their students. Teachers were asked to select a time during this week prior to data collection where they would conduct a practice activity break in their classroom with a researcher present so that feedback could be provided. A detailed schedule of the semester's data collection may be found in Appendix H.

The treatment fidelity checklist was coded while teachers conducted the activity break to ensure similar practices (See Appendix I). The checklist was used to determine 1) the duration of the break, 2) deviations from the break and 3) report any abnormal behavior. This has important implications for the feasibility of implementing activity breaks in preschool settings. The researcher who coded on-task prior to and following the activity break also checked the standards during the activity break.

Table 4. Weekly data collection schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
Week 1	**Class One**: Distribute IRB's; Height, Weight, and TGMD-2 are consents are returned				
Week 2	**Class Two:** Distribute IRB's; Height, Weight, and TGMD-2 are consents are returned				
	Class One: Typical Instruction	Classroom-based activity break	Typical Instruction	Classroom-based activity break	Download accelerometers & calibrate for next week
Week 3	**Class Two:** Classroom-based activity break	Typical Instruction	Classroom-based activity break	Typical Instruction	Download accelerometers & calibrate for next week

- Classrooms will be counterbalanced throughout the project for TI & CAB days
- Continue to collect IRB's, anthropometric, & TGMD-2 data on students, one classroom at a time until all students are assessed

On-site procedures

Data collection started in one classroom; students were brought in small groups (approximately four) to assess their height and weight measurements. These measurements were taken individually in a separate classroom so that information would remain confidential. Students then completed the TGMD-2 protocol to assess motor skill competency levels for locomotor and object control skills. Once these assessments were completed, students returned to the classroom and the next group was assessed (see an example of this schedule in Table 4). During this time, teachers were encouraged to practice conducting activity breaks at least once so that a researcher could observe and provide feedback prior to the actual intervention week. This initial data collection (anthropometric and TGMD-2) was repeated until the first class was completed and ready for data collection the next week. The initial data collection team would move on to the next class if time allowed.

During the activity break implementation week, accelerometers were placed on the student's once they arrived to the classroom that had been calibrated with their height, weight, gender, and age according to the Actical manual. Accelerometers were attached with an elastic belt, fastened on the child's right hip (anterior to the iliac crest). The researcher wrote down the exact time each child had the accelerometer placed on them before moving on to the next child. Accelerometers were removed as students were leaving the classroom in the afternoon; the researcher recorded the time each device was removed. During the intervention week, teachers were assigned, based on a counterbalanced schedule to conduct breaks on a Monday and Wednesday or a Tuesday and Thursday. This was to reduce the possibility that certain days of the week may influence a child's on-task behavior or activity levels. On the other two days of the week (that do not have an activity break scheduled) teachers were asked to conduct their typical instruction schedule.

Researchers, based on the scheduled times of the activity breaks, arrived to the classroom approximately 35 minutes prior to the scheduled activity break or control condition to prepare to code on-task behavior. Researchers coded for approximately 32 minutes prior to the scheduled activity break time, did not code during the activity break or control time, and then coded for another 32 minutes after that time period for time on-task. One researcher completed the treatment fidelity checklist during the activity break.

Data Analysis

A projected sample size of 82 children was needed in order to detect differences in variables based on a medium effect, power of .80 and alpha at .05 (G*Power 3.1.7 software, Germany). In addition, based on previous research, this will be an appropriate sample size for the research questions provided from a pilot study conducted in two small classrooms that found breaks accounted for 69% of daily MVPA in one classroom (n = 9, M = 4.8) and 90% of total MVPA for the second classroom (n = 9, M = 4.3; Wadsworth et al., 2012). Additionally, it was predicted that in a naturalistic research setting that 10% of the data will not be usable, due to removal of the monitor or preschool absence and is accounted for in the sample size.

A within-subject design was most appropriate for this study so that individuals could be compared against their own behavior, serving as their own control for activity; this eliminated variance found by individual differences. Descriptive statistics were generated for the sample (mean and standard deviation). Using age-appropriate data cut points for the accelerometer data, the numbers of epoch lengths associated with light, moderate, and vigorous physical activity were determined. A percentage of each activity category was determined for the whole day dependent on the amount of time each student wore his or her accelerometer. Using a 2x3 within-subjects analysis of variance (ANOVA), we were able to compare the percentage of time a student participated in light, moderate and vigorous physical activity with the experimental condition of a typical instruction day or an activity break day. Within this same research question, a paired samples t-test was also conducted to examine the percent of MVPA physical activity participation with each experimental condition during the ten-minute physical activity break time period (on both control and experimental condition days). Lastly, we also compared the percent of time spent in sedentary behavior for each experimental condition with a paired samples t-test to determine if there was a difference due to the implementation of the physical activity break. Additional paired samples t-tests were conducted to examine whether sedentary behaviors were similar among conditions for the physical activity break and recess. A within subjects 2x3 ANOVA was conducted to additionally assess recess activity, specifically to examine the percent of light, moderate, and vigorous physical activity participation for each experimental condition.

Time on-task was first converted to a percentage of time on-task, separated by the pre- and post- conditions, then averaging the two activity break and two typical instruction days, resulting in four percentages: percent of time on-task prior to activity break, percent of time on-task following activity break, percent of time on-task prior to typical instruction condition, and percent of time on-task following the typical instruction condition. A 2x2 within subjects ANOVA was then conducted for this data using our percentages for pre and post conditions and the test conditions as our dependent variable.

A simple linear regression was conducted to examine the equality of influence between MVPA participation during the activity break between various levels of motor skill competency and weight classification status, independently. The TGMD-2 total raw score was used for this analysis and compared with percent of MVPA participation during the break. The second regression used BMI percentiles and compared this with percent of MVPA participation. BMI percentiles were determined using CDC normative data based on each student's height (cm), weight (kg), age, and sex. Weight classification status for children this age is determined by comparing a child's BMI to normative data from children in the United States and is given a percentile based on this information. Children who are overweight are classified above the 85^{th} percentile, obese above the 95^{th} percentile and underweight are children below the 5^{th} percentile. Additionally, a multiple regression was conducted to examine the TGMD-2 subscales, locomotor and object control, raw scores and BMI percentiles together to see if one was more influential than the other in predicting MVPA participation. A multiple regression used the independent variables: locomotor raw score, object control raw score, and weight percentile. These three independent variables were used to examine their influence on the dependent variable, MVPA participation during the physical activity break time. This an important measure to use for this question due to the ability to examine each variable's contribution to the dependent variable and also examining the uniqueness of each. All alpha levels will be set at .05. A detailed list of each statistical procedure may be found in Table 5.

Table 5. Research questions and appropriate statistical procedures

Research Question	Variables	Statistical Procedure
1. What is the effect of classroom-based physical activity breaks on a preschooler's school-day physical activity participation?	a. DV: % of day spent in Light activity, Moderate activity, Vigorous activity and combined MVPA for the entire school day; IV: experimental condition (AB, TI) b. DV: Amount of MVPA during the 10-minute classroom-based physical activity break,; IV: experimental condition **c.** DV: Sedentary activity for the school day; IV: experimental condition (AB, TI)	a. 2x3 Within-subject ANOVA b. Paired samples t-test c. Paired samples t-test
2. What is the acute effect of classroom-based physical activity breaks on time on-task?	DV: Time on-task (percentage of on-task behavior), pre and post activity break; IV: experimental condition (AB, TI)	A 2x2 within-subjects ANOVA
3. Is the influence of classroom physical activity breaks on MVPA equal among different levels of motor skill competency?	IV: TGMD-2 total raw score; DV: percent of MVPA during the activity break	Simple linear regression
4. Is the influence of classroom physical activity breaks on MVPA equal among different levels of weight status?	IV: BMI Percentile; DV: percent of MVPA during the activity break	Simple linear regression

Chapter 4

Results

The purpose of this intervention was to examine the acute effects of teacher-implemented classroom based physical activity breaks on physical activity participation and academic time on-task for a preschool-age population. Motor skill competency and weight classification status were also examined to determine if classroom-based physical activity breaks could equally influence MVPA participation. This chapter presents the results of the study relative to the research questions of interest.

Demographic Information

A total of 118 preschoolers participated in this research project (*M* age = 3.7966 ± 0.69 years). All participants attended one preschool Head Start center in the southeastern region of the United States. The center serves approximately 196 preschool students, between 11 classrooms for this age group. All 11 classrooms participated in this study. Demographic information may be found in Table 6.

Table 6. Demographic information for participants included in the study

	Demographic Variable	Percent
Gender	Male	46.6%
	Female	53.4%
Ethnicity	African American	83.1%
	Caucasian	8.5%
	Hispanic	5.1%
	Mixed decent	3.4%
Age	3 years	35.6%
	4 years	49.2%
	5 years	15.3%

Physical activity participation

Preschoolers' physical activity participation was assessed with the use of an Actical accelerometer (Mini-Mitter Co., Inc. Bend, OR, USA). The Actical measures acceleration in all directions via an omnidirectional sensor and is validated for use in the preschool population (Pfeiffer et al., 2006). Accelerometers were calibrated for each child based on height, weight, sex, and age according to the Actical manual guidelines. The epoch length was set to 15-second intervals, a time that is recommended for use in preschool children (Cliff et al., 2009). Cut points were set at 715 counts/15 seconds for moderate and 1411 counts/15 seconds for vigorous physical activity (Pfeiffer et al., 2006). Additionally, sedentary behavior was identified as less than 200 counts/15 seconds and light physical activity was classified as behaviors between sedentary and light (i.e., 201 counts/15 seconds – 714 counts/15 seconds). The accelerometers were placed on the student upon arrival to the classroom (approximately 8:00 am) and were worn for the duration of the school day until the student departed (approximately 1:00 pm). Times were recorded individually for each student since there were variations in arrival and departure times. On average, students wore the accelerometers for 257.61 minutes a day (*SD* = 12.35 minutes), which is approximately 4.29 hours daily.

School Day Physical Activity

<u>Research Question #1:</u> What is the effect of classroom-based physical activity breaks on a preschooler's school-day physical activity participation?

Hypothesis #1a: Preschooler's will participate in more physical activity throughout the day on days classroom-based physical activity breaks are implemented compared to typical instruction days.

Examining preschooler's light, moderate, and vigorous physical activity throughout the school day yielded similar results between days that incorporated physical activity breaks and typical instruction days. There was a violation of the sphericity assumption while performing a 2x3 within-subjects analysis of variance; therefore a Greenhouse-Geisser adjustment was used to analyze the results. There was no significant difference between conditions in terms of percentage of school day physical activity participation ($F_{1, 117} = 1.059$, $p = 0.315$; Table 7).

Table 7. 2x3 within-subjects ANOVA examining whole day physical activity participation between activity break and typical instruction conditions

	$F_{1, 117}$	Sig.
Main Effect: Condition	1.547	$p = 0.216$
Main Effect: Physical Activity	1134.779	$p <.001$*
Interaction Effect: Condition x Physical Activity	1.059	$p = 0.315$

* denotes significance

Although the difference was non-significant, MVPA was slightly higher on days the breaks were implemented with 36.03 cpm (*SD*=18.5 cpm; 9.01 minutes) compared to typical instruction days where students averaged 30.24 cpm (*SD*=15.82 cpm; 7.56 minutes). This indicates only a minute and a half difference between the two conditions. Descriptive information about the average daily counts per minute and the equivalent of minutes spent in each category may be found in Table 8. Light physical activity comprised 10.8% of the school day for both conditions. This would equate to an average of 6.48 minutes each hour of preschool attendance spent in light activity. Information regarding the average percentage of time spent in physical activity participation throughout the school day can be found in Table 9 and the average minutes per hour (average minutes per hour = 60 * percentage of activity) for each activity category may be found in Table 10. Hypothesis #1a was not upheld for this research question, as classroom-based physical activity breaks did not enhance total school day physical activity participation levels.

Table 8. Accelerometer data reporting cpm and the equivalent minutes for physical activity participation during the school day between typical instruction and activity break conditions

	TI (cpm)	Minutes	AB (cpm)	Minutes
Sedentary	885.55 ± 65.7	221.39	885.87 ± 69.01	221.47
Light	111.06 ± 34.01	27.77	112.08 ± 45.16	28.02
Moderate	21.32 ± 10.5	5.33	23.56 ± 11.81	5.89
Vigorous	8.91 ± 6.91	2.23	12.47 ± 8.65	3.12
MVPA	30.24 ± 15.82	7.56	36.03 ± 18.5	9.01

* Epoch lengths were set to 15 seconds

Table 9. Percentage of physical activity participation for the duration of the school day between typical instruction and activity break conditions

	TI	AB
Sedentary	86.22%	85.7%
Light	10.8%	10.8%
Moderate	2.08%	2.27%
Vigorous	0.87%	1.2%
MVPA	2.95%	3.48%

Table 10. Average minutes per hour spent in each physical activity category throughout the school day

	TI	AB
Sedentary	51.732	51.42
Light	6.48	6.48
Moderate	1.248	1.362
Vigorous	0.522	0.72
MVPA	1.77	2.088

Classroom-based physical activity break

Hypothesis #1b: Preschooler's will participate in more MVPA during the classroom-based physical activity breaks compared to the control condition setting.

In each classroom, teachers were asked to conduct a 10-minute activity break at a specified time for two days and had two days of typical instruction where no activity break was conducted. For the breaks, teachers were given a pre-made set of activities to implement that incorporated a warm-up, cool-down, and 8 minutes of MVPA and motor skill activities. Teachers dictated the activity break format and were allowed to start and stop the breaks based on their classroom needs. Due to this freedom, a treatment fidelity checklist was coded while teachers conducted the activity break to ensure similar practices. On average, teacher's conducted the activity breaks for a little over the required time with an average of 10.53 minutes. Approximately 81.8% of the breaks were modeled after the breaks provided. Two classrooms did not conduct the breaks that were suggested, but incorporated activities that were already in use in their classrooms (i.e. movement songs, dancing).

Light, moderate, and vigorous physical activity levels were higher and sedentary behavior was lower during this assigned 10 minute time period compared to the control, typical instruction days (see Table 11 for detailed information of cpm and minutes of activity). On average, children spent a little over half (52.7%) of the teacher-implemented activity break in light, moderate, or vigorous physical activity (5.64 minutes). During the typical instruction day's participants' spent 7.36% of the break spent in light, moderate, and vigorous physical activity (0.76 minutes; see Table 12 for percentages of each activity).

Classroom based physical activity breaks did significantly increase the amount of MVPA performed during this 10-minute period ($t_{116} = 18.083$, $p < .001$). Additionally, the 10-minute time period that was assigned for classroom based physical activity time accounted for approximately one-third (35.12%) of the school day's MVPA during activity break days; less than one percent (0.2%) was accumulated during typical instruction time (Figure 2). Hypothesis #1b, that students would participate in more activity during the break time period on activity break days, was upheld.

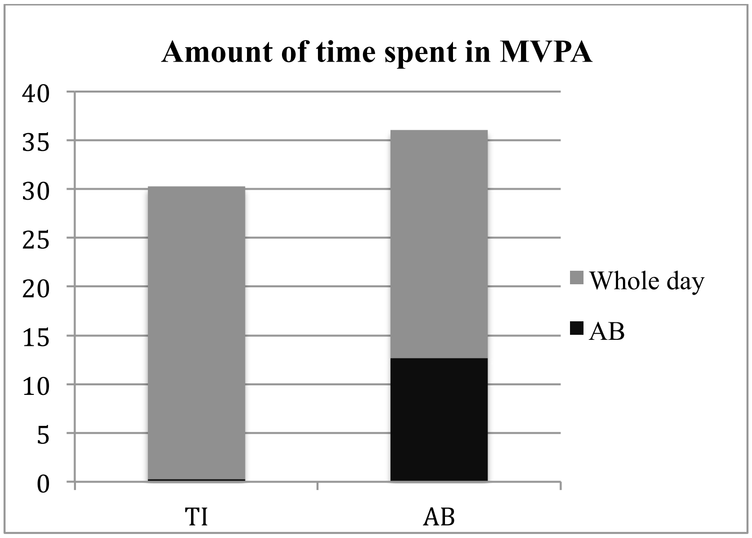
Table 11. Accelerometer data for physical activity participation during the 10-minute physical activity break time period for typical instruction and activity break conditions.

	TI (cpm)	Minutes	AB (cpm)	Minutes
Sedentary	38.5 ± 3.27	9.63	20.27 ± 9.3	5.07
Light	2.76 ± 2.46	0.69	9.89 ± 4.15	2.47
Moderate	0.22 ± 0.46	0.06	6.21 ± 3.64	1.55
Vigorous	0.05 ± 0.22	0.01	6.46 ± 5.06	1.62
MVPA	0.27 ± 0.52	0.07	12.65 ± 7.51	3.16

Table 12. Percentage of physical activity participation during the 10-minute physical activity break for typical instruction and activity break days.

	TI	AB
Sedentary	92.7%	47.3%
Light	6.7%	23%
Moderate	0.53%	14.5%
Vigorous	0.13%	15.2%
MVPA	0.65%	29.7%

Figure 2. Amount of MVPA participated in during the 10-minute activity break compared to school day MVPA participation for typical instruction and activity break conditions.



Recess

Comparatively speaking, the only other opportunity for physical activity during the school day was during a 35-minute recess period. There was a violation of the sphericity assumption while performing a 2x3 within-subjects analysis of variance; therefore a Greenhouse-Geisser adjustment was used to analyze the results. There was a significant interaction effect between the condition and physical activity participation ($F_{1,117}$=5.309, p = .013; Table 13). This can be seen in Figure 3. Students were slightly more active in each of the physical activity intensities on typical instruction days during this recess time period; specifically, students' averaged 4.11 minutes of MVPA compared to the activity break days average of 2.85 minutes of activity (details in Table 14). Students appeared to be slightly less sedentary on typical instruction days as well at 66.2% (compared to 73.5% on activity break days; Table 15). Approximately 33.8% of the recess period during typical instruction days were spent in some form of physical activity compared to 26.5% on activity break days.

Table 13. 2x3 within-subjects ANOVA examining recess physical activity participation between activity break and typical instruction conditions

	$F_{1,\,117}$	Sig.
Main Effect: Condition	22.687	$p < .001$*
Main Effect: Physical Activity	645.356	$p < .001$*
Interaction Effect: Condition x Physical Activity	5.309	$p = 0.013$*

* denotes significance

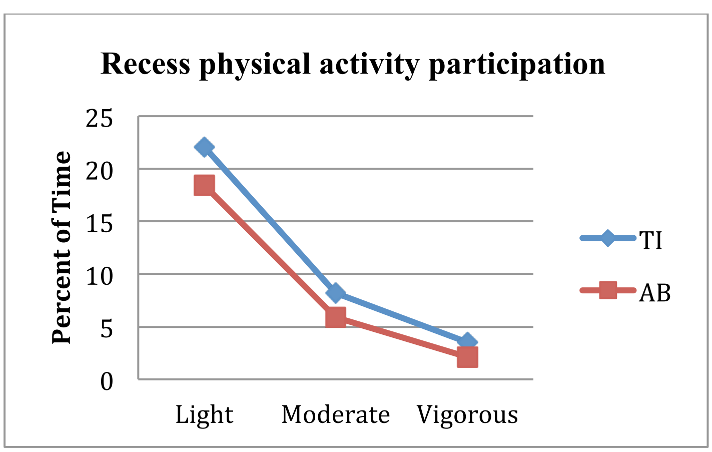
Table 14. Accelerometer data for physical activity participation during recess for typical instruction and activity break days

	TI (Avg. cpm)	Minutes	AB (Avg. cpm)	Minutes
Sedentary	93.8 ± 20.86	23.45	103.63 ± 22.67	25.91
Light	31.32 ± 11.58	7.83	26.0 ± 13.79	6.50
Moderate	11.61 ± 8.1	2.90	8.37 ± 7.78	2.09
Vigorous	4.92 ± 4.9	1.23	3.01 ± 4.36	0.75
MVPA	16.44 ± 11.99	4.11	11.39 ± 11.36	2.85

Table 15. Percentage of time spent in each physical activity intensity during recess for typical instruction and activity break days

	TI	AB
Sedentary	66.2%	73.5%
Light	22.1%	18.4%
Moderate	8.2%	5.9%
Vigorous	3.5%	2.1%
MVPA	11.7%	8.1%

Figure 3. Interaction between physical activity participation during recess on typical instruction and activity break days



Sedentary Behavior

Hypothesis #1c: Sedentary activity for preschoolers' will be lower on days that breaks are implemented (i.e. compensation will not occur) compared to the typical instruction days.

Sedentary behaviors were very similar between the two conditions, 221.39 and 221.47 minutes, for typical instruction and activity break days respectively. On average, students spent 51.73 (TI) and 51.42 (AB) minutes each hour in sedentary activity while in attendance at school. Sedentary behavior was identified as less than 200 counts/15 seconds from the accelerometer. There was not a significant difference between the average sedentary behavior on typical instruction and activity break whole days (t_{117} = -1.244, p = .216). This indicates that the data did not support the hypothesis; sedentary behavior was similar regardless of an addition of a physical activity break.

Due to this finding, a follow-up paired samples *t*-test was conducted to examine the presence of a compensation effect; in this instance, did students become more sedentary when an additional bout of exercise was implemented in the school day. The average accelerometer data for sedentary, light, moderate and vigorous was calculated post-break for each day. A percentage of time spent in each activity category was calculated based on the remaining time in the school day. Sedentary behaviors were significantly different post-break between the typical instruction and activity break conditions; students were more sedentary post-break on activity break days (t_{117} = -2.6, p = .011). Also, light (t_{117} = 2.653, p = .009) and moderate (t_{117} = 2.250, p = .026) activity were significantly different between conditions (full results may be seen in Table 16). Activity break days had lower participation in light and moderate activity during the remaining time at school, indicating compensation did occur post-break. Mean percentages of each physical activity behavior for each condition may be seen in Table 17.

A final paired samples t-test identified that there was a significant difference in the amount of time spent in sedentary behaviors during the activity break (t_{116}=-23.874, p <. 001) and recess time period (t_{117} = 4.763, p < .001). Approximately 63% of classes had the activity break scheduled prior to recess, so this may explain what was observed in differences in light and moderate activity. With typical instruction having more activity during recess and less sedentary behavior, this may have been where in the school day behaviors may have compensated between conditions. Hypothesis #1c was not upheld for this research question, equal amounts of sedentary behavior were observed for typical instruction and activity break days.

Table 16. Paired Samples *t*-test examining compensation in percent of post-Activity Break physical activity participation between TI and AB days

	t_{117}	p-value
Sedentary	-2.6	.011*
Light	2.653	.009*
Moderate	2.25	.026*
Vigorous	.077	.939
MVPA	1.568	.120

* denotes significance

Table 17. Average percent of time spent in each physical activity category post-Activity Break time

	TI	**AB**
Sedentary	86.36 ± 5.40	87.57 ± 5.40
Light	10.95 ± 4.05	10.04 ± 4.05
Moderate	2.00 ± 1.50	1.70 ± 1.50
Vigorous	0.69 ± 0.80	0.69 ± 0.96
MVPA	2.69 ± 2.09	2.39 ± 2.25

Time on-task

Research Questions #2: What is the acute effect of classroom-based physical activity breaks on time on-task?

Hypothesis #2: Preschoolers' time on-task will be greater following the activity breaks than the time immediately preceding the break time, as well as, on typical instruction days.

Time on-task is the amount of time spent participating in on-task behavior, specific to a classroom setting. On-task behavior is defined as verbal or motor behavior that follows class rules and is appropriate to the learning situation. Time on-task was assessed by direct observation immediately before and after the time period assigned for the physical activity break on both experimental and control conditions.

Time on-task was first converted to a percentage of time on-task, separated by the pre- and post- conditions, then averaging the two activity break and two typical instruction days. We found that there was a significant interaction between condition and time spent on-task ($F_{1,117} = 18.857$, $p < .001$; see Table 18, Figure 4). Post-hoc tests indicated there was a significant difference between pre and post on-task behaviors ($p < .001$). The greatest amount of time spent in on-task behavior was seen during the post activity break time period at 81.95%. Pre-activity break had the highest percent of time off-task, 34.7%. It also appears the most frequent category of off-task behavior was in the motor domain; details can be seen in Table 19. Our hypothesis that activity breaks may improve a student's time on-task was upheld.

Table 18. 2x2 within-subjects ANOVA examining time on-task before and after classroom-based physical activity breaks between activity break and typical instruction conditions

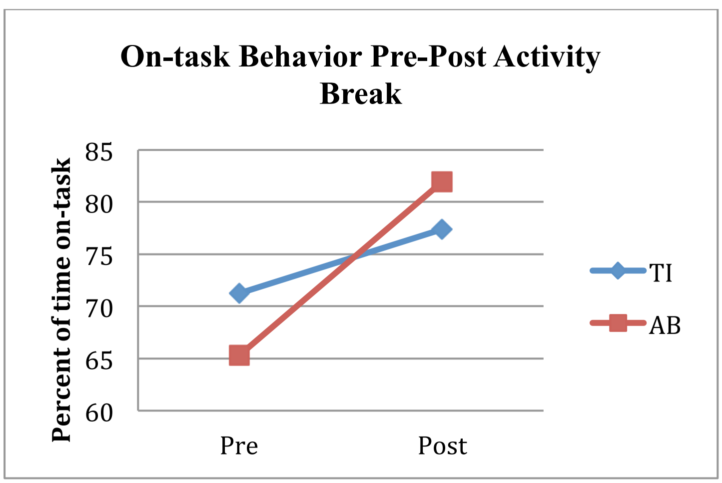
	$F_{1,117}$	Sig.
Main Effect: Condition	0.221	$p = 0.639$
Main Effect: Pre-Post	52.346	$p < .001$*
Interaction Effect: Condition x Pre-Post	18.857	$p < .001$*

* denotes significance

Table 19. Percent of time spent in on or off task behaviors from direct observation prior to and following the activity break time period

	TI Pre	TI Post	AB Pre	AB Post
On	71.23% ± 18.8%	77.38% ± 17.03%	65.3% ± 19%	81.95% ± 15.11%
Off	28.77% ± 18.8%	22.6% ± 17.03%	34.7% ± 19%	17.3% ± 13.4%
Off – Motor	18.74% ± 16.29%	14.67% ± 13.74%	24.36% ± 16.97%	11.4% ± 10.7%
Off – Noise	2.42% ± 4.16%	2.35% ± 3.93%	2.22% ± 4.1%	1.32% ± 3.2%
Off – Passive/Other	7.6% ± 9.36%	5.6% ± 8.78%	8.11% ± 10.76%	4.6% ± 6.81%

Figure 4. On-task behaviors in the classroom pre and post activity break for typical instruction and activity break conditions



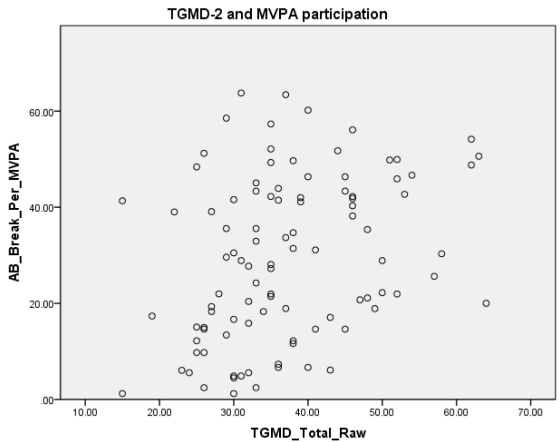
Motor skill competence

Research Question #3: Does motor skill competence have an effect on physical activity participation during classroom physical activity breaks?

Hypothesis #3: Motor skill competency will not have an effect on preschoolers' physical activity participation during classroom physical activity breaks.

Motor skill competence was examined by conducting the Test of Gross Motor Development – 2nd edition for each child. Several children did not assent to beginning or completing the assessment, therefore the sample size for the completed version of this test was n = 100. Raw scores range from 0-48 for each subscale, locomotor and object control; 96 is the highest score for this assessment, with a higher score indicating higher competency in motor skills. For locomotor skills, the average score was 17.19 (*SD* = 6.48). The average raw score for object control skills was slightly higher at 19.99 (*SD* = 5.86). Combined, the average total raw score was 37.18 (*SD* = 10.48; range 26-64). There was a significant correlation between performance in the TGMD-2 and MVPA participation during the activity break (r = 0.366, p < .001; depicted in Figure 5). This indicates there is moderate relationship between MVPA participation during the activity break and higher competency in motor skills. Hypothesis #3 was not supported for this research question; it appears motor skill competency does play a moderate role in MVPA participation during activity breaks.

Figure 5. Linear regression of MVPA participation during the activity break and TGMD-2 Total Raw Score



Weight classification status

<u>Research Question #4</u>: Does weight classification have an effect on physical activity participation during classroom based physical activity breaks?

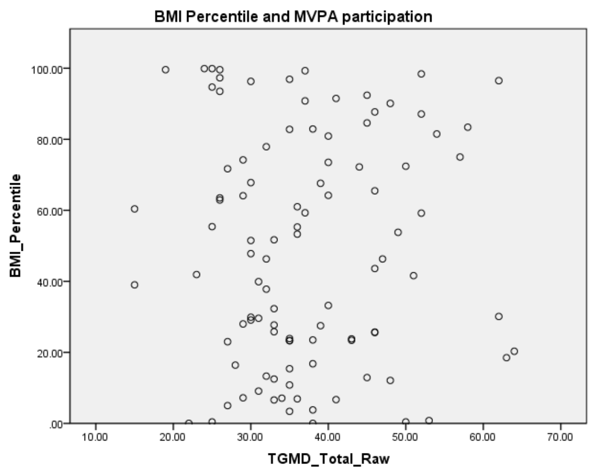
<u>Hypothesis #4</u>: Weight classification status will not have an effect on preschoolers' physical activity participation during classroom physical activity breaks.

The breakdown of weight classification status for this group, according to the appropriate CDC growth charts by age and sex, found that 9.3% of students were underweight, 72% normal weight, 7.6% were overweight, and 11% were classified as obese. The average weight for children in this study was 40.2 ± 8.27 pounds (range 28.4-85.2 lbs.).

The child's weight classification status is based off a percentile from the CDC normative data that ranges from 0-99.9. Using the BMI percentile, we examined the relationship between weight status and participation in MVPA during the activity breaks and found there was no significant correlation (r = -.028, p = .385; depicted in Figure 6).

This indicates that weight classification status did not influence activity participation during the activity breaks, confirming our research hypothesis.

Figure 6. Linear regression of MVPA participation during the activity break and BMI Percentile



MVPA participation during activity breaks

A backward elimination regression was used to determine which factor might have the greatest influence on MVPA participation during the classroom based activity break. TGMD-2 subscale raw scores (locomotor and object control) and BMI percentile were the variables of interest. The backward elimination regression indicated that the locomotor subscale was the best predictor for physical activity participation (F=10.775, p < .001).

Table 20. Backward elimination multiple regression examining MVPA participation during the classroom based activity break

Variables entered	Beta	Sig.	R^2
BMI Percentile	-.138	.151	0.131
TGMD-2 Locomotor Raw	.266	.014	
TGMD-2 Object Control Raw	.119	.266	
BMI Percentile	-.139	.150	0.119
TGMD-2 Locomotor Raw	.318	.001	
TGMD-2 Locomotor Raw	.316	.001	0.100

Chapter V

Discussion

The purpose of this intervention was to examine the acute effects of teacher-implemented classroom based physical activity breaks on physical activity participation and academic time on-task for a preschool-age population. Motor skill competency and weight classification status were also examined to determine if classroom-based physical activity breaks could equally influence MVPA participation. This chapter presents an interpretation and discussion of the findings from this study along with recommendations for future research.

Physical activity

Despite the numerous documented benefits of regular physical activity, a majority of children do not meet national recommendations (CDC, 2003). A review on physical activity participation concluded that only 23% of preschoolers, between the ages of 2 – 5 years, engage in the recommended 120 minutes of daily physical activity (Tucker, 2008). Preschool centers are an ideal venue for implementation of healthy behaviors, such as physical activity, because they serve nearly 56% of preschool age children (between the ages of 3-5) in the United States (Federal Interagency Forum on Child and Family Statistics, 2001). These facilities have the access, personnel, equipment and space to implement physical activity. Preschoolers' spend a large amount of time in school (Dowda et al., 2004; Pate et al., 1996) and health organizations are indicating that schools and early learning centers should be given more attention and support to reverse this obesity epidemic (Glickman et al., 2012).

In a study of over 400 children in 24 preschools, only 3.3% of the school day was spent in MVPA (Pate et al., 2008). Small variations in the amount of MVPA exhibited have been seen in various studies that range between 2%-5% (Cardon & de Bourdeaudhuij, 2008; Gilliam et al., 1981; Kelly et al., 2005; Reilly et al., 2004). These results appear to be consistent with the current research study where children spent approximately 2.95% of a typical instruction school day in MVPA. This would account for only 12.6% of the recommended amount of MVPA participation a preschooler should accumulate throughout the day (i.e. 60 minutes of MVPA); the school day only accounted for approximately 4 hours of the day, however, studies have indicated the low-income families have few physical activity opportunities outside of school. There was a slight, but non-significant increase on days that classroom based physical activity breaks were implemented at 3.48% of the day spent in MVPA. This equates to approximately 7.01 (typical instruction) to 9.56 (activity break) minutes a day spent in MVPA. This appears to be substantially less than what Pate and colleagues found in 2008, where students participated in 7.7 minutes of MVPA per hour of preschool attendance. However, Shen and colleagues (2012) found that children at six Head Start centers participated in an average of less than 1 minute per hour of moderate physical activity, and no vigorous activity. This is more similar to what was seen in the present study, on average approximately 1.77 minutes per hour were spent in MVPA on typical instruction days, this increased slightly to 2.09 on activity break days. There is evidence that suggest that children are less likely to be active if attending a Head Start center compared to a university-based childcare center where children are two and a half times more active (Worobey, Worobey, & Adler, 2005). Literature cites differences may be due to the preschool center observed, studies have found that the center attended may account for approximately 45% of variability in physical activity participation (Finn et al., 2002; Pate et al., 2004). In general, feasible explanations may be lack of place space/equipment or emphasis placed on physical activity participation.

Children spent 8-9 minutes on average of physical activity each hour (combined light, moderate, and vigorous); approximately 75% of that activity was a light intensity level. It is recommended that this population should engage in twice the amount of physical activity as school-age children (60 minutes vs. 120 minutes for preschoolers), however, it is apparent that actual physical activity levels are strikingly low for preschoolers'. The implementation of a comprehensive physical activity program may be essential for increasing physical activity levels throughout the school day. More emphasis should be based on integrating physical activity into the classroom, (i.e. classroom based activity breaks, active learning opportunities) but also more structured opportunities such as recess and physical education opportunities.

Sedentary Behavior

Preschoolers primarily elicit sedentary behaviors. The NASPE (2009) guidelines indicate that preschoolers should not be sedentary for more than one hour at a time. The present study found that children spent approximately 86% of the school day sedentary. This high level of inactivity is not uncommon, most studies examining preschoolers' physical activity levels found similar levels. A study by Cardon & de Bourdeaudhuij (2008) found that preschoolers spent 85% of their time during the school day in sedentary activities measured by accelerometers. Pate et al. (2008) found similar results with children being sedentary 80% of the observed time. Others have found similar results reporting high levels of sedentary behavior in preschool settings and low levels of MVPA (Fisher et al., 2005; Reilly et al., 2004). In a study examining six Head Start centers, researchers found that on average preschoolers' spent 56 minutes of each hour in sedentary activities (Shen et al., 2012). The present study found that on typical instruction days' preschoolers spent on average 51.73 minutes each hour in sedentary activities, this was 51.42 minutes per hour on activity break days.

Sedentary behaviors may be detrimental to the health of children, but this also is an important aspect for schools since there appears to be negative academic implications for prolonged inactivity. Jarrett and colleagues (1998) have found that students participated in significantly less fidgeting behaviors and significantly more on-task behaviors on days when the instructional period was not prolonged. Thus, long periods of instructional time without a break may be counterproductive to academic behaviors (Jarrett et al., 1998; Pellegrini & Davis, 1993).

Classroom based physical activity breaks

A recent strategy to increase daily physical activity participation in school is the implementation of structured, classroom-based physical activity breaks. This strategy has been found to be effective in significantly increasing physical activity levels of elementary school-age children (Ernst & Pangrazi, 1999; Kibbe et al., 2011; Mahar et al., 2006; Scruggs et al., 2003). The findings emphasize the effectiveness and feasibility of providing classroom-based, structured opportunities for physical activity for a school-age population. The preschool population is often an overlooked group for the implementation of these breaks, therefore literature is limited in examining the effects of classroom based breaks on this young population.

Overall, physical activity was higher and sedentary behavior was lower during this assigned 10 minute time period compared to the control, typical instruction days. This indicates that during typical instruction students were not already engaging in physical activities. On average, children spent a little over half (52.7%) of the teacher-implemented activity break in light, moderate, or vigorous physical activity. Specifically, 3.16 minutes were spent in MVPA. The MVPA accumulated during the 10-minute time period that was assigned for classroom based physical activity time accounted for approximately one-third (35.12%) of the school day's MVPA during activity break days. In a comparable study, Mahar et al. (2006) implemented 10-minute breaks and found from the use of pedometers, students increased step counts ranging from 160-1223 steps during the activity. They did find a significant difference in total school day step counts for the intervention group, compared to the control group; however, individual variations could not be accounted for in this between groups design (Mahar et al., 2006). Additionally, being able to detect intensity from accelerometers was a strength of the present study, however it is more difficult to compare these results to previous work with pedometers.

There were no significant differences between conditions on physical activity levels or sedentary behaviors for the entire school day, despite a significant difference in physical activity participation during the break. There may be several explanations for this occurrence. The pilot work had researchers implementing the activity breaks. It was necessary in this study to show that teachers may adequately influence physical activity behaviors in their classrooms. It appears that this was a successful endeavor as statistical significance indicates breaks did have more physical activity participation compared to typical instruction. However this did not carry over to influencing the entire day's physical activity levels. Results from the pilot work found there was a 69% and 90% increase of daily MVPA participation from the activity breaks at each center, respectively (Logan et al., in review; Wadsworth et al., 2012). With the breaks significantly increasing activity during this 10-minute time period, strategies to influence overall activity throughout the day may be an important component to focus on. In the current study, whole day activity was consistent between conditions indicating that certain routines may have been changed slightly to accommodate these activity breaks. Areas such as active transitioning or large group time with activity may be areas to focus on so that teachers may increase activity levels apart from the activity break time period. Also, there was a very small sample size for the pilot work, so the current study's participants may have had a larger variation in individual differences based on physical activity participation.

Another area that may have influenced activity may be variations across classrooms. There were class variations between timing and activities chosen; therefore differences may be present due to these reasons. Approximately 81.8% of the breaks were modeled after the breaks provided. Two classrooms did not conduct breaks that were suggested, but incorporated activities that were already in use in their classrooms (i.e. movement songs, dancing). Students were also not required to participate and therefore may skew the results based on assent during the break time. Variations may be needed for the activity breaks to encourage all children to want to participate. Also, research has indicated that interventions conducted by teachers are more likely to induce change in MVPA behaviors in preschoolers, when compared to parents in the home environment (Tucker, in press). This may be of particular important as child care centers have been increasingly cited as a potential advocate for improving health behaviors, such as physical activity (Story et al., 2006). One thing that will be important to consider is with a teacher's increasing role in influencing a preschooler's physical activity participation, increased education on structured physical activity programs and appropriate movement skills may be necessary.

Teachers may not have had enough training to elicit more physical activity in all children and would be an appropriate follow-up for assessing a dose-response relationship in terms of training. For example, a longer training protocol or instructional resources (i.e. videos, pre-made activity breaks) could have elicited more physical activity in children. In this regard, teachers' may be adequately trained for appropriate physical activity leadership while not over-burdening them with additional responsibilities. Research has indicated that interventions requiring little teacher training yielded positive increases in physical activity participation in preschoolers (Hannon & Brown, 2008). However, this improvement was boasted through use of portable play equipment during recess and not during classroom based activities, so results might not be applicable to the findings from this current study. Alternatively, a physical activity program that lasted 24 weeks found no significant increases in physical activity participation, despite a rigorous training regimen for teachers (Reilly et al., 2006). Future research may be pertinent in determining what the appropriate amount of training/resources may be needed to increase physical activity in child care facilities.

Compensation

Another concept that may influence whole day physical activity may be compensation. Compensation indicates that certain behaviors may be transferred to another behavior (Barnett & Ceci, 2002). This has been adapted in health literature to discuss the phenomenon of the transference of a healthy behavior to an unhealthy substitute to understand failures in behavior change modifications (Väth et al., 2012). For this study implementing an additional 10-minute bout of activity into the school day found certain physical activity behaviors were different post activity break time. On days that activity breaks were conducted, students spent significantly less time in light and moderate physical activity post break and significantly more time in sedentary activities. This could be an explanation as to why there was no statistical difference in the physical activity participation dependent on the condition for the entire school day. Compensation appears to have negatively dissuaded children from maintaining more healthy behaviors with the addition of a 10-minute activity break time. It appears that this difference was minimum, there was approximately 1% difference for light activity and less than 1% difference for moderate intensity physical activity differences post-physical activity break. Donnelly and colleagues (1996) observed that children may compensate for increased periods of physical activity during the school day by being more sedentary at other times throughout the day. This could negate efforts to increase physical activity levels. Contradictory findings were reported by Dale et al., (2000) involving children's physical activity behavior, they found children are more sedentary throughout the entire day if physical activity opportunities are diminished at school, and total day activity is increased on days opportunities are present. This may indicate that implementing physical activity into the classroom may increase activity later on in the day (i.e. while students are at home), and deter the potential negative effect of compensation. Since accelerometer data was only recorded during the school day and not the entire day, there is a possibility that students could potentially be more active when they get home from increased opportunities in school. However, this relationship was not examined in this study.

For this center, there was only one other opportunity for physical activity during the school day, a 35-minute recess period. This could have been the alternative activity where compensation may have occurred during the school day. One explanation for this occurrence may have been low fitness levels in this particular group. Although there is no current fitness assessment for this age group it is likely that diminished cardiorespiratory fitness may be a culprit in influencing compensation. Approximately 63% of classes had the activity break scheduled before recess. Children with lower fitness levels may have less capacity to maintain fitness levels throughout the day. As the results from the follow-up compensation analysis post-break indicate, days that activity breaks were conducted children were less physically active in light and moderate intensities.

Recess

As mentioned, the only other opportunity for physical activity during the school day was during a 35-minute recess period. This was typically held on an outdoor playground that consisted of a sand box, swings, a sidewalk track to ride tricycles on, and a small playground structure where students could climb and crawl. There were two outdoor playgrounds at this Head Start center for preschoolers' that were identical. Additional equipment was available at the teachers' discretion (e.g. footballs, rubber balls, etc.). If there was inclement weather, recess was conducted inside dependent on the classes' schedule. Only two classes could be on an outdoor playground or inside the gym at once, therefore if there was inclement weather classes had to switch days participating in indoor activities if necessary. During data collection, recess was conducted in the gym 13.6% of the time. Inside the gymnasium students would alternate between a tumbling station that consisted of mats and mattresses to jump, climb and bounce on and an open gym floor where students played on sitting scooters that they could control with their legs.

There was a significant interaction effect between the condition and physical activity participation; preschoolers were slightly more active in each of the physical activity intensities on typical instruction days during this recess time period. There was a difference in the amount of time spent in MVPA, 4.11 minutes (TI) versus 2.85 minutes (AB). This appears to be where the differences occurred when accounting for the whole day physical activity being similar between conditions, regardless of the addition of a 10-minute activity break. Students appeared to be slightly less sedentary on typical instruction days with 66.2% of the time spent in sedentary activities compared to 73.5% on activity break days. There appears to be mixed results when examining the literature about recess in young children. Preschoolers' were slightly less sedentary during recess time in this study, compared to previous literature that reported time spent in sedentary activities. One group examining outdoor recess time found that preschoolers were sedentary 89% of the time (Brown et al., 2009). Other research has found that even a suitable environment may not be enough to elicit activity in this group (Kelly et al., 2005); describing this age group as sedentary during recess time (McKenzie et al., 1997). A study conducted by Alhassan and colleagues (2007) found that by increasing the amount of time available for recess daily (i.e. an hour more of recess play) the result was no increase in physical activity for preschoolers.

Contradictory research suggests that being outdoors facilitates activity in the preschool-age population. Boldemann and colleagues (2006) suggested that simply being outdoors in a space available for activity might elicit physical activity in preschoolers. Numerous studies found that physical activity among preschoolers is correlated with outdoor playtime (Baranowski et al., 1993; Burdette et al., 2004; Hinkley, et al., 2008; McKenzie et al., 1992; Tucker, 2008).

The mixed results of this literature reinforce the notion that variations among preschool centers may play a substantial role in differences in preschoolers' activity levels (Finn et al., 2002; Pate et al., 2004). Built environment in schools may play a substantial role in the physical activity behaviors of preschoolers'. Some research has cited that structure may be an important component to enhancing physical activity participation in preschoolers (Alhassan, Sirard, & Robinson, 2007). Other studies suggest that small changes to the environment may assist teachers in improving activity in young children (Loucaides, Jago, & Charalambous, 2009).

Additionally, teacher's direction and structure may be able to evoke changes in physical activity during this time period. This seems apparent when you compare the 10-

minute, teacher-directed activity break elicited MVPA participation 29.7% of the time; compared to children participating in 11.74% of a 35-minute recess period in MVPA. It seems apparent that a structured physical activity programs may provide more opportunity for increasing MVPA behavior in preschool-age children, as indicative of children being twice as active. Classroom-based breaks require no cost or equipment; therefore, teachers may easily be able to transfer structured activities (e.g. marching, hopping) into recess time periods, where more space and even equipment is available.

Time on-task

Although the importance of physical activity for overall health is well known, the positive impacts of physical activity on increasing concentration, cognition, and academic performance, as well as reducing self-stimulatory behaviors (e.g. fidgeting) and school-related stress, are not as well understood. The CDC (2010) reviewed studies that examined the association between classroom-based physical activity and academic performance in elementary school-age children. Results indicated that eight of nine published studies found positive effects of physical activity on outcomes such as academic achievement and classroom behavior. For classroom-based physical activity participation to become a priority of early childhood curriculum and policy, it is also important to provide research-based evidence that physical activity breaks do not negatively dissuade from academic behaviors.

One behavioral outcome that has received empirical consideration is the effect of physical activity on attention (i.e. on-task behavior) in the classroom. Previous research has solidified these findings in elementary students and indicates an increase in on-task behavior in the classroom after participation in a physical activity break (Grieco et al., 2009; Jarrett et al., 1998; Mahar et al., 2006; Mahar, 2011). However, the effect and benefits of classroom based physical breaks in preschool populations have not been thoroughly investigated. In the pilot work, **c**hildren were found to be on-task 62.3% (*SD* = 7.8) of the time after the control condition (no activity break) and were on-task 77.7% (*SD* = 5.03) after the activity break condition; tests indicated that this was not statistically significant (Logan et al., in review). For this particular study, students were significantly more on-task following an activity break (81.95% ± 15.11%) compared to following a control condition (77.38% ± 17.03%) or prior to each condition (TI, 71.23% ± 18.8%; AB, 65.3% ± 19%). This appears to be consistent with literature that cites the advantages of implementing physical activity into the classroom. Other programs such as the Take 10!, Energizers, or Texas ICAN! incorporate academic concepts into their physical activity breaks, which may be the next step in improving breaks for the preschool-age population.

Motor skill competence

One concern when implementing these classroom-based physical activity breaks is that breaks would equally influence children with varying levels of competency in motor skills. Preschool children that demonstrate higher motor skill competence are the most physically active (Fisher et al., 2005; Graf et al., 2004; Robinson et al., 2012) compared to their less skilled peers. Results from this study identify that there is a moderate correlation with a child's fundamental motor skill raw score and their participation in MVPA during the classroom based activity break (*r* = 0.366). Research indicates an association between level of motor skill competence and engagement in MVPA in preschool children (Cliff, Okely, et al., 2009; Robinson et al., 2012; Sääkslahti et al., 1999; Williams et al., 2008). Therefore, an important component in creating acute programs like this into the school day may be educating teacher's on basic, fundamental motor skills to build a child's motor repertoire available for skill execution. The Active Start guidelines (2^{nd} edition) promote children to have a solid base that improves the acquisition of FMS and increases a child's capability to engage in appropriate movement patterns (NASPE, 2009).

When motor skill competency subscales were combined with weight classifications status, a backward eliminiation multiple regression indicated the item that contributed the most to a student's MVPA participation were their TGMD-2 locomotor subscale raw scores. Locomotor skills are positively correlated with physical activity in preschoolers (Hardy et al., 2010). This appears to be consistent with what Alhassan and colleagues (2012) found, interventions that target specific FMS (i.e. locomotor skills) may significantly decrease the amount of sedentary behavior that preschoolers' participate in daily. This may be evidence to suggest that increases in structured programs that incorporate FMS may decrease sedentary behavior in this age group. The preschool years are a critical time for fundamental motor skill development and execution of these skills to begin to adapt healthy physical activity behaviors.

Weight classification status

Childhood obesity is a serious health concern that coexists with a wide range of health disparities (Strong et al., 2005) and may be avoided if proper intervention can be implemented. Physical activity is a modifiable risk factor that comes with a large number of positive outcomes including healthy weight management. High amounts of inactivity have been associated with an increased risk of being overweight or obese (Dietz, 1997; Janz et al., 2002; Reilly, 2008; Trost et al., 2003), while increased physical activity is associated with a reduced risk of being overweight or obese (CDC, 2006; Reilly et al., 2003). Early intervention appears to be a vital tool that could deter early onset of obesity related illness and prepare young children for a lifetime of healthy activity levels (CDC, 2001). Overweight and obesity may also significantly impair certain motor skills in preschool children (e.g. jumping), by being unable to navigate their increased body weight potentially leading to decreased activity as they age (Castlebon & Andreyeva, 2012). This relationship has been speculated to be stronger in overweight or obese preschool boys (Cawley & Spiess, 2008).

For this study, the relationship between MVPA participation during the activity break were examined to determine whether or not breaks could equally influence all levels of weight classification status in preschoolers. 18.6% of students were classified as overweight or obese, and there was no significant difference between MVPA participation in overweight and normal weight children during the activity break. Evidence shows that greater participation in physical activity is associated with a healthy body weight in preschoolers (Trost et al., 2003). Conversely stated, Bayer and colleagues (2008) found that preschool children who are the most physically active are less likely to be overweight or obese. Classroom-based physical activity breaks equally influenced levels of activity among normal weight and overweight children and may deter what has been described as an "inactivity cycle" an association between children who are overweight being less likely to be physically active (Fit Kids Australia, 2010). This may translate to tracking studies that support the consistency of physical activity levels from childhood to adulthood (Kelder et al., 1994; Pate et al., 1996).

Limitations

This study had several limitations that should be considered when generalizing findings to other settings. First, research was conducted at one Head Start facility in the southeastern region of the United States. Characteristics of the school may have influenced results. However, it has been shown that the environment at a childcare center influences approximately 45% of the variance in activity, therefore control of the extraneous variable was necessary (Finn et al., 2002; Pate et al., 2004). Findings may be limited to this particular setting or for a program similar to a curriculum-based center such as those provided by Head Start.

Another limitation was the experimental design being within subjects; this does not provide a true comparison group, but this also eliminates variability due to individual differences as subjects serve as their own control. Diffusion was a concern at this center. Classrooms were close in proximity; it would have been difficult to test a true control group without concerns of other classrooms incorporating some form of break. Having a control at another center could be an option; however differences in the setting may play a large role in variability of behavior.

Children’s physical activity participation outside of school was not assessed. This was an acute intervention examining the immediate effects during the school day of implementing a classroom based activity break. Therefore, accelerometers were not sent home with the children, however, important information could have been derived from this such as whether or not compensation may have occurred outside of school. It would have also provided a more holistic understanding of total physical activity behaviors for this age group. Future research may look to send accelerometers home with preschoolers to determine compensation effects and whole day activity levels, particularly in low-income areas where children may be the most inactive.

Another limitation could have been the amount of training provided to the teachers. There was only one training session and demonstration with teachers prior to implementing these breaks into the classroom. Informational packets, activity cards and CD’s were also provided to the teachers. It is important that physical activity interventions are cost-effective and feasible to implement while promoting daily physical activity so they are more likely to be adopted. Since activity appeared to be prevalent during breaks, it may have been important to stress to teachers to try and incorporate more activity throughout the school day (e.g. active transitions). These breaks were successful in increasing activity, however there was no difference overall between activity days and typical instruction days.

Finally, this was an acute intervention looking at the short-term effects of classroom-based physical activity breaks on physical activity participation, time on-task, and examining the influences of weight classification status and motor skill competency levels. Longitudinal work could be an important next step to examine the long-term effects of a program like this. As evidence has presented that these classroom breaks do increase activity during these time periods, maybe a longer standing program would change the overall atmosphere of physical activity participation among teachers and students, specifically cardiorespiratory endurance. Furthermore, a comprehensive physical activity program throughout the day is necessary for preschoolers to meet physical activity recommendations. More information regarding appropriate structured activities and movement practices may be necessary to investigate to increase regular physical activity in child care centers through avenues such as classroom-based physical activity, recess, and physical education.

Policy Recommendations

There are several policy recommendations that may be derived from the current findings. At this Head Start center, detailed schedules that incorporated curriculum-based activities made it difficult for teachers to implement activity during the school day. Scheduling an activity break during the school day found significant increases in activity during this time. Therefore, Head Start centers may consider incorporating physical activity breaks into their policies and practice, so students may be more active throughout the school day. These breaks did elicit more on-task behaviors in the classroom and therefore could be used as an asset to reinforce important curriculum concepts after children participate in physical activity. These breaks are low-cost and feasible for teachers to conduct in their classrooms.

Some research has found that physical activity breaks may also reinforce academic concepts in elementary-age children, this could be an easy way for teachers to work on kinesthetic learning for children that may learn more efficiently this way. This particular Head Start center had “Plan, Do, and Recall” program where physical activity may also be incorporated. Teachers could influence children’s positive perceptions of physical activity by placing emphasis on these activities during the day and encouraging opportunities for play. Also, physical activity and motor skill vocabulary words may be an appopriate way of teachers adopting physical activity into their curriculum and educating students on different varieties of activities and how to properly engage in these activities.

Research has found that young children are more likely to adopt healthy behaviors in preschool (CDC, 2001); it seems feasible that Head Start centers may prioritize physical activity as a component of their health intitiative. Cost-effective programs such as classroom-based activity breaks could be used to enhance physical activity adoption for young children and may be easy to incorporate into center policies with limited time needed for teacher training. For children from low socioeconomic status families, physical activity opportunities may be limited outside of school and physical activity participation is an important component of a child’s health. It may deter overweight and obesity in this population, as children from minority group and low socioeconomic status homes may be unequally affected. It may be an imperative initiative for Head Start programs and similar facilities to try to incorporate structured movement activties for children to enhance engagement.

Conclusions

There are several important conclusions to derive from this study. First, this is the first study to examine how classroom based physical activity breaks may influence the preschool-age population. Breaks were successful in increasing MVPA during the activity break time and improved on-task behavior immediately following the breaks. Additionally, results indicated that breaks equally elicited MVPA participation from all levels of weight classifications, indicating a viable solution to increasing physical activity, specifically in overweight or obese children. This appears to be promising as teachers' conducted the breaks, with minimal training. Future work could be conducted into increasing the amount of education and training provided to teachers on appropriate movement strategies, proper motor skill execution, and active transitions throughout the school day to see if children may be more active.

Another area that may prompt future research is that with the addition of a 10-minute bout of physical activity into the school day, preschoolers participated in approximately the same sedentary behaviors and light, moderate, and vigorous physical activity participation as they did during a typical instruction day. Reasoning behind this may be due to compensation, as children may be less active following activity breaks. A follow-up analysis indicated that post-break, children were less likely to participate in light and moderate activity and more likely to be sedentary. Low fitness levels may be an explanation for this occurrence and indicate that long-term interventions may be necessary to build up cardiorespiratory fitness levels in this age group. Further investigation of preschooler's whole day physical activity participation may be an important next step in fully understanding this concept. Also, having teachers integrate more active opportunities throughout the school day may be an important component to increasing physical activity in this population.

Another result of this study found that locomotor skills (of the variables examined) contributed the most to a child's MVPA participation during an activity break. This appears to be consistent with research that higher FMS competency is associated with more physical activity in children, particularly locomotor skills in this population. The incorporation of more structured activity opportunities that focus on locomotor skills may be a useful integration to prompt more activity. This may coincide with increasing teachers' education and targeting specific activities during breaks.

One important component of these breaks is that there are feasible to conduct in any preschool setting. With minimal training and no equipment, teachers were able to increase physical activity during the break and thereby improving on-task behavior following the implementation of activity. Physical activity has a vital role in schools, as children may obtain health and academic benefits from participation. Specifically, overweight and obese children appear to equally partake in MVPA participation during these short breaks. As a low resource intervention, it may be easy for all teachers to incorporate small doses of activity into their classroom; even through reinforcing academic concepts. Ultimately, breaks may be an effective strategy to increase physical activity in a highly sedentary group and further research in this area will provide more information on its influence in a variety of preschool settings and locations.

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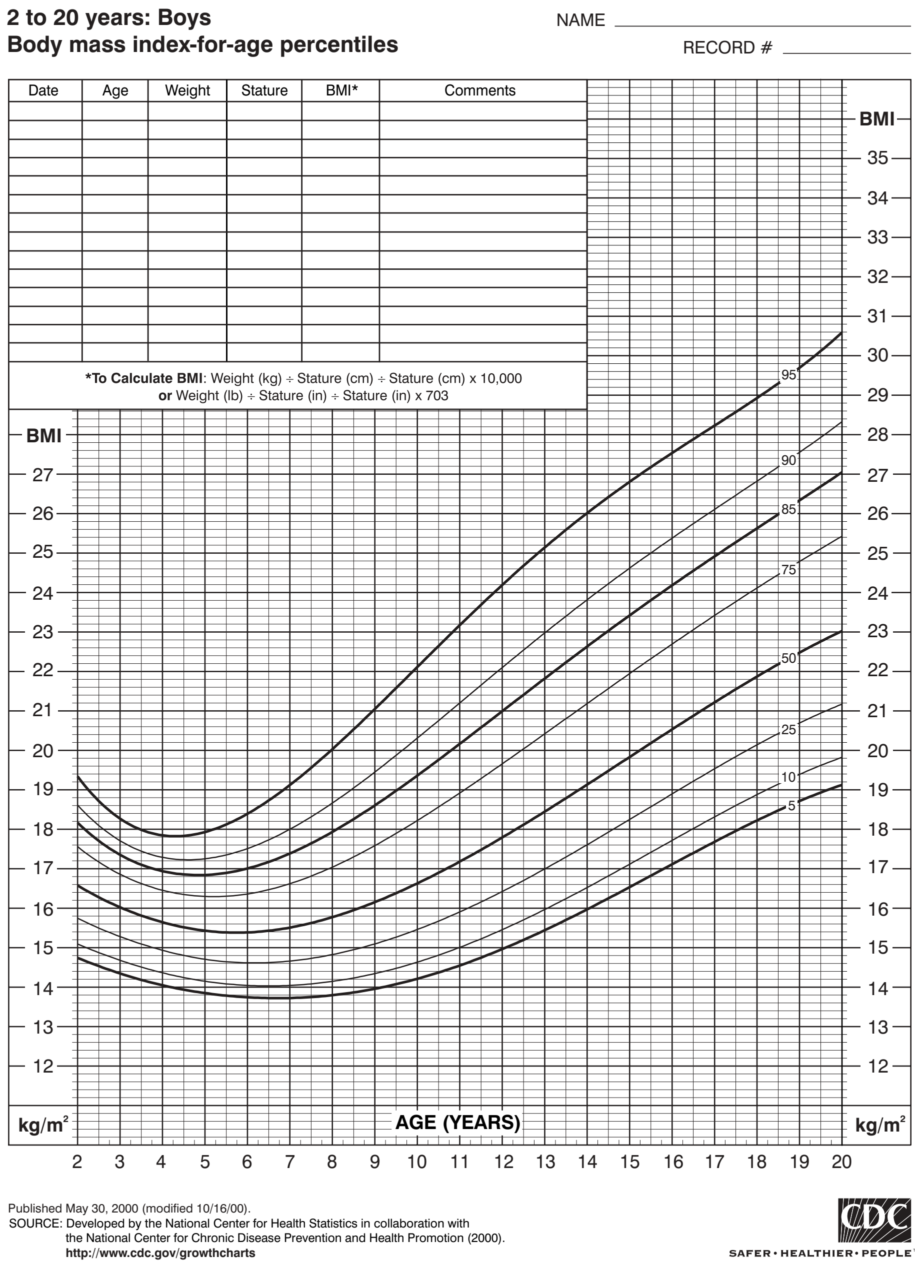
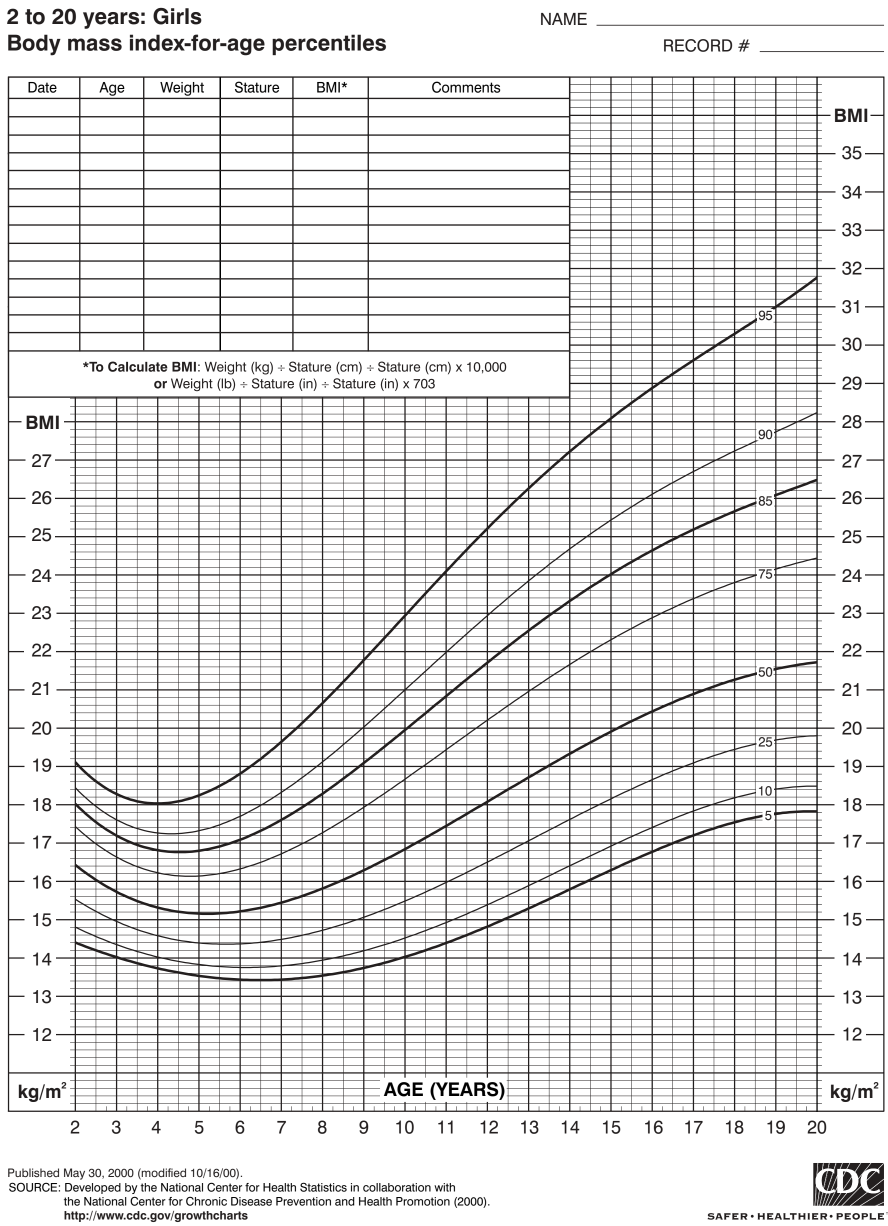
Appendices

Appendix A: CDC BMI-for-Age growth charts

CDC BMI-for-Age chart for boys, ages 2-20



CDC BMI-for-Age chart for girls, ages 2-20



Appendix B – Institutional Review Board Consent Form

AUBURN
UNIVERSITY

COLLEGE OF EDUCATION

KINESIOLOGY

The Auburn University Institutional Review Board has approved this document for use from 9/13/12 to 9/17/13
Protocol # 10-217 MR 1009

Informed Parental Consent

The Influence of a planned movement and physical activity program on the Physiological and Psychology Parameters in a Pediatric Population.

Your child is invited to participate in a research project that aims to discover: 1) how a planned movement program improves your child's physical activity and motor skills and 2) how physical activity affects your child's ability to stay on task during classroom activities. A secondary objective is to understand the relation between ideal and healthy perceptions of body image perception to motor behavior in preschool-age children. This study is being conducted by Drs. Wadsworth and Robinson in the Auburn University Department of Kinesiology. Your child was selected as a possible participant because he or she attends preschool at a data collection site. Since your child is age 18 or younger we must have your permission to include him/her in the study.

What will be involved if your child participates? If you decide to allow your child to participate in this research study, your child will be asked to wear an accelerometer that measures physical activity, complete a motor skill assessment and be observed during class time. The variables will be collected at your child's preschool throughout the day and are described below:

The following assessments are not a part of your child's regular school activities. By signing this form, you give us permission to let your child take part in this research component and keep any information about your child that we gather during this session.

1. **Physical Activity** information will be collected to examine children's physical activity throughout their day with ***accelerometers.*** Accelerometers are small devices (smaller than a pager) that will attach to the waistband of each child at the start of the school day and removed before your child departs the preschool center. This device records the total number of steps and physical activity.

2. **Time Spent On-Task** information will be collected by an independent observer and record the amount of time your child spends on-task (i.e. following directions or engaging in a task) or off-task (i.e. not following directions). This assessment is conducted by observing your child during the preschool hours and recording the frequency of their behaviors.

3. **Body Perceptions** will be assessed with black and white line drawing of body figures for children (boys or girls) and for mothers, respectively. Your child will be asked to point to the picture that they perceive *"looks most like them, they like the most, and see as healthy for them and their mother"*.

Page 1 of 3________________Parent/Guardian Initials

2050 Beard-Eaves
Memorial Coliseum
Auburn, AL 36849-5323

Telephone:
334-844-4483

Fax:
334-844-1467

www.auburn.edu

The following assessments are part of the regular school curriculum activities at your child's school. By signing this form, you agree that we can have the following information gathered:

1. **Descriptive Information** will include ***height, weight, sex, race,*** and ***date of birth.*** Height will be measured using a standard tape measure. Children will be asked to stand with their back against a wall while height will be measured to the nearest inch. Children will also stand on a weight scale backwards to measure their weight to the nearest pound. Your child will not be told their weight. It takes 5 minutes to complete each child's height and weight measurement.
2. **Gross Motor Skills** information will be collected using the ***Test of Gross Motor Development – 2nd Edition (TGMD-2).*** The test will examine your child's ability to run, jump, hop, leap, gallop, slide, roll, throw, catch, strike, dribble, and kick. The TGMD-2 takes about 20 – 25 minutes to complete.
3. **Movement Program** – Your child participates in daily physical play at school. For this project we will incorporate physical play breaks that lasts about 10-minute into your students daily curriculum, in addition to their regular play activity time. Time spent in physical activity will be assessed with accelerometers during this activity.

Are there any risks or discomforts? There are no foreseeable risks or discomforts associated with these assessments or participating in the movement program. To preserve confidentiality, all names and other recognizable information will be removed from all information collected (i.e., data will be recorded confidentially) at the completion of the study.

Are there any benefits to your child or others? In terms of benefits, your preschool center will receive a copy of the information that demonstrates the effectiveness and/or benefits of the program. Additionally, a health and wellness profile will be provided to each parent/guardian for their child, along with tips to promote optimal growth and development. There are no costs for the program and your child will not receive compensation for participation.

If you (or your child) change your mind about your child's participation, your child can be withdrawn from the study at any time. Your child's participation is completely voluntary. If you choose to withdraw your child, your child's data can be withdrawn as long as it is identifiable. Your decision about whether or not to allow your child to participate or to stop participating will not jeopardize your or your child's future relations with Auburn University, the Department of Kinesiology or your childcare center.

Your child's privacy will be protected. Any information obtained in connection with this study will remain confidential. The data collected will be protected by securing the data on a password protected computer. Information obtained through your child's participation may be used for publication and presentation but will be reported anonymously and in aggregate.

The Auburn University Institutional Review Board has approved this document for use from 9/13/12 to 9/7/13
Protocol # 10-217MR1009

____
Parent/Guardian Initials

Should you have any questions, please ask them now or contact Dr. Leah Robinson (334-844-8055 or lerobinson@auburn.edu) or Dr. Danielle Wadsworth (334-844-1836 or wadswdd@auburn.edu). A copy of this form will be provided for your records. For more information regarding your rights, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH FOR YOUR CHILD TO PARTICIPATE IN THIS RESEARCH STUDY AND ALLOW THE RESEARCHERS TO USE THE DATA. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO ALLOW YOUR CHILD TO PARTICIPATE.

Child's Name (Please Print)	____________________		__________
Parent/Guardian Signature	____________________	Date	__________
Printed Parent/Guardian Name	____________________		__________
Investigator Obtaining Consent	____________________	Date	__________
Printed Investigator Name	Danielle D. Wadsworth		__________

Appendix C – On-task Coding Sheet

On-Task Recording Form

Date		School		Grade	
Time Start		Observer		No. Girls	
Time End				No. Boys	
Location	O or I				
Description					

MINUTES 1-8

Sub.	**Interval**	**On-task**	**Off-task**			**Notes**
1	1	Yes	M	N	P/O	
	2	Yes	M	N	P/O	
m/f	3	Yes	M	N	P/O	
	4	Yes	M	N	P/O	
2	5	Yes	M	N	P/O	
	6	Yes	M	N	P/O	
m/f	7	Yes	M	N	P/O	
	8	Yes	M	N	P/O	
3	9	Yes	M	N	P/O	
	10	Yes	M	N	P/O	
m/f	11	Yes	M	N	P/O	
	12	Yes	M	N	P/O	
4	13	Yes	M	N	P/O	
	14	Yes	M	N	P/O	
m/f	15	Yes	M	N	P/O	
	16	Yes	M	N	P/O	
5	17	Yes	M	N	P/O	
	18	Yes	M	N	P/O	
m/f	19	Yes	M	N	P/O	
	20	Yes	M	N	P/O	
6	21	Yes	M	N	P/O	
	22	Yes	M	N	P/O	
m/f	23	Yes	M	N	P/O	
	24	Yes	M	N	P/O	
7	25	Yes	M	N	P/O	
	26	Yes	M	N	P/O	
m/f	27	Yes	M	N	P/O	
	28	Yes	M	N	P/O	
8	29	Yes	M	N	P/O	
	30	Yes	M	N	P/O	
m/f	31	Yes	M	N	P/O	
	32	Yes	M	N	P/O	

RETURN TO SUBJECT 1 AND CONTINUE OBSERVATION

MINUTES 9-16

Sub.	Interval	On-task	Off-task			Notes
1	1	Yes	M	N	P/O	
	2	Yes	M	N	P/O	
m/f	3	Yes	M	N	P/O	
	4	Yes	M	N	P/O	
2	5	Yes	M	N	P/O	
	6	Yes	M	N	P/O	
m/f	7	Yes	M	N	P/O	
	8	Yes	M	N	P/O	
3	9	Yes	M	N	P/O	
	10	Yes	M	N	P/O	
m/f	11	Yes	M	N	P/O	
	12	Yes	M	N	P/O	
4	13	Yes	M	N	P/O	
	14	Yes	M	N	P/O	
m/f	15	Yes	M	N	P/O	
	16	Yes	M	N	P/O	
5	17	Yes	M	N	P/O	
	18	Yes	M	N	P/O	
m/f	19	Yes	M	N	P/O	
	20	Yes	M	N	P/O	
6	21	Yes	M	N	P/O	
	22	Yes	M	N	P/O	
m/f	23	Yes	M	N	P/O	
	24	Yes	M	N	P/O	
7	25	Yes	M	N	P/O	
	26	Yes	M	N	P/O	
m/f	27	Yes	M	N	P/O	
	28	Yes	M	N	P/O	
8	29	Yes	M	N	P/O	
	30	Yes	M	N	P/O	
m/f	31	Yes	M	N	P/O	
	32	Yes	M	N	P/O	

RETURN TO SUBJECT 1 AND CONTINUE OBSERVATION

MINUTES 17-24

Sub.	Interval	On-task	Off-task			Notes
1	1	Yes	M	N	P/O	
	2	Yes	M	N	P/O	
m/f	3	Yes	M	N	P/O	
	4	Yes	M	N	P/O	
2	5	Yes	M	N	P/O	
	6	Yes	M	N	P/O	
m/f	7	Yes	M	N	P/O	
	8	Yes	M	N	P/O	
3	9	Yes	M	N	P/O	
	10	Yes	M	N	P/O	
m/f	11	Yes	M	N	P/O	
	12	Yes	M	N	P/O	
4	13	Yes	M	N	P/O	
	14	Yes	M	N	P/O	
m/f	15	Yes	M	N	P/O	
	16	Yes	M	N	P/O	
5	17	Yes	M	N	P/O	
	18	Yes	M	N	P/O	
m/f	19	Yes	M	N	P/O	
	20	Yes	M	N	P/O	
6	21	Yes	M	N	P/O	
	22	Yes	M	N	P/O	
m/f	23	Yes	M	N	P/O	
	24	Yes	M	N	P/O	
7	25	Yes	M	N	P/O	
	26	Yes	M	N	P/O	
m/f	27	Yes	M	N	P/O	
	28	Yes	M	N	P/O	
8	29	Yes	M	N	P/O	
	30	Yes	M	N	P/O	
m/f	31	Yes	M	N	P/O	
	32	Yes	M	N	P/O	

RETURN TO SUBJECT 1 AND CONTINUE OBSERVATION

MINUTES 25-32

Sub.	Interval	On-task	Off-task			Notes
1	1	Yes	M	N	P/O	
	2	Yes	M	N	P/O	
m/f	3	Yes	M	N	P/O	
	4	Yes	M	N	P/O	
2	5	Yes	M	N	P/O	
	6	Yes	M	N	P/O	
m/f	7	Yes	M	N	P/O	
	8	Yes	M	N	P/O	
3	9	Yes	M	N	P/O	
	10	Yes	M	N	P/O	
m/f	11	Yes	M	N	P/O	
	12	Yes	M	N	P/O	
4	13	Yes	M	N	P/O	
	14	Yes	M	N	P/O	
m/f	15	Yes	M	N	P/O	
	16	Yes	M	N	P/O	
5	17	Yes	M	N	P/O	
	18	Yes	M	N	P/O	
m/f	19	Yes	M	N	P/O	
	20	Yes	M	N	P/O	
6	21	Yes	M	N	P/O	
	22	Yes	M	N	P/O	
m/f	23	Yes	M	N	P/O	
	24	Yes	M	N	P/O	
7	25	Yes	M	N	P/O	
	26	Yes	M	N	P/O	
m/f	27	Yes	M	N	P/O	
	28	Yes	M	N	P/O	
8	29	Yes	M	N	P/O	
	30	Yes	M	N	P/O	
m/f	31	Yes	M	N	P/O	
	32	Yes	M	N	P/O	

OBSERVATION COMPLETE

COMPLETE SUMMARIZATION FORM

On-Task Summary Form

	Pre – On	Off M	Off N	Off P/O		Post – On	Off M	Off N	Off P/O
Child 1									
Child 2									
Child 3									
Child 4									
Child 5									
Child 6									
Child 7									
Child 8									

TI or AB

Date: _______________

Classroom: __________

Coder: _____________

Notes:

Reminders for coding behavior

- Prior to arrival, make sure your audio recording of the timing intervals is working.
- Arrive to class early and be prepared to observe a minimum of 5-minutes before the start time
- At the appropriate start time begin observation and be sure to note all information on the coding sheets
- Avoid interaction with the children. Let them know that "you are working and cannot play with them"
- At the end of the observation period complete all paperwork and clean up your area.
- Be courteous, kind and accommodating to the children and teachers.

Definitions

On-task behavior – Verbal or motor behavior that follows the class rules AND is appropriate to the learning situation.

Off-task behavior – Motor, noise, passive or other behavior that does not follow the class rules or is not appropriate to the learning situation

Appendix D – TGMD-2 Scoring Sheet

ID #		Assessment Date:		
Preferred Hand		**LOCOMOTOR SKILLS**		
Preferred Foot				
Skill	Performance Criteria	Trial 1	Trial 2	Score
Run	Arms move in opposition to legs, elbows bent			
	Brief period where both feet are off the ground			
	Narrow foot placement landing on heel or toe (i.e., not flat footed)			
	Nonsupport leg bent approximately 90 degrees (i.e., close to buttocks)			
Gallop	Arms bent and lifted to waist level at takeoff			
	A step forward with the lead foot followed by a step with the trailing foot to a position adjacent to or behind the lead foot			
	Brief period when both feet are off the floor			
	Maintains a rhythmic pattern for four consecutive gallops			
Hop	Nonsupport leg swings forward in pendular fashion to produce force			
	Foot of nonsupport leg remains behind body			
	Arms flexed and swing forward to produce force			
	Takes off and lands three consecutive times on preferred foot			
	Takes off and lands three consecutive times on nonpreferred foot			
Leap	Take off on one foot and land on the opposite foot			
	A period where both feet are off the ground longer than running			
	Forward reach with the arm opposite the lead foot			
Horizontal Jump	Preparatory movement includes flexion of both knees and arms extended behind body			
	Arms extend forcefully forward and upward reaching full extension above the head			
	Take off and land on both feet simultaneously			
	Arms are thrust downward during landing			
Slide	Body turned sideways so shoulders are aligned with the line on the floor			

	A step sideways with lead foot followed by a slide of the trailing foot to a point next to the lead foot			
	A minimum of four continuous step-slide cycles to the right			
	A minimum of four continuous step-slide cycles to the left			

ID #		Assessment Date:		
Preferred Hand		**OBJECT CONTROL SKILLS**		
Preferred Foot				
Skill	Performance Criteria	Trial 1	Trial 2	Score
Striking a Stationary Ball	Dominant hand grips bat above nondominant hand			
	Nonpreferred side of body faces the imaginary tosser with feet parallel			
	Hip and shoulder rotation during swing			
	Transfers body weight to front foot			
	Bat contacts ball			
Stationary Dribble	Contacts ball with one hand at about belt level			
	Pushes ball with fingertips (not a slap)			
	Ball contacts surface in front of or to the outside of foot on preferred side			
	Maintains control of ball for four consecutive bounces without having to move the feet to retrieve it			
Catch	Preparation phase where hands are in front of the body and elbows are flexed			
	Arms extend while reaching for the ball as it arrives			
	Ball is caught by hands only			
Kick	Rapid continuous approach to the ball			
	An elongated stride or leap immediately prior to ball contact			
	Nonkicking foot placed even with or slightly in back of the ball			
	Kicks ball with instep of preferred foot (shoelaces) or toe			
Over-arm Throw	Windup is initiated with downward movement of hand/arm			
	Rotates hips and shoulders to a point where the nonthrowing side faces the wall			
	Weight is transferred by stepping with the foot opposite the throwing hand			

	Follow-through beyond ball release diagonally across the body toward the nonpreferred side			
Underhand Roll	Preferred hand swings down and back, reaching behind the trunk while chest faces cones			
	Strides forward with foot opposite the preferred hand toward the cones			
	Bends knees to lower body			
	Releases ball close to the floor so ball does not bounce more than 4 inches high			

Appendix E: Changes to typical school day schedules

Schedule 1 for Classrooms: C, I, K

Normal Schedule			**Proposed Schedule Change**		
Activity	**Time**	**Length**	**Activity**	**Time**	**Length**
Breakfast/ Tooth brushing	8:15-8:45 am	30 min	Breakfast/ Tooth brushing	8:15-8:45 am	30 min
Morning Group Time	8:45-9:05 am	20 min	Morning Group Time	8:45-9:05 am	20 min
Small Group Time / Social Skills	9:05-9:25 am	20 min	Small Group Time / Social Skills	9:05-9:25 am	20 min
Large group time	9:25 – 9:40 am	15 min	Large Group Time	9:25 – 9:40 am	15 min
Bathroom/ Outside Time	9:40 – 10:15 am	35 min	**Activity Break**	**9:40 – 9:50 am**	**10 min**
			Read Aloud	**9:50 – 10:10 am**	**20 min**
Planning Time	10:15-10:25 am	10 min	**Planning Time**	**10:10-10:20**	**10 min**
Work Time	10:25 -11:15 am	50 min	**Work Time**	**10:20-11:00**	**40 min**
Clean – up Time	11:15 – 11:25 am	10 min	**Clean – up Time**	**11:00-11:10**	**10 min**
Recall Time	11:25 – 11:35 am	10 min	**Recall Time**	**11:10-11:20**	**10 min**
Read Aloud	11:35 – 11:55 am	20 min	**Bathroom/Outside Time**	**11:20 – 11:55**	**35 min**
Bathroom/ Lunch/ Tooth brushing	11:55 – 12:30 pm	35 min	Bathroom/ Lunch/ Tooth brushing	11:55 – 12:30 pm	35 min
Afternoon Group Time	12:30 – 12:55 pm	25 min	Afternoon Group Time	12:30 – 12:55 pm	25 min
Transition to Child Care/ Bus Loading	12:50 pm	Until done	Transition to Child Care/ Bus Loading	12:50 pm	Until done
Teacher planning	1:30 – 2:50 pm		Teacher planning	1:30 – 2:50 pm	

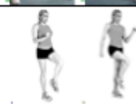
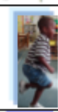
Schedule 2 for classrooms: A, B, J, M

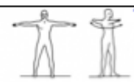
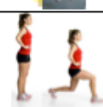
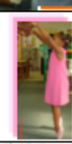
Normal Schedule			**Proposed Schedule Change**		
Activity	**Time**	**Length**	**Activity**	**Time**	**Length**
Breakfast/ Tooth brushing	8:15-8:45 am	30 min	Breakfast/ Tooth brushing	8:15-8:45 am	30 min
Morning Group Time	8:45-9:05 am	20 min	Morning Group Time	8:45-9:05 am	20 min
Bathroom/ Outside Time	9:05-9:40 am	35 min	Bathroom/ Outside Time	9:05-9:40 am	35 min
Small Group Time/ Social Skills	9:40 – 10:00 am	20 min	Small Group Time/ Social Skills	9:40 – 10:00 am	20 min
Read aloud	10:00 – 10:20 am	20 min	Read aloud	10:00 – 10:20 am	20 min
			Activity Break	**10:20-10:30 am**	**10 min**
Planning Time	10:20-10:30 am	10 min	**Planning Time**	**10:30-10:40 am**	**10 min**
Work Time	10:30-11:20 am	50 min	**Work Time**	**10:40-11:20 am**	**40 min**
Clean- up Time	11:20 – 11:30 am	10 min	Clean- up Time	11:20 – 11:30 am	10 min
Recall Time	11:30 – 11:40 am	10 min	Recall Time	11:30 – 11:40 am	10 min
Bathroom	11:40 – 11:50 am	10 min	Bathroom	11:40 – 11:50 am	10 min
Large Group Time	11:50 – 12:05 pm	15 min	Large Group Time	11:50 – 12:05 pm	15 min
Lunch/ Tooth brushing	12:05 – 12:35 pm	30 min	Lunch/ Tooth brushing	12:05 – 12:35 pm	30 min
Afternoon Group Time	12:35 – 12:55 pm	20 min	Afternoon Group Time	12:35 – 12:55 pm	20 min
Transition to child care/ bus loading	12:50 pm	Until done	Transition to child care/ bus loading	12:50 pm	Until done
Teacher planning	1:30 – 2:50 pm		Teacher planning	1:30 – 2:50 pm	

Schedule 3 for classrooms: D, E, H, N

Normal Schedule			Proposed Schedule Change		
Activity	**Time**	**Length**	**Activity**	**Time**	**Length**
Breakfast/ Tooth brushing	8:15-8:45 am	30 min	Breakfast/ Tooth brushing	8:15-8:45 am	30 min
Morning Group Time	8:45-9:05 am	20 min	Morning Group Time	8:45-9:05 am	20 min
Planning Time	9:05-9:15 am	10 min	Planning Time	9:05-9:15 am	10 min
Work Time	9:15 – 10:05 am	50 min	**Work Time**	**9:15 – 9:55 am**	**40 min**
Clean-up Time	10:05 – 10:15 am	10 min	**Clean-up Time**	**9:55 – 10:05 am**	**10 min**
Recall Time	10:15-10:25 am	10 min	**Recall Time**	**10:05-10:15 am**	**10 min**
			Activity Break	**10:15-10:25 am**	**10 min**
Read Aloud/ Social Skills	10:25-10:45 am	20 min	Read Aloud/ Social Skills	10:25-10:45 am	20 min
Bathroom/ Outside Time	10:45 am – 11:20 am	35 min	Bathroom/ Outside Time	10:45 am – 11:20 am	35 min
Small Group Time	11:20 – 11:40 am	20 min	Small Group Time	11:20 – 11:40 am	20 min
Large group time	11:40 – 11:55 am	15 min	Large group time	11:40 – 11:55 am	15 min
Lunch/ Tooth brushing/ Bathroom	11:55 – 12:30 pm	35 min	Lunch/ Tooth brushing/ Bathroom	11:55 – 12:30 pm	35 min
Afternoon Group Time	12:30 – 12:55 pm	25 min	Afternoon Group Time	12:30 – 12:55 pm	25 min
Transition to Child Care/ Bus Loading	12:50 pm	Until done	Transition to Child Care/ Bus Loading	12:50 pm	Until done
Teacher planning	1:30 – 2:50 pm		Teacher planning	1:30 – 2:50 pm	

Appendix F: Activity breaks for intervention

1 min.	**Arm circles:** Small & Large. Forwards & Backwards	
(30 sec – 4x)	**Scissor Kicks:** One leg in front of the other, jump & switch	
(30 sec – 4x)	**Marching:** in place	
(30 sec – 4x)	**One-legged hops:** switch feet	
(30 sec – 4x)	**Squats**	
1 min	**Deep breathing & stretch with arms**	

1 min.	**Trunk twists**	
(30 sec – 4x)	**Bunny Hops:** Both feet	
(30 sec – 4x)	**Lunges:** Alternate feet	
(30 sec – 4x)	**Up + down's:** sit, touch toes, then stand up (can jump!)	
(30 sec – 4x)	**Heel raises:** Up on your toes	
1 min	**Half moon Yoga**	

Appendix G: Teaching training packets

Project Overview

This project's aim is to get a brief snapshot of how a classroom based physical activity break that lasts 10 minutes will influence a preschooler's physical activity participation and their time spent on-task.

Other variables we will examine are the child's height, weight, and waist circumference to get an idea of their weight status and we will also be evaluating students on their motor skill performance.

If you have any questions during the project please don't hesitate to contact us with problems, thoughts or ideas

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How may students participate?

We will be providing you with a permission form to send home to parents so they may give their child permission to participate in this study. Parents must sign whether or not they would like their child to participate.

Although all students will participate in the activity breaks, only the children with a signed consent form will be able to wear the physical activity monitors and have any additional information collected from them.

What kind of time frame can you expect?

Overall we will be in each classroom for <u>two weeks</u>.

- The first week we will discuss with you the best time to pull a few students out to get their height, weight, waist circumference and motor skill performance. These assessments should take no more than 30 minutes at a time and typically we can accommodate small groups of 3-4 students to minimize the amount of class time they should miss.

- The second week will be our "testing" week. For four days during this week, we will place physical activity monitors on your students when they arrive and take them off when they depart. We will also be evaluating time on-task approximately 30 minutes before and after a scheduled "activity break".

    - We will pick a time to conduct the activity breaks during the second week we will be in your classroom.

    - Every day at the same time there will be a 10-minute block where students will either participate in an activity break for 10 minutes or go about a normal class day for that same 10 minutes.

- There will be activity breaks on 2 days and have their normal routine on 2 days = 4 days of testing total.

- For each "10 minute block" we will be observing each child's time on-task for 35 minutes before and 35 minutes after that time period.

So a typical testing period may look like this…

Monday	Tuesday	Wednesday	Thursday	Friday
Collect IRB's	Ht, Wt, WC, and MS	Ht, Wt, WC, and MS	Ht, Wt, WC, and MS	Ht, Wt, WC, and MS
Activity Break + PA monitors & on-task	**Normal Day** + PA monitors & on-task	**Activity Break** + PA monitors & on-task	**Normal Day** + PA monitors & on-task	

* We will flip-flop the order of Activity Break days and Normal Days so that we aren't observing every preschooler on a Monday and so on….

What we would like to ask of you.

To conduct a physical activity break, lasting 10 minutes, in your classroom on two of the four days we will be there during the “testing” week.

Details about the physical activity break:

- ***Who will lead them?*** You, the classroom teacher
- ***What is it?*** A structured movement program
- ***What will we be doing?*** A physical activity break that we provide for you consisting of a warm-up, a few moderate-to-vigorous activities, and a cool-down
- ***When?*** 10 minutes, during the school day
- ***Where?*** In your classroom, no equipment is necessary!
- ***How?*** We will get there!

A few other details…

- **<u>Motor skill performance</u>:** Looking at how well children can: jump, leap, hop, run, slide, gallop, strike, throw, catch, kick, roll and dribble.

- **<u>Physical activity monitors</u>:** students will wear physical activity monitors so that we may measure the amount and intensity of their activities during the school day. Students will wear belts around their waist to hold these monitors and they will be placed on the student when they arrive in the morning and we will take them off right before they leave for the day.

    - If a student leaves for some reason during the day, please help up try to keep these monitors at the school if possible!

- **<u>Time on-task</u>:** This is a direct observation measure where we sit in the classroom and observe whether or not a child is on-task or off-task depending on the classroom activity. This is a time sampling procedure, where we listen to a pre-recorded audio file (so we will be wearing headphones) and switch around to each child in the class. This will be conducted 35 minutes prior to the activity break time and 35 minutes following the break. We will hopefully no be a disruption in your class and hope that during this time activities are the same as they would be for any other day. This is simply to give us an idea if children are fidgety or restless and if physical activity breaks improve some of these behaviors and improve their concentration at all.

Questions about physical activity breaks:

What about music?

Music is a great idea if you would like to use it for an activity break. It is certainly not a necessity, but if you would like to have music coincide with your break you could provide your own or we could bring some for you as well to keep up the tempo.

Can you modify the breaks?

If you want to improvise and change the break provided to an activity that you like that is definitely ok! We want these breaks to work for you and be fun for you as well! We have provided a set of breaks so that all teachers would have similar activities for data collection, but as long as you modify any or all of the activities to something similar and it is 10 minutes long – that is ok! If you do, try to keep the general format:

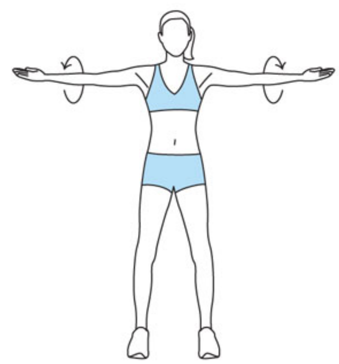
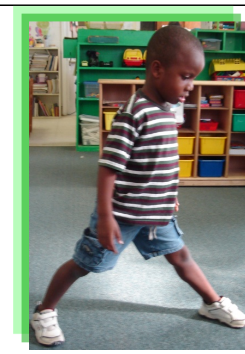
- Warm-up (1 min)
- Physical Activity #1 (30 sec)
- Physical Activity #2 (30 sec)
- Physical Activity #3 (30 sec)
- Physical Activtiy #4 (30 sec))
- Repeat PA #1-4 – 4x (total of 8 min)
- Cool-down (1 min)

Reliability checks

What are they? During each break we will also do this short checklist to give us a little bit of information about the activity breaks you performed. This is just to give us an idea about what the kids are doing and is in no way "grading" your efforts – we just want to look at the this "snap shot" a little closer and see what's effective and what is not. Also, we want to see if physical activity breaks and somewhat equal throughout the classrooms. As mentioned, there is no right or wrong answer to these! As long as you perform a break for 10 minutes that is all we ask! Here is what the checks will look like:

Date:______________________ Time Activity Break Began: _________ Time Activity Break Ended: _________ Did the break last 10 minutes? ___ Yes ___ No What was the warm up? How long did it last? ______ What was the cool down? How long did it last?	What were the four movement activities? 1. 2. 3. 4. Were they conducted for 30 seconds at a time? Was each activity repeated four times?

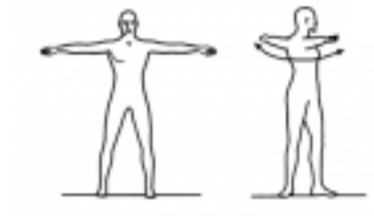
Activity Break #1

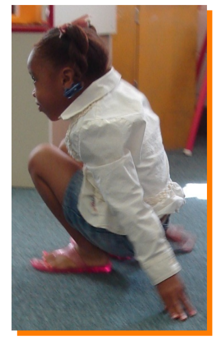
Type	Activity	Time	Picture
Warm-up	**Arm circles:** vary it up! Have children start small and get larger and larger. Can go forwards and backwards for this drill!	**1 min.**	
PA	**Scissor Kicks:** Stand with your legs spread, one foot in front and one in back. You will jump and switch your feet. Repeat.	**30 sec.**	 

PA	**Marching:** can remain stationary, or march around the room. "Like you are in a marching band or military" Knees get high.	**30 sec.**	 
PA	**One-legged hops:** Make sure one foot is back and students continuously hop around. Be sure they switch feet. If they are off-balance you can switch to two feet or holding the back of a chair with one hand	**30 sec.**	
PA	**Squats:** Stand with your feet shoulder width apart. Bend down and bend your knees, make sure that your knees don't go in front of your toes! Like sitting in an imaginary chair	**30 sec.**	 
PA	**REPEAT! Repeat each PA activity 4 times for a total of 8 minutes of PA!**	**8 min total**	Scissor Kicks (30 sec) Marching (30 sec) One-legged hops (30 sec) Squats (30 sec)

			Scissor Kicks (30 sec) Marching (30 sec) One-legged hops (30 sec) Squats (30 sec) Scissor Kicks (30 sec) Marching (30 sec) One-legged hops (30 sec) Squats (30 sec) Scissor Kicks (30 sec) Marching (30 sec) One-legged hops (30 sec) Squats (30 sec)
Cool-down	**Deep breathing and stretching arms** above head and then back down slowly to their sides, repeat	**1 min.**	

Activity Break #2

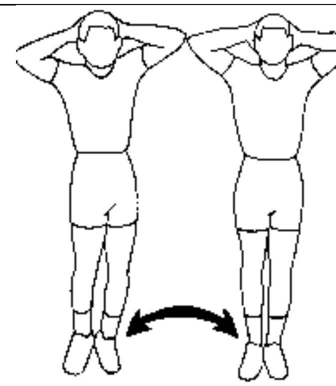
Warm-up	**Trunk twists:** slowly twist back and forth. Can place hand on the hips or out to the side. Slowly rotate back and forth.	**1 min.**	
PA	**Bunny hops:** Feet together, jump up and down like a bunny	**30 sec.**	
PA	**Lunges:** Hands on hips, lunge with one foot forward and bend that knee, then back up. Then lunge with the other.	**30 sec.**	
PA	**Up + Down's:** Start sitting on your bottom with your legs stretched out. Reach down with both hands, touch your toes. Then sit back up, and quickly stand up and raise hands in the air. Repeat. Sit on your bottom, legs stretched out…	**30 sec.**	

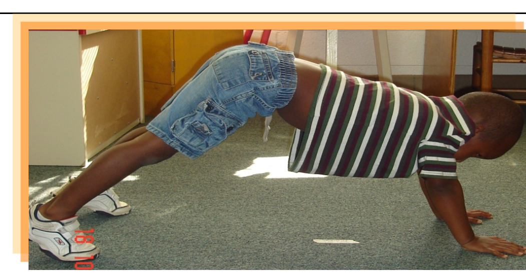
			 
PA	**Heel raises:** Slowly raise up on your toes, your heels should be in the air. Lower your heels and repeat. Can place your hand on a wall for balance.	**30 sec.**	 
PA	**REPEAT! Repeat each PA activity 4 times for a total of 8 minutes of PA!**	**8 min. total**	Bunny hops (30 sec.) Lunges (30 sec.) Up + Down's (30 sec.) Heel Raises (30 sec.) Bunny hops (30 sec.) Lunges (30 sec.) Up + Down's (30 sec.) Heel Raises (30 sec.) Bunny hops (30 sec.) Lunges (30 sec.) Up + Down's (30 sec.) Heel Raises (30 sec.) Bunny hops (30 sec.) Lunges (30 sec.)

			Up + Down's (30 sec.) Heel Raises (30 sec.)
Cool-down	**Half moon – Yoga:** Grab hands over your head. Slowly bend to one side and then the other looking like a "half moon", once you go from one side to the other. Release hands, breathe, and repeat – hands above head and bend to the side.	**1 min.**	

Alternate Activities

"Football feet": Hands up, feet approximately shoulder width apart. Similar to running in place, alternate lifting feet quickly	
Jump rope (with no rope!) Stationary jump like you are jumping rope, can swing hands if you want	

Jumping Jacks: Stand with your feet and arms together at your side. Bend your knees and jump, moving your feet apart and your arms over your head. Jump again, bringing your hands and feet back to start	
Ski Jumps: With hands behind head, jump back and forth over a line (or imaginary line). You can do this backwards and forwards, or side-to-side	
Frog jumps: Bend down like a frog, knees bent and touching the floor between your hands, jump straight up and land with bent knees	
Skipping: Alternate bringing one knee up a time with a jump	

Tip-toeing: walk around the room while balancing on your tip-toes	
Heel walking: walk around the room while balancing on your heels	
Crab walking: sit on your bottom and lift you bottom off the floor balancing on your hands and feet. Walk using your hand and feet	
Bear crawl: Crawl, using your hands and feet only, on all fours. You can use different animals (like a lion) and encourage animal noises…	

	
Balancing act: Balance on one foot, two feet and one hand, both feet and raise one knee… continue on…	 
Wall push-ups: Stand facing the wall, lean against the wall with your hands in front of you. Slowly go down in a push up motion and come back to start.	

Cycling: Sit on your bottom and lean back on your elbows. Put your feet in the air and pretend to be riding a bicycle	
Long jumps: Stand with your feet slightly shoulder width apart. Bend your knees and reach your arms behind your body. Jump as far forward as possible and land with bent knees	
Kick-ups: Run in place, kicking your feet to your bottom	
Run in place	

Appendix H. Semester Data Collection Schedule

Monday	Tuesday	Wednesday	Thursday	Friday
Oct. 22	23	24	25	26
Pass out IRB's, as students return consents, collect demographic, anthropometric and motor skill competency on **Class One**				
29	30	31	**Nov** 1	2
Class One: Implementation of activity breaks, wear accelerometers & code on-task in classroom. Continue to pass out IRB's and collect demographic, anthropometric and motor skill competency on **Class Two**				
5	6	7	8	9
Class Two: Implementation of activity breaks, wear accelerometers & code on-task in classroom. Continue to pass out IRB's and collect demographic, anthropometric and motor skill competency on **Class Three**				
12	13	14	15	16
Class Three: Implementation of activity breaks, wear accelerometers & code on-task in classroom. Continue to pass out IRB's and collect demographic, anthropometric and motor skill competency on **Class Four**				
19	20	21	22	23
Thanksgiving Break – No Data Collection				
26	27	28	29	30
Class Four: Implementation of activity breaks, wear accelerometers & code on-task in classroom. Continue to pass out IRB's and collect demographic, anthropometric and motor skill competency on **Class Five**				
Dec 3	4	5	6	7
Class Five: Implementation of activity breaks, wear accelerometers & code on-task in classroom. Continue to pass out IRB's and collect demographic, anthropometric and motor skill competency on **Class Six**				
10	11	12	13	14
Class Six: Implementation of activity breaks, wear accelerometers & code on-task in classroom. Continue to pass out IRB's and collect demographic, anthropometric and motor skill competency on **Class Seven.**				

17	18	19	20	21
Class Seven: Implementation of activity breaks, wear accelerometers & code on-task in classroom. Continue baseline assessments if needed for additional students/ class make-ups, etc.				

Appendix I: Teacher Activity Break Fidelity Checklist

Teacher Activity Break Fidelity Checklist

Date:_______________ Time Activity Break **Began**: _______________ Time Activity Break **Ended**: _______________ Did the break last 10 minutes? ___ Yes ___ No What was the **warm up**? How long did it last? ______ What was the **cool down**? How long did it last? ______	Teacher:_________________________ What were the four movement activities? 1. 2. 3. 4. Were they conducted for 30 secs at a time? ___ Yes ___ No Was each activity repeated four times? ___ Yes ___ No **Notes:**

*List distractions or issues that may have occurred during the activity break