Outcomes Associated with Teacher-Guided Indoor Preschool Physical Activity Interventions

by

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A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
May 7, 2022

Keywords: structured physical activity, pre-k, childcare, indoor, teacher intervention

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ABSTRACT

In the United States, preschool-aged children are not meeting age specific physical activity recommendations (1-3, 42, 82, 83) and spending a large portion of their days sedentary (4, 27). Minority children living in low-income rural communities and attending low-socioeconomic status (SES) schools are at a greater risk for low levels of physical activity and high levels of sedentary behavior (20, 21, 44-46). Preschool environments, where the majority of preschool-aged children spend a substantial amount of their week (6), have the ability to strongly benefit children's physical activity levels through structured teacher-led activities (22, 84, 95, 96) and involvement (i.e. verbal prompting and demonstrated modeling) (7, 16-19, 26, 141, 142), however, research shows that preschool teachers rarely encourage, prompt, model, plan and lead physical activity opportunities within the preschool setting (9, 15, 61, 65), especially indoors (27). Therefore, teacher behavior change is a priority for preschooler's physical activity opportunities to increase as adopting health behaviors are easier when conducive to change environments are created (126).

While literature shows that teacher-led structured physical activity interventions can be a viable strategy for decreasing sedentary behavior and increasing physical activity among preschoolers (16, 22-25), as a whole, interventions have resulted in small to moderate increases in children's physical activity, lacking in longitudinal success (84, 85). Moreover, interventions tend to have trained professionals implement the intervention in a way that the structured activity is consistent in delivery (25, 100, 101), which lacks realistic implementation for teachers. Because habits prompt frequent, automatic, and longitudinal performance of behavior (108), habit formation should be investigated to determine whether it may be a viable strategy in

changing preschool teacher's behavior and practices in the classroom to increase preschooler's physical activity levels.

The purpose of this study was to examine the effects of a teacher-guided and -led preschool physical activity intervention in low-income schools during indoor classroom time. Moreover, this study aimed to enhance the understanding of these influences by determining which teacher-led strategy, demonstrated modeling or verbal prompting, elicits higher levels of physical activity among children attending a low-SES preschool. Lastly, our study sought to gain more insight on the differences in children's physical activity levels during various routine segments of the preschool day to explore whether different teacher-led strategies (teacher verbal prompting or demonstrated modeling) could be more beneficial for teachers to implement during various segments of the preschool day.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

MANUSCRIPT I.

MANUSCRIPT II.

I. INTRODUCTION

Introduction

Participation in regular physical activity is associated with multiple health benefits for children (6, 31-41, 63), whereas physical inactivity is associated with increased health risk (5, 6, 30). Physical inactivity increases the risk for, many chronic diseases, including but not limited to obesity, cardiovascular disease, diabetes, and cancer (5, 6, 30). Regular physical activity positively influences seven of the ten most common chronic diseases (6) and millions of premature deaths per year could be avoided worldwide if physical inactivity was reduced (30).

Children's physical activity is not only associated with improved health risks, but also with building motor skills (36, 38), enhancing bone health (106), fostering normal growth and development (6, 31, 35), improving early literacy (63), increasing self-esteem (107) and establishing healthy lifestyles into adulthood (39, 40). Physical activity can help children feel, function and sleep better, as well as reduce the symptoms of anxiety and depression (6, 31, 32). Furthermore, physical activity can improve physical, behavioral, cognitive, and social outcomes among children (33, 34, 37, 41).

In the United States, current physical activity recommendations suggest that preschool-aged children should participate in physical activity throughout the day, with a variety of activity types that are encouraged at different intensities (6). Despite the well-documented benefits of physical activity and risks of physical inactivity, the majority of preschool-aged children (ages 3 through 5 years) do not meet age specific physical activity recommendations (1-3, 42, 82, 83) and spend a substantial amount of their day in sedentary behavior (4, 27). Health behavior practices often carry into adolescents and adulthood (56). While preschool-aged children in the United States as a whole show low levels of physical activity and high levels of sedentary

behavior, some children may be at a higher risk for these practices and health concerns than others. Specifically, minority children living in low-income rural communities and attending low-SES schools have a higher risk of low physical activity levels and high levels of sedentary behavior (20, 21, 44-46). Moreover, preschool-aged girls are generally at a higher risk of physical inactivity compared to boys (3, 11, 52, 53).

Because childhood inactivity is likely to continue into adolescents and adulthood (56), preschool (ages 3 to 5) years are a critical period to learn health-related behaviors like physical activity (7). In the preschool years considerable learning is transmitted through the large muscles, where learning comes from hands-on activities (14, 105). This age group is suggested to be more receptive to physical activity related behavior change compared to older children (8). Therefore, the best prevention and promotion opportunities may be during these early learning years because of the opportunity to establish new behaviors, such as physical activity (57).

Preschools are an important environmental setting that plays a major role in contributing daily physical activity opportunities and participation of preschoolers (9-11). Around 60% of preschool-aged children attend preschool, where they generally spend anywhere from 4 to10 hours per day (6). The preschool being attended is a strong predictor or determinant of children's physical activity, explaining nearly 50% of the variance in children's physical activity levels at school (11, 28, 52).

While preschools can play a major role in children's daily physical activity opportunities and participation (9-11), physical activity is often not recognized as integral to the curriculum because preschools often see this time as taking away from instructional time (14). This is problematic because these are the years when much of children's learning is transmitted through the large muscles, where learning comes from hands on activities (14, 105). It is recommended

and developmentally appropriate that preschoolers are provided opportunities and encouragement to engage in a variety of suitable physical activities throughout the day, as well as spend little time sitting throughout the day (6, 103); however, preschoolers are spending nearly 80% of their school day sedentary and approximately 3% of their school day in moderate-to-vigorous physical activity (MVPA) (28, 29). The little activity preschoolers are participating in is generally correlated with outdoor unstructured playtime (recess) (3, 15, 37, 53, 68, 86), which only accounts for 8% of their preschool day (27), leaving a very large portion of their day indoors and sedentary. While most preschools provide children with some daily physical activity opportunities, including recess, few provide planned, structured activity (9, 61, 65). Preschoolers should receive many structured physical activity opportunities to develop gross motor skills, enjoyment of movement, and utilization of all the large muscle groups (13, 64, 88). Therefore, preschoolers are likely not receiving enough, if any, structured physical activity opportunities, which can be a viable strategy to increase children's physical activity levels and decrease sedentary behavior (22, 25, 27, 81, 95, 96).

Teachers are considered the primary gatekeepers to physical activity during the preschool day, due to their high involvement in the decision-making process regarding children's physical activity opportunities (12). Moreover, preschool teachers are important role models (18) that can highly influence children's physical activity behaviors (7, 16-19, 26). While children develop many of their physical capabilities through play, they also need teacher structured movement activities with verbal and modeled instruction and structured physical skill development opportunities (14). Structured physical activities are defined as physical activity that is planned and intentionally directed by an adult (64). Although teachers hold the responsibility to provide age-appropriate opportunities, education, and encouragement, with regard to physical activity (6,

12-14), they rarely do so within the preschool setting (15). This is critical, because teachers have a strong influence on preschooler's physical activity levels (7, 16-19, 26).

Preschool physical activity interventions that target teacher-led strategies can have the highest beneficial outcomes for children's physical activity levels (16, 22-25, 84). Unfortunately, teacher-led physically active play opportunities are very limited in the preschool setting, especially indoors (27). Interventions show that children are more active during outdoor time compared to indoor time (15, 53, 68), therefore there is a strong need for teachers to implement more physical activity opportunities into preschooler's indoor time, where the majority of their school day is spent. In addition, intervention implementation can have a greater effect on girls' physical activity (16, 97, 98), who show lower levels of physical activity compared to boys (3, 11, 52, 53). The literature shows intervention strategies that target teacher involvement through verbal prompting (17) and modeling (18, 19) can increase preschooler's physical activity and decrease their sedentary behavior, however, it is unknown what strategies may elicit higher or lower levels of the desired behavior change. The findings within the literate suggest that teacher behavior change is a priority for preschooler's physical opportunities to increase. Because habit formation can aid in the frequent, automatic, and longitudinal performance of a behavior and behavior change (108-110), it may be a viable strategy in changing preschool teacher's behavior in the classroom to increase children's physical activity levels.

The high levels of sedentary behavior coupled with the lack of teacher's encouragement, leadership, and provision of physical activity strengthens the need for teacher involvement and behavior change to improve preschoolers' physical activity levels and create active classroom environments. However, teachers have perceived barriers when it comes to incorporating physical activity into the preschool setting (14, 64, 66, 67) and implementing new teacher

physical activity practices (109, 110). Previous research indicates teachers identify lack of ability, self-efficacy, knowledge, time, space, and resources to provide physical activity as barriers (66, 67, 87). Thus, interventions that help teachers overcome these previously identified barriers to aid in the promotion of physical activity opportunities that are conducive to increasing physical activity levels and decreasing sedentary behavior in the classroom setting should be effective.

Partnering with preschool teachers to create active classroom environments and overcome the hindrances associated with personal barriers can help teachers to consistently offer children physical activity opportunities and successfully prepare for and overcome potential obstacles that might occur during the preschool day. Therefore, helping teachers strategically plan daily structured physical activities during indoor classroom time, with a goal of children becoming more active, is needed in the preschool setting to help maximize children's physical activity opportunities and levels.

Statement of the Problem

Although the benefits of physical activity and risks of physical inactivity are well known, reports show only 50% of preschool-aged children meet physical activity recommendations (1, 3, 42), and nearly 80% of their day is spent in sedentary behavior (28, 29). Minority children living in low-income rural communities are typically at an even greater risk of low physical activity levels and high levels of sedentary behavior (20, 21). While it is said that preschools are an important environmental setting that plays a major role in contributing daily physical activity opportunities and participation of preschoolers (9-11), physical activity and outdoor play are often not recognized as integral to the curriculum because preschools often see this time as taking away from instructional time (14).

When investigating potential factors related to preschooler's physical activity levels, researchers have utilized theories (i.e., Social-Ecological Model) and techniques to gain insight on what influences behavior and behavior change to better guide intervention strategies. Despite researchers ongoing efforts to prevent low levels of physical activity in the preschool setting by testing intervention strategies, increases in children's physical activity levels have been small-to-moderate and have produced mixed findings (84, 85). However, research does show physical activity interventions, specifically those that include teacher-led structured physical activities, can be a viable strategy for decreasing sedentary behavior and increasing physical activity levels among preschoolers (16, 22-25). Unfortunately, teacher-led physically active play opportunities and encouragement are very limited in the preschool setting (15), especially indoors (27). Furthermore, although preschooler's physical activity behaviors can be influenced by teachers (7, 16-19, 26), they rarely encourage physical activity (15).

COVID-19 Statement

The details of this planned research study were disrupted and hindered by the impact of COVID-19. Due to the global COVID-19 pandemic shutdown, we were unable to undertake fieldwork due to Auburn University's campus shutting down, preschool facilities closing and changes in the way in which we were able to interact with research participants. We adjusted the scope of our research project by using pilot data that we collected pre-COVID-19 and resembled the purposed research project. The remainder of this document is altered to reflect the modified research study.

Purpose of the Study and Study Objectives

The purpose of this study was to examine the effectiveness of a structured, teacher-guided and -led preschool physical activity intervention in low-income schools during indoor classroom time.

Primary Objective: Determine whether a structured, teacher guided and led preschool physical activity intervention is a feasible approach to increase children's MVPA levels.

Secondary Objective: Determine the effect of the intervention on preschooler's physical activity levels.

Tertiary Objective: Determine whether teacher verbal prompting, or demonstrated modeling elicits higher levels of physical activity in preschoolers.

Research Questions and Hypotheses

1. What is the effect of a structured, teacher-guided and -led physical activity intervention on preschooler's physical activity levels? We hypothesized that preschoolers within intervention classrooms will show increases in levels of light and MVPA (measured using ActiGraph GT3X triaxial accelerometers) compared to the control group.
2. What are children's physical activity levels during various indoor segments of the preschool day? We hypothesized that the highest levels of light and MVPA during indoor time will occur during morning group, large group, and work time. Moreover, we hypothesize that the lowest levels of physical activity will occur during small group and read aloud. Physical activity was measured objectively with the ActiGraph GT3X triaxial accelerometer.
3. Does teacher verbal prompting or demonstrated modeling elicit higher levels of activity for preschoolers during the school day? We hypothesized that teacher demonstrated modeling will elicit higher levels of activity for preschoolers during the school day

compared to teacher verbal prompting. Teacher demonstrated modeling and teacher verbal prompting will be measured using stage 1 of the SOSMART.

Significance of the Study

Most interventions targeting physical activity in preschoolers have a small to moderate effect and do not result in long-term implementation and engagement. Moreover, intervention strategies are not guided by the teachers regarding what activities would best suit their schedule, classroom, and preschoolers. Gaining teachers perspectives and working with them to implement their own ideas might increase how often children are provided physical activity opportunities in the classroom setting. By implementing this intervention into preschool classroom practices, this study attempts to increase physical activity levels indoors, where the lowest levels are seen, as well as help teachers incorporate activity into the content already planned.

Research suggests teacher-led physical activity is one of the most effective strategies with regard to increasing preschooler's physical activity levels. Comparing different teacher-led physical activity strategies (i.e., demonstrated modeling and verbal prompting) can help gain an insight on what teacher approaches elicit higher levels of physical activity in preschoolers. Based on the following literature review, a structured, teacher-guided and -led intervention promoting physical activity in low-income schools during indoor daily classroom time was the most beneficial intervention approach for preschoolers.

Limitations

The following are limitations of this study:

1. This study only examined a snapshot of the preschool school year; therefore, results may differ across time.

2. Because children and teachers are from one Head Start center and the majority are African American, the findings will not be generalizable to other population samples and geographic regions.
3. Our study in Manuscript I. relied on teacher self-report to determine implementation fidelity. This is a limitation due to reliability and validity issues are often associated with self-report.
4. Manuscript I. study did not include a baseline measure for either group in order to determine physical activity levels prior to the intervention implementation.
5. While the literature suggests that preschool physical activity interventions lasting less than four weeks tend to have the greatest impact on children's physical activity levels, longer durations to assess sustainability are likely necessary.
6. Due to the teacher-guided nature of this intervention, classroom activities will likely differ amongst all classrooms. In addition, because classroom activities may differ, the duration of the physical activity will not be consistent across classrooms.
7. Because there are two teachers in each classroom, they will need to collaborate with each other and with the researcher to agree on the physical activity and time the intervention will be implemented into their indoor classroom time. While we do not expect this to be an issue, differing ideas and opinions can be a potential limitation.
8. The student to teacher ratio within the program is approximately 18:2. A different ratio of students to teachers may yield different results.

Delimitations

The following are delimitations of this study:

1. Participants include preschool-aged children and preschool teachers enrolled in and employed by a Head Start program, located in a rural, southeastern town in the United States.
2. The results of this study will be delimited to the intervention data collection periods. Physical activity and teacher involvement were measured two days per week for three weeks within the intervention duration.

Summary

This chapter has summarized the background, statement of the problem, the purpose of the study and study objectives, the research questions and hypothesis, the significance of the study, and the limitations and delimitations. Chapter two includes a review of the related literature concerning physical activity, preschool, teachers, and interventions. Chapter three outlines Manuscript I. titled "The Effect of a Teacher-Guided and -Led Indoor Preschool Physical Activity Intervention: A Feasibility Study." Chapter four outlines Manuscript II. titled "How Teacher Verbal Prompting and Demonstrated Modeling Correlate to Preschooler's Physical Activity Levels." The body of both manuscripts includes an abstract, introduction, methods, results, discussion, and conclusion.

II. LITERATURE REVIEW

Overview

The majority of preschool-aged children (ages 3 through 5 years) do not meet age specific physical activity recommendations (1-3, 42, 82, 83) and spend a significant amount of their day in sedentary behavior (4, 27). Minority children living in low-income rural communities are at an even greater risk of low physical activity levels and high levels of sedentary behavior (20, 21).

Children's physical inactivity (5, 6, 30) is associated with poor health outcomes, and inversely there are many health benefits and positive influences health outcomes associated with children's regular physical activity participation (6, 31-41, 63). Because childhood inactivity is likely to continue into adolescents and adulthood (56), preschool years are a critical period to learn health-related behaviors like physical activity (7). Moreover, this age group is suggested to be more receptive to physical activity related behavior change compared to older children (8). The best prevention and promotion opportunities may be during these early learning years because of the opportunity to establish new behaviors, such as physical activity (57).

Preschools have been identified as an important environmental setting that play a major role in contributing daily physical activity opportunities and participation of preschoolers (9-11). Although teachers hold the responsibility to provide age-appropriate opportunities, education, and encouragement, with regard to physical activity (6, 12-14), they rarely do so within the preschool setting (15). The high levels of sedentary behavior coupled with the lack of teacher's encouragement and provision of physical activity, strengthens the need for teacher involvement to improve preschoolers' physical activity levels. However, teachers have perceived barriers when it comes to implementing physical activity into the preschool setting. Some perceived

barriers that teachers have identified in previous research include lack of ability/knowledge to teach physical activity, personal health and values, poor attitudes toward physical activity, lack of time, resources, and facilities, insufficient space, and weather (12, 144-148). Therefore, interventions that address and/or overcome teachers' barriers might be beneficial to increasing physical activity in preschoolers.

Previous research shows physical activity interventions, specifically those that include teacher-led structured physical activities, can be a viable strategy for decreasing sedentary behavior and increasing physical activity levels among preschoolers (16, 22-25). Unfortunately, teacher-led physically active play opportunities and encouragement are very limited in the preschool setting, especially indoors (27). Research supports children are more active during outdoor time compared to indoor time (15, 53, 68). Therefore, there is a strong need for teachers to implement more physical activity opportunities into preschooler's indoor time, where most of their school day is spent. Among the many beneficial outcomes that can derive from interventions that assist teachers with the implementation of physical activity into the indoor setting at low-income preschool programs, they can help increase children's activity levels, decrease children's sedentary levels, and decrease teachers perceived barriers to physical activity implementation. Helping teachers strategically plan these physical activities and encouraging implementation into indoor classroom content, with a goal of children becoming more active, is needed in the preschool setting to help maximize children's physical activity opportunities and levels. The main purpose of this study was to examine the effectiveness of a structured, teacher-guided and -led preschool physical activity intervention in low-income schools during indoor classroom time. Chapter 2 reviews the literature leading to this intervention.

Physical Activity

The health benefits of physical activity and inactivity among children are well documented. Physical inactivity can increase the risk of many chronic diseases, including but not limited to obesity, cardiovascular disease, diabetes, and cancer (5, 6, 30). New research shows that any length of moderate to vigorous physical activity (MVPA) contributes to health benefits, and some health benefits activate immediately following physical activity (6). Regular physical activity positively influences seven of the ten most common chronic diseases (6) and approximately 5.3 million premature deaths per year could be avoided worldwide if physical inactivity was reduced (30).

Preschooler's physical activity is not only associated with improved health outcomes, but also with building motor skills (36, 38), fostering normal growth and development (6, 31, 35), improving early literacy (63), and establishing healthy lifestyles into adulthood (39, 40). Physical activity can help children feel, function and sleep better, as well as reduce the symptoms of anxiety and depression (6, 31, 32). Furthermore, research shows physical activity can improve physical, behavioral, cognitive, and social outcomes among children (33, 34, 37, 41). Despite this well documented information, the majority of preschool-aged children (ages 3 through 5 years) do not meet age specific physical activity recommendations (1-3) and spend a significant amount of their day in sedentary behavior (4, 27).

In the United States, current physical activity recommendations suggest that preschool-aged children should engage in three hours of physical activity throughout the day, with a variety of activity types (i.e., unstructured or structured) that are encouraged at different intensities (i.e., light, moderate, or vigorous) (6). Because gross motor skills are dominant in preschoolers and they can only sit still for brief periods of time (103), developmentally appropriate practices in these years recommend children spend little time sitting throughout the day, therefore, teachers

should provide children with ample opportunities to use large muscles in both play and planned movement activities (14). According to Alabama Department of Education (13), daily activities should include many opportunities for young children to develop competence and confidence in their gross motor skills. In a systematic review of literature, Tucker (3) found only around 50% of preschoolers are engaged in 60 minutes of physical activity daily. This is concerning as this is far less than the recommended target of around 3 hours per day of activity of all intensities (6). Research continues to show around 50% of preschool-aged children do not meet physical activity recommendations (1, 42). There is a common misconception that children are very physically active, however, research shows the majority tend to be physically inactive (28, 54, 55), spending an average of 80% of their day sedentary both during school hours and during waking hours (28, 29). A study using accelerometers to measure preschooler's physical activity found children only spend 13% of their school day in MVPA (11). A similar study of minority children attending low-SES preschools found children engaged in even less (1%) time in MVPA during their school day (60). Direct observation measures found during the preschool day, preschoolers engage in MVPA for around 3-6% of the observed time (15, 28, 114). Studies specifically examining physical activity during outdoor recess found preschoolers spend around 11-27% of this time in MVPA (15, 114, 115, 116). Recess is an allotted time in the school day where children are encouraged to be physically active and engage with peers in age-appropriate physical activities, including equipment (i.e., tricycle) and/or sedentary alternatives (i.e., sandbox) (115, 117, 118). Recess typically takes place outdoors and although children's physical activity and play are monitored by trained staff and/or volunteers, the activities are often unstructured, meaning they are activities the child starts themselves and are not planned and intentionally directed by an adult (64, 113, 115).

Structured Physical Activity

Structured activities are those that are planned and intentionally directed by an adult (64). Structured physical activity opportunities should encourage and contribute to a child's basic motor development and skills and their enjoyment of movement, as well as utilize large muscle groups (64, 88). It is developmentally appropriate that preschoolers receive many structured opportunities to improve gross motor skills (13) and that teachers educate them on the importance of physical activity (14). Although most centers provide daily physical activity opportunities, including outdoor free play, few provide planned, structured activity (9, 61, 65). Therefore, preschoolers may only be receiving unstructured physical activity opportunities, when the provision and participation of both structured and unstructured activities are recommended and developmentally appropriate (6, 13).

Determinants of Physical Activity in Preschoolers

Physical activity is influenced by many factors, including but not limited to, demographic factors and socioeconomic status (SES). While preschool-aged children as a whole show low levels of physical activity and high levels of sedentary behavior, minority children living in low-income rural communities are at an even greater risk of low physical activity levels and high levels of sedentary behavior (20, 21). Across the United States, African American (19.5%) children show higher levels of physical inactivity when compared to Hispanic (16%) and Caucasian (11.1%) children, which only continues to increase with age (43). Similar to other age groups, preschool-aged boys participate in more physical activity than girls (3, 11, 52, 53). To support this finding, a systematic review (61) found 12 out of the 15 studies that examined a gender variable had these same results. Household education levels have been associated with the prevalence of obesity in children and adolescents (21, 47, 48) and the prevalence of obesity

levels are highly correlated with physical activity levels, where lower levels of physical activity are associated with higher risks and levels of obesity (16, 49-51). Children and adolescents living in homes where the head of the household had a college degree or higher are 10% less likely to be obese compared to those living in a home where the head of the household had less than a high school degree (48). This particular study also found the prevalence of obesity was on average 4.5% higher among African American girls for both high- and low-education households, however, this difference was not observed for African American boys (48). Low-SES schools typically provide fewer physical activity supportive practices (45, 46) and are less likely to offer recess (44) compared to high-SES schools. Moreover, the literature shows children who attend high-SES schools spend 4.4 more minutes per school day in MVPA and are 31% more likely to have a physical education teacher compared to children attending low-SES schools (46). Even employees working at low-SES preschools experience greater health risks, showing that Head Start staff are three times more likely to have a fair or poor health status compared to the national sample of individuals with similar sociodemographic characteristics (62). Moreover, this study found 37% of the adults in this population were obese (62), which is highly associated with physical inactivity in both adults (73-75) and children (16, 49-51, 69-72).

Preschool

Years and Setting

Preschool years are a vital time to learn health-related behaviors like physical activity (24) because this age group is suggested to be more receptive to physical activity related behavior change compared to older children (8). Research supports preschools are an important environmental setting that play a major role in contributing to daily physical activity opportunities and participation of preschoolers (9-11). In the preschool setting, physical activity

and outdoor play are often not recognized as integral to the curriculum because preschools often see this time as taking away from instructional time (14). However, children aged 3 to 5 years learn through the large muscles, where learning comes from hands-on activities (14, 105). According to the U.S. Department of Education (6), around 60% of children aged three to five years attend preschool, where they generally spend anywhere from 4 to10 hours per day.

Theoretical Underpinnings

The Social Ecological Model (SEM) acknowledges different factors that influence and contribute to behavior (121, 122). Specifically, the SEM theorizes that individual behavior, social environments, physical environments, and policies all contribute to behavior as well as behavior change (121). Studies using the SEM have recognized the strong influence social and physical environments have on children's physical activity levels (16, 114, 123-125). Moreover, studies show teacher behavior has an influence on children's physical activity at the individual and interpersonal levels (16, 125). Adopting health behaviors are easier when environments conducive to change are created (126). Habit formation can aid in the longevity of behavior change, as habits prompt frequent and automatic performance of a behavior (108). Moreover, health-related behaviors are more beneficial when they are repeated or become habits (134). According to Gardner (108), a habit is a progression by which environmental cues automatically trigger an impulse towards action that has become linked with those cues, through repetition. Therefore, the SEM and habit formation provide strong theoretical foundation to guide physical activity interventions in preschools.

Studies examining factors that predict physical activity levels in the preschool setting determined the preschool a child attends is the strongest predictor or determinant of physical activity when compared to other factors (i.e., gender, age, and race/ethnicity) (11, 28, 52).

Specifically, the preschool a child attends explains nearly 50% of the variance in children's physical activity levels at school (11, 28, 52). Therefore, although preschoolers' physical activity levels are often low, they are strongly influenced by the characteristics of the school they are attending. The findings of low physical activity levels and preschools having a substantial influence on children's physical activity levels confirms the need for preschools to provide more active and less sedentary opportunities while children are at school.

Guidelines, Requirements, and School Schedule

In the United States, early learning guidelines and resources related to early learning education varies within each state. There are five broad domains of early learning and development including approaches to learning, social and emotional development, language and literacy development, cognitive development, and physical development (14, 120), which are all benefitted by physical activity (6, 31-38, 41, 63). Preschool environments consist of outdoor and indoor spaces that include intentional age-appropriate learning materials, wall displays, toys, and equipment, where the social environment (i.e., schedules, routines, responsibilities) works in unison with the physical environment (i.e., materials, displays, learning areas) to create a positive, supportive, and developmentally appropriate learning atmosphere (119, 127).

In the state of Alabama, it is recommended to have one lead teacher assigned to each classroom of nine or less children, and an additional auxiliary teacher for classes that have 10-20 children (119), however, minimum requirements include a 1 to 11 teacher-child ratio for children 2.5 to 4 years and 1 to 18 teacher-child ratio for children 4 years to lawful school age (129). According to the state of Alabama's minimum standards (129), lead classroom teachers, or those that have primary responsibility for the care of a group of children, are at least 19 years of age and have completed a high school diploma or general education diploma (G.E.D). Moreover,

teacher aides or assistants are at least 16 years of age, have at minimum an 8th grade education, work under the direct supervision of a person qualified as a lead teacher, and are not to be counted in the required staff-child ratio.

Daily preschool schedules, based off the *Alabama First Class Pre-K Classroom Guidelines* (119), include time spent in whole group, small group, free choice, and gross motor activity, where teachers are to adhere to state program and classroom guidelines. Reflecting a 6.5-hour school day, whole groups should occur multiple times a day and not exceed 20 minutes in duration. Whole groups should provide opportunities for the entire class to share, discuss, and learn the current classroom material, and incorporate daily read-aloud, music, movement, and finger plays. Whole group may be an ideal time for teacher-led activities (129). Small group should occur at least once daily for up to 20 minutes per occurrence. During small group time children are divided into smaller groups (ideally 6 to 8 children per group) in the classroom, where they meet with a teacher to explore and try various materials and discuss and solve problems (i.e., science, math, etc.). Free choice is a time where children have the autonomy to play in a classroom activity area of their choice, which should last about one hour and ten minutes in duration. Although teachers are expected to interact and engage with children during small group, this time is intended to be uninterrupted. Preschools are encouraged to schedule 60 minutes of daily gross motor activity, which can be incorporated into different segments throughout the school day. While gross motor activity is typically encouraged during outdoor free play (recess) on the playground, there is no duration that children are required to spend outside during the preschool day in the state of Alabama. Physical activity implementation can be incorporated in and benefit all areas mentioned above during the preschool day.

Head Start Program

As mentioned, minority children living in low-income rural communities are at an even greater risk of low physical activity levels and high levels of sedentary behavior compared to their counterparts (20, 21). Therefore, Head Start programs are vital settings to implement and establish physical activity practices, where levels of indoor MVPA are lowest when compared to private and church preschool programs (114). Head Start is the largest federally funded preschool program in the United States, serving millions of children from diverse, low-income, and disadvantaged families (58-60). Head Start's leading goal is to promote school readiness by enhancing children's cognitive, social, emotional, and physical development and health through providing educational, nutritional, social, and other services to children (62, 64). As mentioned, physical activity positively impacts these areas that Head Start preschools strive most to promote in their programs. However, Head Start does not include physical activity and physical education in their health component or educational curriculum (60). For preschool facilities to meet physical activity recommendations, they must provide opportunities for children to increase physical activity as well as engage in a variety of gross and fine movement activities (14).

Teachers

Children's physical activity behaviors can be influenced by teachers (7, 16-19, 26). Preschool teachers are involved in the decision-making process regarding what or what does not occur in terms of physical activity and are significant role models (18) as well as the primary gatekeepers to physical activity at preschools (12). Although teachers hold the responsibility to encourage physical activity, they rarely do so (15). This may be due to teachers' perceived barriers to providing children physical activity opportunities in their school day. Previous research indicates teachers identify lack of ability, self-efficacy, knowledge, time, space, and resources to provide physical activity as barriers (66, 67, 87). Thus, interventions that help

teachers overcome these previously identified barriers to aid in the promotion of physical activity opportunities that are conducive to increasing physical activity levels and decreasing sedentary behavior in the classroom setting should be effective.

Physical Activity Interventions

Despite researchers ongoing efforts to prevent low levels of physical activity in the preschool setting by testing intervention strategies, increases in children's physical activity levels have been small and have produced mixed findings. Some research shows that physical activity interventions can increase preschooler's physical activity levels in school (16, 78-81), while others reported they do not have an impact on children's activity levels at school (7, 68, 76, 77).

Systematic Reviews and Meta-Analysis

A systematic review and meta-analysis revealed physical activity interventions only have a small effect (around 4 minutes more per day) on children's (ages 16 and younger) overall activity (85). While this study showed no significant differences in intervention effects between boys and girls, there was a trend for girls responding more positively to interventions than boys (85). Although the literature findings are mixed regarding sex differences in the responses to interventions, other studies have also found interventions have a greater effect on girls' physical activity when compared to boys (16, 97, 98).

A more recent meta-analysis (84) that examined the effectiveness of physical activity interventions on preschooler's physical activity participation showed overall, interventions have a small-to-moderate effect on general physical activity and a moderate effect on MVPA. Furthermore, the highest outcomes for MVPA were identified for interventions that were conducted in the preschool environment, teacher-led, involved outdoor activity, and incorporated unstructured activity (84).

Results confirm that preschools are an important environment to target preschool physical activity levels (9-11) and children's physical activity is correlated with outdoor playtime (3, 15, 37, 53, 68, 86). Moreover, these findings support Copeland and colleagues (12) idea that interventions must involve the teachers to influence children's physical activity and ensure the maximum benefit is achieved. Interventions may be a better approach to increase physical activity levels among girls, as they respond more positively to them and show the lowest levels of physical activity.

Structured and Unstructured Physical Activity Interventions

While Gordon and colleagues' (84) meta-analysis found a greater effect for MVPA in interventions that incorporated unstructured activity, this result may have been skewed due to unstructured activity often taking place in an outdoor environment, such as during recess or "free play". An intervention conducted by Palmer, Matsuyama, and Robinson (9) that examined structured and unstructured physical activity programs during outdoor free play found children who received a structured movement program spent 15.5 minutes of a 30-minute period in higher levels of physical activity behaviors than those who were in the unstructured program.

Although structured physical activity may be a viable approach for increasing preschooler's physical activity levels during recess, tampering with their allotted time for unstructured outdoor play may be more harmful to their well-being. Recess is on average only offered for 8% or 33 minutes of the preschool day (27). Unstructured outdoor free time plays a key role in providing children in school with a needed break from the daily rigors of academic tasks and can improve children's physical activity, cognitive function, disruptive behavior in the classroom, creativity, and social and emotional development (89-91). Therefore, intervention approaches should not interfere with preschoolers designated outdoor free playtime. In addition,

because recess is a commonly scheduled period in the preschool day, children are regularly provided unstructured physical activity opportunities, leaving children with an even greater need for structured indoor physical activity opportunities.

While structured physical activity interventions can increase preschoolers' physical activity (22, 25, 27, 81, 95, 96), they can also aid in the success of preschoolers' physical, cognitive, emotional, and social development (112). Moreover, structured physical activity programs can stimulate the growth and development of fundamental motor skills (25, 77, 92, 96, 113), which often leads to higher levels of motor skill competence (93), resulting in a greater probability of participation in physical activity and more skill development (40, 55, 94).

Teacher Involvement

Interventions that promote teacher involvement benefit preschooler's physical activity levels. Interventions have shown simple changes in teachers' instructional practices, teacher verbal prompting, positive role-modeling, and teacher–child interaction can immediately encourage children to change their activity levels toward higher activity levels (16-19, 26). However, it is unclear as to what teacher strategies generates higher levels of physical activity and lower levels of sedentary behavior.

Multi-component

Pate and colleagues (16) conducted a multicomponent intervention that focused on increasing preschoolers' physical activity by changing instructional practices through structured, teacher-led physical activity opportunities in the classroom, unstructured and structured physical activity opportunities at recess, and physical activity integrated into pre-academic lessons. This multi-component approach resulted in significantly higher levels of MVPA in intervention schools (7.4 minutes/hour) compared to control schools (6.6 minutes/hour). Sex-specific analysis

revealed a significant difference for girls MVPA (6.8 vs 6.1 minutes/hour) but not for boys MVPA (7.9 vs 7.2 minutes/hour) when comparing intervention schools and control schools, respectively. While these findings add to this body of literature, it is unknown if some variables of this multi-component intervention elicited higher levels of physical activity in children than others. Although approximately one minute of MVPA more per hour might not seem impactful, for a child who attends an 8-hour program, that can calculate to be around 40 more minutes in MVPA per week or 160 more per month.

Verbal Prompting

Trost, Ward, and Senso (99) suggest teachers should frequently prompt children to be active in the preschool setting. This area is not well-researched among the preschool population. However, a study that examined the effects of manipulating teacher-child interactions through research-initiated physical activity prompts during outdoor free play found teacher prompting significantly increased previously identified sedentary children's MVPA during the intervention compared to baseline data and decreased overall sedentary activity throughout the recess period (17). Additional studies have also found teacher-encouraged and prompted physical activity on preschool playgrounds increased preschoolers MVPA (141) and were significantly and positively related to activity intensity (142). However, research also suggests teacher prompting is exceedingly rare both indoors and outdoors, occurring less than 1% of a study's observed intervals (15). Among the few studies that explore the effect teacher prompting has on preschooler's physical activity levels, the majority use direct observation methods to measure their data and implemented prompts during outdoor free play. This confirms a need to target teacher prompting during indoor classroom time as well as the use of accelerometers to measure physical activity levels.

Role-modeling

Cheung (18) and Fossdal, Kippe, Handegar, and Lagestad (19), found a significant association between teacher's activity levels and preschoolers physical activity levels. Children who are taught by teachers who model higher activity levels at school have significantly higher step counts (1712 verses 951 steps) and are more likely to show greater levels of physical activity than children taught by teachers who model less activity (18, 19).

Interaction and Instruction

While teacher–child interaction is associated with higher levels of non-sedentary behavior (15), teacher-child social interactions can limit preschooler's physical activity levels. In Eveline and colleagues' study (26) that examined preschoolers' physical activity during a physical education class found that the time teachers spend teaching movement skills and content knowledge, providing instruction, and managing students can result in elevated levels of sedentary behavior (20- of a 37-minute class) and less time spent in MVPA. These findings generated a suggestion for preschool teachers to provide knowledge content, instruction, and classroom management in a more active way, as there is still a great need for teachers to provide children with proper instruction and feedback.

Intervention Needs

Although some preschool physical activity intervention strategies have seen some improvements in preschooler's physical activity, they do not show longitudinal success. Moreover, interventions that focus on structured, teacher-led programs tend to have trained professionals implement the intervention in a way that the structured activity is consistent in delivery (25, 100, 101), which may look completely different from teachers incorporating the intervention into their day in real-time. Therefore, intervention strategies need to be regularly

implemented by the preschool teacher to result in realistic, long-term behavior change and adaptation. Because habits can generate greater benefits in health-related behaviors, aid in the longevity of behavior change, and prompt automatic performance, interventions that include habit formation can be a viable strategy regarding changing teacher behaviors and practices to increase preschooler's physical activity levels.

Incorporating habitual physical activity into already planned daily classroom activities might help eliminate teachers previously identified lack of time, ability, self-efficacy, and knowledge to physical activity implementation (66, 67). In addition, integrating physical activity with the academic subjects can positively impact children's academic motivation (104) and can lead to acceptable increases in physical activity (102). Developmentally appropriate practices are best provided when teachers take into consideration each child as an individual (14, 103, 105). To my knowledge, there are no interventions that partner with the teachers, who have a better understanding of the needs of the children in their classes individually and, to communicate what activities would work best in their classroom lesson plans and help them implement their intervention ideas into their school day.

Conclusion

Guided by the findings of this body of literature, working with teachers to identify and implement structured physical activities into their classroom time, may be a successful approach to increase preschooler's physical activity levels. The main purpose of this study was to examine the effectiveness of a structured, teacher-guided and led preschool physical activity intervention in low-income schools during indoor classroom schedules. Furthermore, our goal was to identify which type of teacher strategies (i.e., modeling or prompting) leads to increases in physical activity.

COVID-19 Statement

As previously mentioned, due to the COVID-19 global pandemic some of the proposed study areas were unable to be conducted, including teacher's habit formation and perceived barriers regarding implementing physical activity during indoor time. The adjusted scope of our research project using data that we collected pre-COVID-19 can be found in the following two manuscripts.

III. Manuscript I.

The Effect of a Teacher-Guided and -Led Indoor Preschool Physical Activity Intervention: A Feasibility Study

Alexandra V. Carroll, Katherine E. Spring, and Danielle D. Wadsworth

Abstract

Preschoolers are not meeting physical activity recommendations and spend an extensive amount of their day sedentary. Interventions targeting teacher-led strategies can have the highest benefits on children's physical activity levels. The purpose of this feasibility study was to examine the effects of an indoor teacher-guided and -led preschool physical activity intervention in low-income schools. Sixty-six preschoolers and twelve preschool teachers participated in this study. Intact classrooms were randomly assigned to either an intervention or control group. A 2x3 mixed ANOVA was used to test changes by group and time. Post-hoc analysis followed upon significance. There was a significant group by time interaction in children's moderate-to-vigorous physical activity (MVPA) levels during indoor time (p = .036) and a significant effect on time in children's MVPA levels during outdoor time (p = .002). Teachers identified that planned, physical activity opportunities are easy to implement during indoor time. Moreover, teachers indicated that they enjoyed providing physical activity opportunities into the classroom setting and the children enjoyed participating in the activities implemented. Teachers identified implementation barriers could be correlated with decreased levels of children's physical activity. Our findings show that a teacher-guided and -led indoor preschool physical activity intervention is a feasible approach that can acutely increase children's MVPA levels.

Key Words: childcare, pre-k, movement, implementation

Introduction

Current United States physical activity recommendations stipulate that preschool-aged children should engage in physical activity throughout the day, with a variety of activity types at different intensities (U.S. Department of Health and Human Services, 2018). The benefits of physical activity and the risks of physical inactivity are well-documented for this population (Centers for Disease Control and Prevention, 2020a; Centers for Disease Control and Prevention, 2020b; Janssen & LeBlanc, 2010; Kirk et al., 2014; Lee et al., 2012; Lees & Hopkins, 2013; Schneifer & Lounsbery, 2008; Stodden et al., 2008; U.S. Department of Health and Human Services, 2018). However, the majority of preschool-aged children (ages three to five years) do not meet age specific physical activity recommendations (Dowda et al., 2009; Jurakic & Pedisie, 2012; Pate et al., 2015; Raustorp et al., 2012; Tucker, 2008) and spend a substantial amount of their day in sedentary behavior (Byun et al., 2013; Tandon et al., 2015). While preschool-aged children in the United States as a whole show low levels of physical activity and high levels of sedentary behavior, minority children living in low-income rural communities and attending low-socioeconomic status (SES) schools are typically at an even greater risk of low physical activity levels and high levels of sedentary behavior (Carlson et al., 2014; Gibson et al., 2012; Nelson et al., 2019). Current evidence suggests this age group is more receptive to physical activity related behavior change compared to older children (Natale et al., 2016). Thus, the best prevention and promotion opportunities may be during these early learning years to establish new behaviors, such as physical activity (Henderson et al., 2015).

Around 60% of preschool-aged children attend preschool, where they generally spend anywhere from four to ten hours per day (U.S. Department of Health and Human Services, 2018). Preschools are an important environmental setting that play a major role in contributing

daily physical activity opportunities and participation of preschoolers (Copple & Bredekamp, 2009; Pate et al., 2004). Preschools can play a significant role in children's daily physical activity opportunities and participation, yet aside from recess, physical activity is often not recognized as integral to the curriculum because preschools often see this time as taking away from instructional time (Brown et al., 2009).

The little activity preschoolers are participating in is generally correlated with outdoor unstructured playtime (recess) (Baranowski et al., 1993; Brown et al., 2009; Tucker, 2008) which only accounts for 8% of their preschool day (Tandon et al., 2015) leaving a very large portion of their day indoors and sedentary. While most preschools provide children with some daily physical activity opportunities, including recess, few provide planned, structured activity (Hinkley et al., 2008) which can be a viable strategy to increase children's physical activity levels and decrease sedentary behavior (Annesi et al., 2012; Jones et al., 2011; Tandon et al., 2015; Webster et al., 2020; Williams et al., 2009). Structured physical activity is an activity that is planned and intentionally directed by an adult to contribute to a child's basic motor development and enjoyment of movement (Alabama Department of Public Health, 2019).

Teachers are considered the primary gatekeepers to physical activity during the preschool day, due to their high involvement in the decision-making process regarding children's physical activity opportunities (Copeland et al., 2012). Moreover, preschool teachers are important role models (Cheung, 2020) that can highly influence children's physical activity behaviors (Fossdal et al., 2018; Kahan et al., 2016; Pate et al., 2016; Van Cauwenberghe et al., 2012). Although teachers hold the responsibility to provide age-appropriate opportunities, education, and encouragement, about physical activity (Brown et al., 2009; Copeland et al., 2012; U.S.

Department of Health and Human Services, 2018), they rarely do so within the preschool setting (Brown et al., 2009; Tandon et al., 2015).

Research suggests preschool physical activity interventions that target teacher-led strategies can have the highest beneficial outcomes for children's physical activity levels (Gordon et al., 2013; Pate et al., 2016; Webster et al., 2020). The low levels of physical activity coupled with the lack of teacher's encouragement, leadership, and provision of physical activity highlights the need for teacher involvement to improve preschoolers' physical activity levels and create active classroom environments. Researchers conversing with and instructing teachers to create active classroom environments can assist teachers in offering children more physical activity opportunities during the preschool day. Therefore, communicating strategic teacher-guided (i.e., the teacher's ideas and plan) and -led (i.e., the teacher's implement their ideas and plan) physical activities during indoor classroom time, with a goal of children becoming more active, is needed in the preschool setting to help maximize children's physical activity opportunities and levels. The purpose of this study was to examine the effects of a teacher-guided and -led preschool physical activity intervention in low-income schools during indoor classroom time. We hypothesize children in the intervention group will experience a greater increase in physical activity levels compared to children in the control group.

Methods

Participants and Setting

Seventy-one (34 males, 37 females) preschool-aged children attending a Head Start center in the Southeastern United States participated in this study. In addition, 12 (six head, six assistant) preschool teachers employed by the center also participated in this study. This federally funded center specifically serves diverse and disadvantaged children and families living

in low-income housing surrounding rural communities. Preschool hours were from 8:00 am – 12:30 pm, Monday through Friday. Daily schedules included breakfast (8:00-8:30 am), curriculum instruction including small/large group, centers, and an allotted 40-minute outdoor play time (8:30-11:30 am), lunch (11:30 am- 12:00 pm), and dismissal (12:30 pm).

Approval from the University's Institutional Review Board for Research Involving Human Subjects and child and teacher informed consent was received prior to this study. Letters for child consent were sent home in weekly folders for parents/guardians to complete for child participants and teachers consent forms were provided to the teachers. Six classrooms were randomly assigned to either the intervention (three classrooms) or control (three classrooms).

Procedures

This study lasted three consecutive weeks in duration; stemming from a recent meta-analysis that found some of the greatest effects for MVPA in preschoolers were identified for interventions that were less than four weeks in duration (Gordon et al., 2013). On Thursdays before weekly intervention implementation, teachers in the intervention group were asked a series of questions (Figure 1) related to the physical activities they were planning to incorporate during their indoor classroom time for the upcoming week. At the end of each week of intervention implementation, teachers were asked a series of follow-up questions related to the physical activities that were implemented that week (Figure 2).

Teacher interviews were conducted by a single member of the research team in order to improve consistency and reliability. Teacher interviews latest around 5 minutes in duration and occurred in the classroom at the teacher's convenience. The research member who conducted the interviews took notes of teacher responses during the interview.

Children in both the control and intervention group wore accelerometers (ActiGraph GT3X) on their right hip using a Velcro belt, during the preschool day two times per week (Tuesdays and Thursdays) over three consecutive weeks. Researchers applied and removed children's accelerometers, that were programmed to collect data from 8:30 am to 11:30 am for all six sessions. Physical activity data were separated into indoor and outdoor time based on researchers' time stamped notes.

Figure 1

Teacher Indoor Physical Activity Questions

1. What are the "themes" you are covering in your classroom next week?
2. Are there any activities that you can think of that can be incorporated into that lesson content or during your indoor time? If yes, when?
3. Is there any equipment that you need from us to incorporate these activities?
4. Are you planning on doing any of these activities with the children or do you plan on only instructing them on what to do?

Figure 2

Teacher Indoor Physical Activity Follow-Up Questions

1. Were you able to incorporate any of the activities we discussed the previous week? If so, which ones?
2. What made it difficult or easy to implement these activities?
3. Did you enjoy incorporating these activities into your day?
4. Did the kids enjoy the activities incorporated?
5. Did any of these activities not work well for your class? If so, why?

Intervention

The control group consisted of three classrooms participating in their typical preschool day and did not involve a discussion with teachers regarding the inclusion of physical activity during indoor time. The intervention's week-by-week breakdown can be seen in Figure 3. The

intervention group consisted of three classrooms in which teachers were asked a series of questions on a weekly basis (for three consecutive weeks) to identify physical activity opportunities to incorporate into their indoor classroom time. Teachers implemented their indoor physical activity ideas the following week and provided a copy of their planned weekly indoor physical activity ideas to increase teacher's content retention. Teachers were asked another series of follow-up questions pertaining to the indoor activities they implemented the week prior. All interviews were conducted on Thursdays at the classroom teacher's convenience and answers were noted by the researcher.

Figure 3

Week-by-Week Intervention Protocol

	Physical Activity	**Weekly Interviews**	
	Child	*Teacher Weekly Interviews*	*Teacher Weekly Follow-up Interviews*
Pre-Intervention	• Height and weight measurements. • Calibrate accelerometers for each participant.	• On the Thursday teachers are asked the series of questions found on Figure 1. • Teachers responses to the questions are noted by the interviewee researcher. • Teachers are instructed to implement the activities discussed in the interview during week 2 of the intervention.	
Week 1	• Researchers put accelerometers on child participants on Tuesday and Thursday at 8:30 am and take them off at 11:30 am.	• On the Thursday before week 1 of the intervention, teachers are asked the series of questions found on Figure 1. • Teachers responses to the questions are noted by the interviewee researcher. • Teachers are instructed to implement the activities discussed in the interview during week 1 of the intervention.	• On Thursday teachers are asked the series of questions found on Figure 2, regarding their week 1 interview. • Teachers responses to the questions are noted by the interviewee researcher.
Week 2	• Repeat what was done in week 1 for week 2.	• Repeat what was done in week 1for week 2.	• Repeat what was done in week 1for week 2 interviews.
Week 3	• Repeat what was done in week 1 and week 2 for week 3.		• Repeat what was done in week 1and week 2 for week 3 interviews.

Measures

Demographics and Anthropometrics

Children's date of birth, sex, and race were provided by parents on the parental informed consent form. Children's height and weight were measured in a secluded setting within the preschool. Height was measured to the nearest 0.25 cm using a portable stadiometer and weight was measured to the nearest 0.10 kg using a precision electronic scale.

Physical Activity

Physical activity data were separated into indoor and outdoor time and collected two days per week (Tuesdays and Thursdays) during the preschool day over three consecutive weeks via

accelerometry (ActiGraph GT3X). Accelerometers were worn on participants' right hip and attached with a Velcro belt. Children's accelerometer data were programmed, collected, and stored in 15-second intervals (epochs), which is recommended for preschool children (Bailey et al., 1995). Moreover, children's accelerometer activity intensity was quantified using Butte et al. (2014) cut-points, developed specifically for preschool-aged children. The reliability of the ActiGraph accelerometer for preschoolers, reported by previous studies, is .90-.94 (Costa et al., 2014). Based on the accelerometer cut points, data were divided into two activity categories: light and moderate-to-vigorous physical activity (MVPA). Due to potential participant accelerometer wear time differences, the percent of time spent in light and MVPA for both indoor and outdoor time, was averaged for the week.

Data Analysis

All data were analyzed using statistical software (SPSS: Version 26) with a level of significance $p < 0.05$. A 2x3 mixed ANOVA examined intervention effects on group (control and intervention) and time (week 1, week 2, and week 3). If an interaction or main effect was found, Bonferroni Post-Hoc analysis was used to determine point of significance.

Results

Five children did not wear the monitor during the intervention and were removed from the analysis. Final analysis included 66 children (31 control; 35 intervention). The control group was primarily composed of males (58%), while the intervention group was primarily composed of females (63%). The majority (77%) of child participants were African American. Children's demographic variables for groups are presented in Table 1. Teacher subjects included 12 teachers (six control; six intervention) that were all female. Teacher demographic variables for group are presented in Table 2.

Table 1

Child Participant Demographics

Variable		Group	
		Control (n=31)	Intervention (n=35)
Sex			
	Female	18	22
	Male	13	13
Race			
	African American	25	26
	Hispanic/Latino	4	3
	Caucasian	1	2
	Other	1	4

Table 2

Teacher Participant Demographics

Variable		Group	
		Control (n=6)	Intervention (n=6)
Sex			
	Female	6	6
	Male	0	0
Race			
	African American	5	4
	Hispanic/Latino	1	1
	Caucasian	0	1
	Other	0	0

The teacher interview response notes revealed that, when asked during the intervention period, teachers in the intervention group often (78%) indicated they did not know what classroom content was being covered in the upcoming week. All teachers in this group identified various physical activities they felt could be incorporated into their indoor lesson content each week of the study. The most common time teachers identified that they wanted to incorporate these activities were during group (i.e., large group (90%), transition (90%), and reading (56%) time. Each week teachers indicated that they implemented most of the activities they planned on incorporating during the specified indoor time that week. Every teacher found that incorporating physical activity into indoor time was easy to implement, especially when planned, and seemed to benefit children's focus in the classroom. In addition, all teachers identified that they, as well as the children, enjoyed the implementation of indoor physical activity and that the activities worked well in their classrooms. Implementation difficulties were identified in week two due to field trips, and in week three due to elevated teacher absence attributable to the flu.

A 2x3 mixed ANOVA was used to determine whether the teacher intervention influenced children's indoor and outdoor physical activity levels across a three-week duration, compared to children in the control group. All assumptions of homogeneity were met except for MVPA during outdoor time where the Green-house Geiser effect was used. Moreover, all assumptions for sphericity were met.

The effects of within-subject's factors can be found in Table 3. There was not a significant group-by-time interaction in children's light physical activity levels during indoor or outdoor time, nor was there an effect on time. There was a significant group-by-time interaction in children's MVPA levels during indoor time (p = .036). About 8% of the variance in children's

MVPA levels indoors was explained by the group-by-time interaction ($\eta^2 = .078$). Moreover, there was a significant effect of time on children's MVPA levels during outdoor time ($p = .002$); however, there was not a significant group-by-time interaction. About 15% of the variance in MVPA levels outdoors was explained by time ($\eta^2 = .147$).

Table 3

Tests of Within-Subjects Contrasts

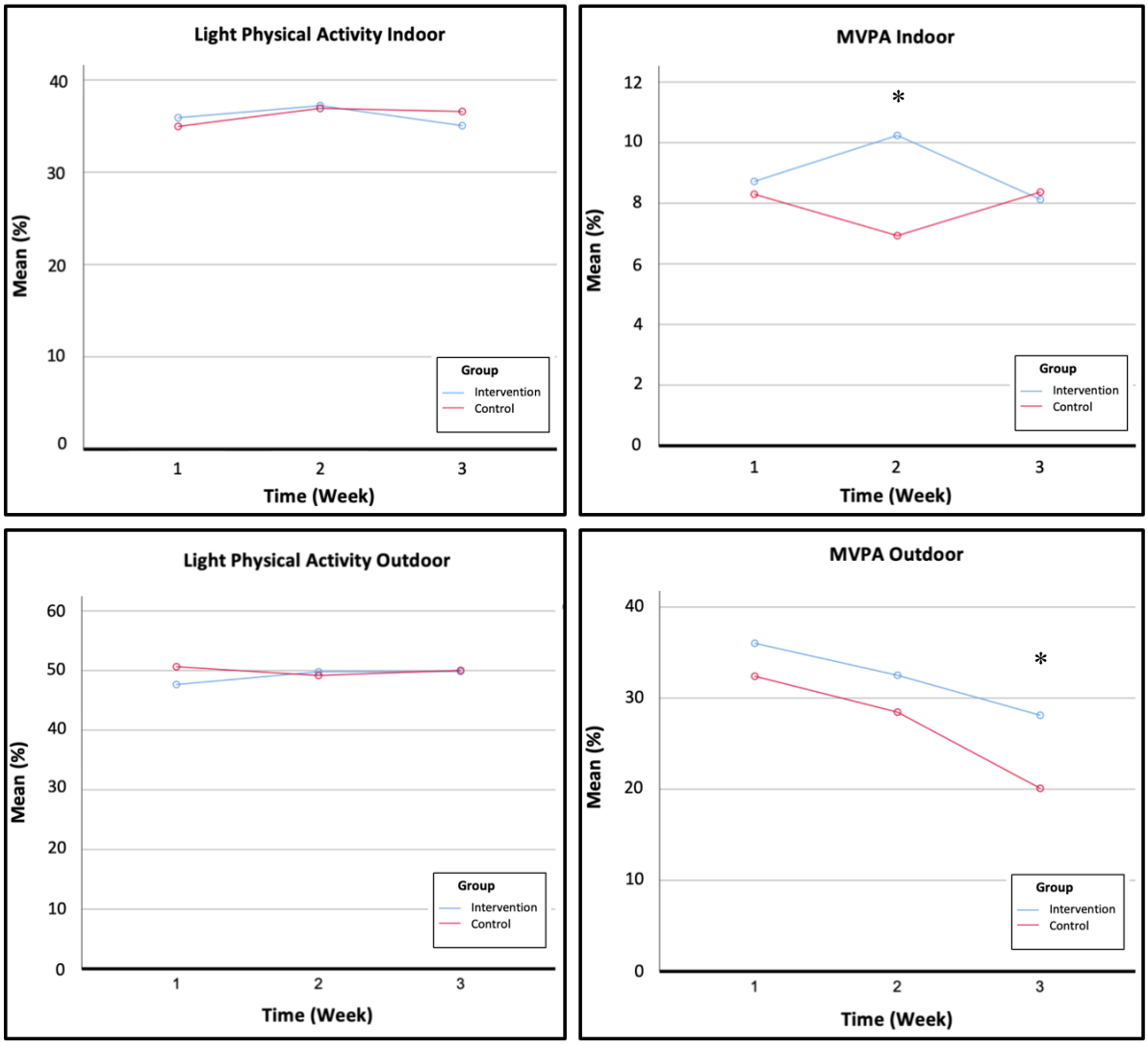
Measure	Source	F	η^2	*p*
Indoor Time:				
Light Physical Activity	Time	.999	.024	.373
	Group * Time	.560	.013	.574
MVPA	Time	.122	.003	.885
	Group * Time	3.449	.078	**.036**
Outdoor Time:				
Light Physical Activity	Time	.057	.001	.944
	Group * Time	.322	.008	.726
MVPA	Time	6.883	.147	**.002**
	Group * Time	.389	.010	.679

Note. Level of significance is $p < 0.05$. Significant *p*-values are bolded within this table.

To determine where our significant differences occurred, we used the Bonferroni Post-Hoc test. We found that the significant group-by-time interaction seen in children's MVPA levels during indoor time occurred in week 2 ($p = 0.45$). In addition, the significant effect on time seen in children's MVPA levels during outdoor time occurred in week 3 ($p = .022$). See Figure 4 for descriptive statistics.

Figure 4

Physical Activity Levels Across the Intervention



Note. Top: Percentage of means in light (left) and MVPA (right) for weeks 1, 2, and 3 by group (control and intervention) for indoor time. Bottom: Percentage of means in light (left) and MVPA (right) for weeks 1, 2, and 3 by group (control and intervention) for outdoor time. * ($p <$ .05).

Discussion

This feasibility study examined the effects of a teacher-guided and -led indoor physical activity intervention on preschooler's physical activity levels. Our hypothesis was partially

supported in that children in the intervention group experienced a greater increase in physical activity levels compared to children in the control group in MVPA during indoor time early in the intervention (week 2). While there was a steady decline seen in children's MVPA during outdoor time for both groups, the intervention group decreased less, particularly at week 3.

Our findings showed that a teacher-guided and -led intervention can increase MVPA levels during indoor time, which agrees with Pate et al. (2016) as well as Annesi, Smith and Tenant (2012) who suggest preschoolers' MVPA levels can be increased by modifying teachers' instructional practices. Although, our intervention was initially successful in week 2, there was a decrease in indoor physical activity from week 2 to week 3. These data changes may be associated with intervention implementation difficulties teachers in the intervention group faced due to field trips (week 2), and teacher absences due to the flu (week 3). Although teachers were able to plan and implement indoor physical activity opportunities within the preschool setting, as well as identify an ease when planned and beneficial outcomes in children's behavior, teachers perceived implementation difficulties (i.e. field trips and elevated teacher absences) appear to take precedence over application.

While MVPA during outdoor time decreased for both groups, there was less of a decline seen in week 3 for the intervention group. Moreover, although there was a continual decrease in children's MVPA levels during outdoor time seen in both groups at week 1 and week 2, it was significantly larger at week 3 for the control group. While the intervention's goal was to increase preschoolers MVPA levels during indoor time, this change reduced the declines seen during outdoor MVPA for the intervention group.

Our feasibility study found that teacher-guided and -led intervention acutely changed physical activity. These findings align with Gordon et al. (2013) as well as Metcalf, Henley, and

Wilkin (2012) who suggest preschool physical activity interventions see the greatest effects early in the intervention, have small-moderate increases in children's physical activity, and lack longitudinal success. Clearly further research is necessary on how to provide sustainable physical activity interventions for this population.

Conclusions

In conclusion, a teacher-guided and -led preschool physical activity intervention is a feasible approach to acutely benefit children's MVPA during indoor time, however, future research needs to be done to determine how to make this type of intervention effective long-term. Although teachers identified that physical activity is easy to incorporate during indoor time at school when planned, changes in weekly routine continue to be a barrier that hinders their intended implementation. Therefore, there is a need for future research to explore ways that will assist preschool teachers in overcoming perceived physical activity implementation barriers when changes in their weekly routines occur. In the current study, children in the intervention group showed less of a decline in MVPA during outdoor time compared to children in the control group. These findings indicate structured physical activity provides additional opportunities to be physically active during the school day that can compensate for various obstacles that may reduce or impact unstructured play time. There are several aims which should be considered for future research direction. Firstly, future research should aim to gain more insight on how indoor physical activity participation effects outdoor physical activity participation at the preschool setting. This study demonstrates how simple changes in preschool teachers' indoor instructional practices can immediately benefit children's MVPA levels; however, it would be beneficial to include a measurement of teacher physical activity in future studies. Additionally, in order to identify which strategies elicit higher levels of physical activity

during indoor time, future research could benefit from examining individual measures of teacher implementation strategies that influence children's physical activity levels during indoor time (i.e., modeling verses verbal prompting). Direct observation strategies could be helpful for related future studies to determine whether physical activity opportunities were being implemented during indoor time as opposed to relying on teacher's self-report.

While our feasibility study adds to the body of literature, it is not without limitations. The intervention was implemented at one Head Start center where the population was primarily low-income African American children, which limits the results of this study for other geographic regions and races. In addition, our study relied on teacher self-report to determine whether the intervention was being implemented during indoor time, this is a limitation due to reliability and validity issues are often associated with self-report. Furthermore, our study did not include a baseline measure for either group in order to determine physical activity levels prior to the intervention implementation. Finally, while the literature suggests preschool physical activity interventions lasting less than four weeks tend to have the greatest impact on children's physical activity levels (Gordon et al., 2013) a longer duration to assess sustainability is necessary.

Acknowledgements

The authors would like to acknowledge the teachers, participants, and parents for their contribution and their time devoted to the study. This study was developed without external funding support. All contributing authors declare no conflicts of interest.

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IV. MANUSCRIPT II.

How Teacher Verbal Prompting and Demonstrated Modeling Correlate to Preschooler's Physical Activity Levels

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Abstract

Preschool physical activity interventions that target teacher-led strategies have the highest beneficial outcomes for children's physical activity levels. Specifically, intervention strategies targeting teacher involvement through verbal prompting and demonstrated modeling can increase preschoolers' physical activity levels, however it is unknown which strategy promotes higher levels of physical activity. The purpose of this study was to explore which of the teacher-led strategies, verbal prompting or demonstrated modeling, elicits higher levels of physical activity among preschoolers. Participants included 117 preschoolers attending a Head Start program. MANOVAs were used to examine differences for light physical activity, MVPA, teacher verbal prompts and demonstrated modeling between segments in the preschool day. A forward stepwise linear regression was used to evaluate whether teacher demonstrated modeling and teacher verbal prompting would affect preschooler's physical activity levels. There was a significant difference for verbal prompting (p<.001) demonstrated modeling (p=.032), light activity (p < .001) and MVPA (p < .001) between segments of the preschool day. Preschooler's MVPA (p = .005) and MVPA and light physical activity (p = .036) were significantly related to demonstrated modeling but not verbal prompting. During indoor time, light and MVPA were highest during large group, work time, and morning group, where teacher demonstrated modeling occurred the most. Higher MVPA and light activity are associated with teacher demonstrated modeling during indoor time and should be encouraged among teacher-led strategies to increase physical activity among preschoolers.

Key Words: childcare, pre-k, movement, intervention strategies

Current physical activity recommendations in the United States suggest that preschool-aged children participate in physical activity throughout the day, with a variety of activity types and at different intensities (US Department of Health and Human Services, 2018). Although the benefits of physical activity and risks of physical inactivity are well known, studies show that the majority of preschool-aged children (ages 3 through 5 years) do not meet age specific physical activity recommendations (Dowda et al., 2009; Jurakic & Pedisic, 2012; Pate et al., 2015; Raustorp et al., 2012; Tucker, 2008) and spend an extensive amount of their day in sedentary behavior (Byun et al., 2013; Pate et al., 2008; Reilly et al., 2004; Tandon et al., 2015). While preschool-aged children as a whole show low levels of physical activity and high levels of sedentary behavior, minority children living in low-income rural communities attending low-SES schools are typically at an even greater risk of low physical activity levels and high levels of sedentary behavior (Beighle, 2012; Carlson et al., 2014; Nelson et al., 2018; Rossen & Schoendorf, 2012; Young et al., 2007).

Approximately 60% of preschool-aged children are enrolled in some type of preschool program, where they generally spend anywhere from 4 to 10 hours per day (US Department of Health and Human Services, 2018). Preschool settings can play a major role in contributing to children's daily physical activity opportunities and participation (Henderson et al., 2015; Palmer et al., 2016; Pate, 2004). In preschools, teachers are the primary gatekeepers to physical activity during the preschool day, due to their high involvement in the decision-making process regarding children's physical activity opportunities (Copeland et al., 2012). Furthermore, research shows that preschool teachers are important role models (Cheung, 2019) that can highly influence children's physical activity behaviors (Eveline et al., 2012, Kahan et al., 2016; Pate et al., 2016; Ward et al., 2017).

Despite researchers' ongoing efforts to prevent low levels of physical activity in the preschool setting, intervention outcomes have been small-to-moderate and have produced mixed findings (Gordon et al., 2013). Current findings suggest preschool physical activity interventions that target teacher-led strategies have the highest beneficial outcomes for children's physical activity levels (Alhassan et al., 2019; Goldfield et al., 2016; Gordon et al., 2013; Jones et al., 2011; Pate et al., 2016; Ward et al., 2010). Specifically, intervention strategies targeting teacher involvement through verbal prompting (Kahan et al., 2016) and demonstrated modeling (Cheung, 2019; Fossdal et al., 2018) can increase preschoolers' physical activity levels.

While we know that teacher involvement through verbal prompting and demonstrated modeling can improve preschooler's physical activity levels, it is unknown which strategy promotes higher levels of physical activity. The purpose of this study was to enhance the understanding of these influences by determining which teacher-led strategy, verbal prompting or demonstrated modeling elicits higher levels of physical activity among children attending a low-SES preschool. We hypothesized that teacher demonstrated modeling would have a greater impact on increasing children's physical activity levels compared to teacher verbal prompting.

Methods

Participants and Setting

This study consisted of 10 intact preschool classrooms. Participants included 117 (61 boys, 56 girls) preschool children attending a Head Start center that specifically serves diverse and disadvantaged children and families living in low-income housing surrounding rural communities in the Southeastern United States. Table 1 shows demographic characteristics of the participants. Preschool hours were from 8:00 am to 12:55 pm, Monday through Friday. Daily schedules included preschoolers' arrival (8:00 -8:15 am), breakfast/teeth brushing (8:15-8:45

am), curriculum instruction (8:30-12:00 am) including morning-, small-, and large-group, work time, and read aloud, a 45-minute allotted outside time, lunch/teeth brushing (12:00 pm- 12:30 pm), and dismissal (12:30-12:55 pm).

Table 1

Child Participant Demographics

Race	n	Age (mean)	Girls N	Boys n
	117	3.77 (.54)	56	61
African American	100	3.69 (.62)	45	55
Caucasian	6	3.50 (.49)	4	2
Hispanic	4	4.20 (.25)	0	4
Other	7	3.71 (.85)	7	0

During breakfast time/teeth brushing (30 minutes) children sit in their assigned seats to eat breakfast together. After a child finishes their breakfast, personal hygiene in practiced by brushing teeth, using the restroom, and washing hands. During morning-group (20 minutes) the class and teachers come together as a group to welcome each other and start the preschool day. This time consists of teachers and children briefly discussing the day's planned events, weather, listening to music, singing songs, and other child initiated, and teacher directed activities. During small-group time (20 minutes), teachers implement developmentally appropriate activities for children in small groups to learn, develop and practice activities that include problem solving, experimenting with materials, and trying new skills. Large group (15 minutes), generally referred to as circle time, aims to build community for all teachers and children in the classroom through interactive activities like movement and music, storytelling, and other shared experiences; often

providing children with leadership and choice making opportunities. Work time (80 minutes) includes a four-part sequence that includes planning, work, clean-up, and recall. The breakdown of work time includes planning time (10 minutes) when children make a plan of which center they would like to play at during work time; work time (50 minutes) when children engage in the planned center; clean-up time (10 minutes) when children work with each other to clean up the center that they played at; and recall time (10 minutes) when the children and teachers review and recall what they've done and learned during work time. Work time center activities often include blocks, creative arts, dramatic play, reading, writing, math or science. During read aloud (15 minutes), teachers read a story to the children. During outside time (45 minutes) children and teachers spend time outside on the playground or outdoor covered areas depending on the weather. This time is free play and not directed by the teachers. At lunch time (30 minutes) children sit in their assigned seats where they eat a meal and snack together. During dismissal (25 minutes), teachers prepare children for the transition of finishing the school day (pick-up, after school care, or bus loading).

Procedures

Prior to the study, approval from the University's Institutional Review Board for Research Involving Human Subjects and informed consent from all teachers and parents of participating children were obtained. Parent consent letters were sent home in weekly folders and returned to the classroom teacher if parental consent for the child was provided.

Members of our research team trained in SOSMART were randomly assigned to observe a classroom during the preschool day (8:30 am – 11:30 am) over three days in 10 different preschool classrooms. For continuity and reliability, the same observer was assigned to the same classroom for all three observation days throughout the study. Researchers observed the

classrooms using SOSMART to determine teacher involvement in demonstrated modeling and verbal prompting during movement integration throughout the preschool day.

On classroom observation days, children wore accelerometers (ActiGraph GT3X) on their right hip using a Velcro belt. Researchers applied and removed children's accelerometers, that were programmed to collect data during academic instruction from 8:30 am to 11:30 am for all observed sessions. Data collection forms for SOSMART were tallied by one member of the research team to determine the percentage of occurrences that movement integration was implemented via verbal prompting or demonstrated modeling by the teacher during each observation session for each classroom. Observation sessions were divided into planned segments of the preschool day and include morning group, small group, large group, outside time, read aloud and work time. These data for teacher-led verbal prompting and teacher demonstrated modeling were integrated with the timestamp from the accelerometer to determine whether teacher demonstrated modeling or teacher verbal prompting elicited higher levels of children's physical activity during each time segment of the preschool day.

Measures

Demographic and Anthropometrics

Parents provided children's date of birth, sex, and race on the parental informed consent form. Children's height and weight were measured in a secluded setting within the preschool. A portable stadiometer was used to measure height to the nearest 0.25 cm and a precision electronic scale was used to measure weight to the nearest 0.10 kg.

Physical Activity

Accelerometry (ActiGraph GT3X) was used to measure children's physical activity levels during classroom observations days. Accelerometers were worn on participants' right hip

and attached with a Velcro belt. As recommended for preschool-aged children, accelerometer data was programmed, collected, and stored in 15-second intervals (epochs) (Bailey et al., 1995; Cliff et al., 2009). Accelerometer activity intensity was quantified using Butte et al. (2014) cut-points, which were developed specifically for preschool-aged children. For preschoolers, the reliability of the ActiGraph accelerometer, reported by previous studies, is .90-.94 (Costa et al., 2014). Based on the accelerometer cut points, data were divided into two activity categories: light and moderate-to-vigorous physical activity (MVPA).

Teacher Involvement

The System for Observing Student Movement in Academic Routines and Transitions (SOSMART) is a systematic observation tool that assesses movement integration in classrooms through a 20-second continuous interval-recording format. The instrument consists of a two-stage decision-making process focused on teacher involvement and student response. For the purposes of this study, only the first stage of this instrument (teacher involvement) was examined; specifically, the teacher-led variable that determines whether movement integration was implemented through verbal or demonstration strategies (See Appendix F). Coding was conducted live by trained observers. Prior to coding, observers trained for 4-5 hours with a trained observer until interrater reliability was above .90. In addition, interrater reliability was assessed for 20% of the live coding sessions and was .94. Researchers listened to an interval timer while coding to ensure accurate 20 second observations and 10 second coding intervals. Outcome variables for this study included the average number that teacher-led verbal prompting occurred, and teacher-led demonstrated modeling occurred for physical activity throughout specific times during the daily schedules of the preschool day.

Data Analysis

All data were analyzed using statistical software (SPSS: Version 27). A priori sample size calculations, utilizing G*power (Faul et al., 2007) with a power of .80, an alpha level of .05, and an effect size of .15 - .25, indicated a required sample size of 60 and 101, respectively. For each classroom, data from the three observations days were averaged to determine a mean for light activity, MVPA, number of verbal prompts and number of teacher demonstrations for each segment of the preschool day (i.e., morning group, outside time, read aloud, etc.). MANOVAs examined differences for light physical activity, MVPA, verbal prompts and teacher demonstrated modeling between segments in the preschool day (i.e., morning group, outside time, read aloud, etc.). A forward stepwise linear regression evaluated whether teacher-led strategies, specifically demonstrated modeling and verbal prompting, would affect preschooler's physical activity levels. All statistical assumptions were met for the MANOVA and regression analysis.

Results

Table 1 shows the participants demographics. Table 2 presents the data for all 10 classrooms across the intervention at various times of the preschool day and include the average percent of light and MVPA, the average number of times teachers verbally prompted and demonstrated modeling, and the average time spent in specified times during the day across all 10 classrooms.

Table 2

Data Means for all Classrooms Across the Intervention

Time	Minutes	Verbal Prompting	Demonstrated Modeling	Light (%)	MVPA (%)
Morning Group	18.769 (4.072)	29.050 (13.026)	11.683 (9.672)	42.146 (5.732)	8.665 (3.456)
Small Group	20.120 (5.621)	33.433 (15.652)	4.117 (5.867)	31.133 (7.246)	3.937 (2.193)

Large Group	15.136 (5.751)	34.000 (24.608)	10.900 (9.389)	48.214 (21.572)	16.289 (8.065)
Outside Time	40.720 (6.947)	20.167 (14.733)	5.300 (7.835)	55.096 (4.403)	29.235 (4.544)
Read Aloud	15.684 (6.407)	18.334 (14.605)	1.889 (2.517)	24.177 (13.275)	5.004 (3.540)
Work Time	71.840 (9.415)	58.517 (25.282)	7.217 (5.953)	46.571 (3.317)	9.463 (2.495)

Note. Data is presented as mean (±SD).

MANOVA results are located in Table 3. The MANOVA results showed a significant difference for teacher verbal prompting between segments of the preschool day. Post-hoc analysis showed that teachers gave significantly more physical activity prompts during work time compared to morning group ($p = .014$), outside time ($p < .001$) and read aloud ($p < .001$). MANOVA results also showed a significant ($p = .032$) difference in teacher demonstrations throughout the day, however, post-hoc analysis showed no significant differences between segments. Both light activity ($p < .001$) and MVPA ($p < .001$) showed significant differences between segments of the preschool day. For light physical activity, participants spent 55% or 22 minutes of light activity during outside time and this time was significantly more than read aloud time indoors ($p < .001$). For indoor activities, work time represented the largest percentage of light activity at 47% or 33 minutes, followed by large group with 46% or 6.9 minutes. Light activity during work time was significantly higher compared to small group ($p = .049$) and read aloud ($p = .001$). Light activity was the lowest during read aloud and was significantly less compared to morning group ($p = .015$), large group ($p < .001$), outside time ($p < .001$) and work time ($p < .001$). Light activity indoors was also significantly less during small group compared to large group ($p = .019$), outside time ($p < .001$) and work time ($p < .001$).

For MVPA, participants spent approximately 29% of the time outdoors in MVPA, which equates to approximately 11.5 minutes of MVPA. MVPA during outdoor time was significantly

higher compared to all other time periods during the day ($p < .001$). Large group activities consisted of the highest levels of indoor MVPA with approximately 14% or 2 minutes in MVPA and this was significantly higher compared to morning group ($p = .006$) and all other indoor times ($p < .001$). Small group represented the smallest contribution to MVPA at 4% and this was significantly less compared to large group ($p < .001$).

Table 3

MANOVA Results

	F	Sig	Eta Squared	Observed Power	95% CI
Verbal Prompting	5.84	<**.001**	.355	.989	26.67-38.30
Demonstrated Modeling	2.65	**.032**	.200	.768	4.89-8.98
Light PA	10.12	<**.001**	.488	.990	37.61-45.41
MVPA	20.35	<**.001**	.804	.990	9.68-14.76

Note. Level of significance is $p < 0.05$. Significant p-values are bolded within this table.

A forward stepwise linear regression evaluated whether teacher-led strategies, specifically demonstrated modeling and verbal prompting, would impact preschooler's physical activity levels. Preschooler's MVPA ($B = .1.331$, $\beta = .802$, $t = 3.796$, $p = .005$) and MVPA and light physical activity ($B = .1.511$, $\beta = .910$, $t = 2.596$, $p = .036$) were significantly impacted by the amount of teacher demonstrated modeling. At step 1 and step 2 of the analysis, the overall regression equation was significant for teacher demonstrated modeling for preschooler's MVPA ($F_{1,8} = 14.413$, $p = .005$) and both MVPA and light physical activity ($F_{2,7} = 6.530$, $p = .025$). About 64.3% of the variance was explained by the model for MVPA ($R^2 = .643$, Adjusted $R^2 = .598$) and about 65.1% of the variance was explained by the model for MVPA and light physical activity ($R^2 = .651$, Adjusted $R^2 = .551$). Neither MVPA nor light physical activity were

significantly related to teacher verbal prompting. See Table 4 for regression table. Based on these results, teacher's demonstrated modeling significantly impacts preschoolers MVPA and light physical activity levels.

Table 4

Regression for Teacher Demonstrated Modeling and Verbal Prompting

Model		β	R Square	R Square Change	β (95% CI)	Sig.
Demonstrated Modeling[a]						
1	(Constant)	-8.013	.643	.643	(-17.882, 1.856)	**.005**[c]
	Mean MVPA	1.331			(.523, 2.140)	
2	(Constant)	-5.905	.651	.008	(-22.321, 10.512)	**.025**[d]
	Mean MVPA	1.511			(.134, 2.887)	
	Mean Light	-.105			(-.722, .513)	
Verbal Prompting[b]						
1	(Constant)	17.071	.075	.075	(-26.171, 60312)	.444[c]
	Mean MVPA	1.238			(-2.305, 4.781)	
2	(Constant)	-26.429	.534	.459	(-78.063, 25.206)	.069[d]
	Mean MVPA	-2.469			(-6.799, 1.860)	
	Mean Light	2.157			(.215, 4.099)	

Note. Level of significance is $p < 0.05$. Significant p-values are bolded within this table.

a. Dependent Variable: Mean Demonstrated Modeling

b. Dependent Variable: Mean Verbal Prompting

c. Predictors: (Constant), Mean MVPA

d. Predictors: (Constant), Mean MVPA, Mean Light

Discussion

This study examined which teacher-led strategy, demonstrated modeling or verbal prompting, promoted higher levels of physical activity among children attending a low-SES preschool. Our hypothesis was supported in that teacher demonstrated modeling had a greater influence on preschooler's physical activity levels compared to teacher verbal prompting.

Results of this study indicate that while teacher-led strategies can play a key role in increasing preschooler's physical activity levels, some approaches can elicit higher levels than others. Specifically, our study found that teacher demonstrated modeling had a significant relationship to children's MVPA and light physical activity levels, while teacher verbal prompting did not. These results emphasize the need for preschool teachers in low SES schools to model physical activity rather than simply using verbal prompts.

While there remains a need for indoor physical activity implementation throughout the preschool school day, based on this childcare center daily schedule, the most beneficial times for teachers to provide children with indoor physical activity opportunities may be during small group and read aloud time where children show the lowest levels of both light and MVPA. In addition, teacher demonstrated modeling might be a more viable strategy when aiming to increase children's physical activity levels during small group and read aloud time as these segments had the least amount of teacher demonstrated modeling about physical activity. Not including outdoor time, our findings also found that teacher's may find it easier to incorporate physical activity opportunities during morning group, large group, and work time, where the highest levels of both light and MVPA were seen.

There are mixed findings in the literature regarding the relationship between teacher verbal prompting and physical activity. Our findings were not in agreement with several studies

including one conducted by Kahan, Nicaise, and Reuben (2016) that found teacher verbal prompting significantly increased preschoolers MVPA. However, Kahan and colleagues only examined recess and significance was met when being compared to baseline data. Moreover, the intervention observed children who were previously identified as sedentary individuals and did not incorporate teacher demonstrated modeling strategies. Furthermore, Efrat (2013), who explored teacher modeling and prompting during elementary outdoor time (recess) to increase children's MVPA levels, found that teacher modeling was not an effective strategy for increasing MVPA during outside time; however, teacher verbal prompting may be an effective strategy. The findings in both studies may indicate that teacher verbal prompting can be a more effective strategy in increasing children's physical activity levels during outside time. Nonetheless, on average, outside time only accounts for 8% of the preschool day (Tandon et al., 2015) leaving a very large portion of the day spent indoors.

Research shows that the little activity preschoolers are participating in is generally correlated with outside time and the highest outcomes for preschoolers MVPA are identified for interventions conducted outside (Alhassan et al., 2007; Baranowski et al., 1993; Brown et al., 2009; Burdette et al., 2004; Timmons et al., 2007; Tucker, 2008). In addition, preschoolers spend around 11-27% of outdoor time in MVPA (Brown et al., 2009; Cardon et al., 2009; Dowda et al., 2004; Hannon & Brown, 2008). These findings agree with our study, as the highest amount of MVPA (around 30%) throughout the preschool day across the study was seen during outside time. Previous findings coupled with ours indicate the need for future research to target more strategies that can be used for indoor activity because preschoolers are spending the majority of the school day indoors, where they are more sedentary.

Previous research studies have found that preschool teachers who model higher levels of physical activity result in higher levels of physical activity for their students (Cheung, 2019; Fossdal et al., 2018). Another study that evaluated verbal prompting alone and teacher modeling combined with verbal prompting to increase gross motor task completion (GMTC) in physical activity programming for children with autism spectrum disorder found that participants engaged in low levels of GMTC in conditions that involved verbal prompting alone, while improvements were found when modeling and prompting together were introduced (Dieringer et al., 2017). Although Pate et al. (2016) saw an increase in preschooler's MVPA levels when implementing a curriculum that supported teacher-led strategies through verbal prompting and demonstrated modeling, it is unknown as to which individual strategies that were incorporated into the curriculum intervention had an effect on children's physical activity levels.

This area of research findings is scarce. Therefore, future research and intervention efforts should individually evaluate teacher-led strategies that promote preschooler's physical activity levels to determine which strategies elicit higher levels of physical activity. In addition, future studies should assess how these different strategies impact children's physical activity levels during specific times of the preschool day, as previous research shows that teacher verbal prompting can be a more effective strategy in increasing children's physical activity levels during specific times of the day (i.e. outside time) and other results, including ours, indicate that teacher demonstrated modeling can be a more effective strategy during other times of the preschool day (i.e. music and full school day). Efforts to explore other teacher-related factors that influence children's physical activity levels could be continued in order to identify additional effective strategies to promote physical activity among preschool children. Lastly,

assisting teachers with effective practices and strategies that promote physical activity for both children and teachers should be a continued model to follow in future preschool interventions.

This study is not without limitations. First, this study only examined a snapshot of the preschool school year and results may differ across time. Second, this data may reflect culturally based intervention strategies specific for this population. Results may differ for other preschool samples.

Acknowledgements

The authors would like to acknowledge the teachers, participants, and parents for their contribution and their time devoted to the study. This study was developed without external funding support. All contributing authors declare no conflicts of interest.

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V. Conclusion

Research shows that preschool interventions targeting teacher-led strategies can have the most beneficial outcomes for children's physical activity levels. To our knowledge, there have not been any interventions where a researcher works with preschool teachers individually to create an indoor physical activity plan that is specific to each classroom encouraging the implementation of teachers' physical activity ideas into their already planned lesson content. Therefore, our aim in Manuscript I. was to determine whether this type of intervention strategy was a feasible approach. The overarching finding in Manuscript I. showed that a teacher-guided and -led indoor preschool physical activity intervention is a feasible approach that can acutely increase children's MVPA levels.

The findings determined in Manuscript I. further encouraged our drive to explore how different teacher-led strategies correlate with preschoolers' physical activity levels in Manuscript II to direct future intervention strategies. Similar to Manuscript I., to our knowledge, there have not been any preschool physical activity interventions that have individually looked at different teacher-led strategies to determine whether some elicit higher levels of children's physical activity than others. Manuscript II. found that higher MVPA and light activity are associated with teacher demonstrated modeling during indoor time.

While a teacher-guided and -led preschool physical activity intervention is a feasible approach to acutely increase children's MVPA during indoor time, future research needs to examine the sustainability of this intervention. Although teachers identified that physical activity is easy to incorporate during indoor time at school when planned, changes in weekly routine continue to be a barrier that hinder their intended implementation. Therefore, there is a need for future research to explore ways to assist preschool teachers in overcoming perceived physical

activity implementation barriers when changes in their weekly routines occur. In the current study, children in the intervention group showed less of a decline in MVPA during outdoor time compared to children in the control group. These findings indicate structured physical activity opportunities were able to maintain physical activity during outdoor time even though indoor physical activity declined. Future research should aim to gain more insight on how indoor physical activity participation affects outdoor physical activity participation at the preschool setting. Although our study demonstrates how simple changes in preschool teachers' indoor instructional practices can immediately benefit children's MVPA levels, it would be beneficial to include a measurement of teacher physical activity in future studies.

Research that examines how different teacher-led strategies correlate to preschooler's physical activity levels is scarce, therefore future research and intervention efforts should individually evaluate teacher-led strategies that promote preschooler's physical activity levels to determine which strategies elicit higher levels of physical activity. In addition, future studies should assess how these different strategies impact children's physical activity levels during specific times of the preschool day, as previous research shows that teacher verbal prompting can be a more effective strategy in increasing children's physical activity levels during specific times of the day (i.e. outside time) and other results, including ours, indicate that teacher demonstrated modeling can be a more effective strategy during other times of the preschool day (i.e. music and full school day). Efforts to explore other teacher-related factors that influence children's physical activity levels could be continued in order to identify additional effective strategies to promote physical activity among preschool children. Lastly, assisting teachers with effective practices and strategies that promote physical activity for both children and teachers should be a continued model to follow in future preschool interventions.

Preschool physical activity implementation is arguably more critical now than ever. In March 2020, the World Health Organization (WHO) declared a pandemic and national emergency in the United States caused by COVID-19. To date (Mar. 3, 2022), numerous COVID-19 restrictions have been enacted to prevent the spread of the virus. COVID-19 restrictions include but are not limited to school, park, and recreational center closures, extracurricular activity cancellations, and physical interaction restrictions. Not surprisingly, preschoolers' recent physical activity levels have been profoundly hindered due to the insufficient opportunities for physical activity resulting from the current and ongoing COVID-19 pandemic (143). While this area of research is still new, it supports an even greater need for more physical activity implementation and opportunities in schools, as many school closures have recently been lifted and are now open. Future research should target preschool policy with the aim to increase the duration of outdoor time, where the highest levels of children's physical activity is seen, as well as increasing indoor physical activity implementation and opportunities. Specially, the findings for our studies can help guide researchers in the development of simple yet effective future preschool physical activity interventions that can immediately benefit the ongoing low levels of physical activity among the preschool population; especially in low-SES schools.

In conclusion, coupled findings in Manuscript I. and II. conclude that simple changes in preschool teachers' indoor instructional practices, such as discussing teachers' physical activity ideas and encouraging them to incorporate their own ideas into their classroom time through demonstrated modeling rather than simply using verbal prompts, can immediately benefit children's MVPA levels. It is important to note that certain segments of the preschool day, specifically small group and read aloud time, may have the greatest need of teacher-led physical

activity implementation through demonstrated modeling. However, teachers may find it easier to incorporate physical activity opportunities during other indoor segments such as morning group, large group, and work time. Regardless of which segments future interventions choose to target, there remains a strong need for indoor physical activity implementation to occur, as children spend the majority of the preschool day indoors and lowest levels of physical activity occur indoors as well.

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V. APPENDICES

Appendix A: Institutional Review Board Approval for Children

AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS

REQUEST for PROJECT RENEWAL

For Information or help completing this form, contact: THE OFFICE OF RESEARCH COMPLIANCE (ORC), 115 Ramsay Hall
Phone: 334-844-5966 e-mail: IRBAdmin@auburn.edu Web Address: http://www.auburn.edu/research/vpr/ohs/index.htm

Revised 2.1.2014 **Submit completed form to IRBsubmit@auburn.edu or 115 Ramsay Hall, Auburn University 36849.**

Exempt Activities: Must be renewed at least every 3 years.

Expedited and Full Board Protocols: Must be renewed at least annually, prior to the expiration date of the protocol.

If you do not plan to collect additional data and/or you do not have access to identifiable data (code lists, etc.), you may be able to file a "FINAL REPORT" for this project. Contact the ORC for more information.

Form must be populated using Adobe Acrobat / Pro 9 or greater standalone program (do not fill out in browser). Hand written forms will not be accepted.

1. **Protocol Number:** 06-262-EP 0701
2. **Original IRB Approval Dates:** **From: 1/29/2007** **To: 12/11/2020**
3. **Requested Renewal Period (ONE YEAR MAXIMUM):** **From:** 12/11/2019 **To:** 12/11/2020
4. **PROJECT TITLE: Project title for**
   The influence of mastery motivational climates on the physiological parameters of young children
5. Mary Rudisill | Director | Kinesiology | 844-1458 | rudisme
   PRINCIPAL INVESTIGATOR | TITLE | DEPT | PHONE | AU E-MAIL
   PI SIGNATURE | 301 Wire Road, Auburn, AL 36849 (MAILING ADDRESS) | ALTERNATE E-MAIL

   FACULTY ADVISOR | SIGNATURE | DEPT | PHONE | AU E-MAIL

   Name of Current Department Head: Mary Rudisill **AU E-MAIL:** rudisme
6. **Current External Funding Agency and Grant number:** n/a
7. **a. List any contractors, sub-contractors, other entities associated with this project:** n/a

   b. List any other IRBs associated with this project:
8. **Explain why you are requesting additional time to complete this research project.**

   We implement a movement program two days a week at a local preschool. This project is ongoing and continues every year.

FOR ORC OFFICE USE ONLY

DATE RECEIVED IN ORC: _____ by _____ RENEWAL # _____
DATE OF IRB REVIEW: _____ by _____ PROTOCOL APPROVAL CATEGORY: _____
DATE OF IRB APPROVAL: _____ by _____ INTERVAL FOR CONTINUING REVIEW: _____
COMMENTS:

1 of 3

9. **Briefly list** *(numbered or bulleted)* **the activities that occurred over the past year, particularly those that involved participants.**

Over the past year the movement program assessed the effects of a movement program on physical activity, body composition, perceived competence and cognition. 90 children returned parental consent forms.

10. **Do you plan to make any changes in your protocol if the renewal request is approved?**
(e.g., research design, methodology, participant characteristics, authorized number of participants, etc.)

XX **NO** **YES**

11. **PARTICIPANT INFORMATION**

a. **How many individuals have actually participated in this research?** 90
If retrospective, how many files or records were accessed? _____

b. **Were there any adverse events, unexpected difficulties or unexpected benefits with the approved procedures?**

XX **NO** **YES**

d. **How many participants have withdrawn from the study?** 8 ☐ **NA**
If participants withdrew from the study, please explain.

e. **How many new participants do you plan to recruit during the renewal period?** 100 ☐ **NA**

f. **During the renewal period, will you re-contact any individual that has already participated in your research project?**

XX **NO** **YES**

If "YES", please explain reasons for re-contacting participants. (If "YES" and the procedure to re-contact has not been previously approved, please complete and attach a "REQUEST for PROTOCOL MODIFICATION" form.)

12. **PROTECTION OF DATA**

a. **Is the data being collected, stored and protected as previously approved by the IRB?**

☐ **NO** ☒ **YES**

If NO, please explain.

b. **Are there any changes in the "key research personnel" that have access to participants or data?**
Attach CITI completion reports for all new key personnel.

☒ **NO** **YES**

If YES, please identify each individual and explain the reason(s) for each change.

c. **What is the latest date (month and year) you now expect all identifiable data to be destroyed?**
(Identifiable data includes videotapes, photographs, code lists, etc.)

DATE: 12/11/2022 ☐ **Not Applicable – no identifiable data has been or will be collected.**

13. **Attach a copy of all "stamped" IRB-approved documents used during the previous year.**
(Information letters, Informed Consents, Parental Permissions, flyers etc.).

14. **If you plan to recruit participants, or collect human subject data during the renewal period,** attach a new copy of the consent document, information letter, or any flyers **you will use during the extension.**

(Be sure to review the ORC website for current consent document guidelines and updated contact information: http://www.auburn.edu/research/vpr/ohs/sample.htm .)

Appendix B: Institutional Review Board Approval for Teachers

AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUM AN SUBJECTS

R E Q UE S T f o r P RO J E CT R E NE W A L

For Information or help completing this form, contact: **THE OFFICE OF RESEARCH COMPLIANCE (ORC)**, 115 Ramsay Hall
Phone: 334-844-5966 **e-mail:** IRBAdmin@auburn.edu **Web Address:** http://www.auburn.edu/research/vpr/ohs/index.htm

Revised 2.5.2020 **Submit completed form to IRBsubmit@auburn.edu or 115 Ramsay Hall, Auburn University 36849.**

Exempt Activities: Must be renewed at least every 3 years.

Expedited and Full Board Protocols: Must be renewed at least annually, prior to the expiration date of the protocol.

If you do not plan to collect additional data and/or you do not have access to identifiable data (code lists, etc.), you may be able to file a "FINAL REPORT" for this project. Contact the ORC for more information.

Complete this form using Adobe Acrobat Writer (versions 5.0 and greater). *Hand written forms will not be accepted.*

1. **Protocol Number:** 18-075 EP 18002 **Today's Date:** 03/2/2020
2. **Original IRB Approval Dates:** **From:** 03/08/2019 **To:** 03/08/2020
3. **Requested Renewal Period (ONE YEAR MAXIMUM):** **From:** 03/08/2020 **To:** 02/08/2021
4. **PROJECT TITLE:** Examining Head Start Teacher's Perception, Barriers, and Facilitators to implementing a Mastery Motivational Climate PE climate.
5. Danielle Wadsworth | assoc prof | KINE | 334-844-1836 | wadswdd
   PRINCIPAL INVESTIGATOR | **TITLE** | **DEPT** | **PHONE** | **AU E-MAIL**

   Danielle Wadsworth (Digitally signed by Danielle Wadsworth DN: cn=Danielle Wadsworth, o=Auburn University, ou=Kinesiology, email=wadswdd@auburn.edu, c=US Date: 2020.03.07 07:18:08 -06'00') | 301 Wire Road |
   PI SIGNATURE | **MAILING ADDRESS** | **ALTERNATE E-MAIL**

   FACULTY ADVISOR | **SIGNATURE** | **DEPT** | **PHONE** | **AU E-MAIL**

   Name of Current Department Head: Mary Rudisill **AU E-MAIL:** rudisme
6. **Current External Funding Agency and Grant number:** None
7. **a. List any contractors, sub-contractors, other entities associated with this project:** None

   b. List any other IRBs associated with this project: None
8. **Explain why you are requesting additional time to complete this research project.**

   We are currently analyzing data that was collected in Spring 2019 and Fall 2019.

Version Date (date document created): 03/02/2020 page x of y

9. **Briefly list** *(numbered or bulleted)* **the activities that occurred over the past year, particularly those that involved participants.**

30 teachers were consented and completed brief semi-structured interviews.

10. **Do you plan to make any changes in your protocol if the renewal request is approved?**
(e.g., research design, methodology, participant characteristics, authorized number of participants, etc.)

[x] **NO** [ ] **YES**

(If "yes", please complete and attach a "REQUEST for PROTOCOL MODIFICATION" form.)

11. **PARTICIPANT INFORMATION**

a. **How many individuals have actually participated in this research?** 30
If retrospective, how many files or records were accessed? 0

b. **Were there any adverse events, unexpected difficulties or unexpected benefits with the approved procedures?**

[X] **NO** [ ] **YES**

If YES, please describe.

d. **How many participants have withdrawn from the study?** 0 [ ] **NA**
If participants withdrew from the study, please explain.

e. **How many <u>new</u> participants do you plan to recruit during the renewal period?** _____ [X] **NA**

f. **During the renewal period, will you re-contact any individual that has already participated in your research project?**

[ ] **NA**

[X] **NO** [ ] **YES**

If "YES", please explain reasons for re-contacting participants. (If "YES" and the procedure to re-contact has not been previously approved, please complete and attach a "REQUEST for PROTOCOL MODIFICATION" form.)

Version Date (date document created):_____ page x of y

12. PROTECTION OF DATA

a. Is the data being collected, stored and protected as previously approved by the IRB?

☐ **NO** ☒ **YES**

If NO, please explain.

b. Are there any changes in the "key research personnel" that have access to participants or data?
Attach CITI completion reports for all new key personnel.

☒ **NO** ☐ **YES**

If YES, please identify each individual and explain the reason(s) for each change.

Please note the orginal contact person for this IRB was Jerraco Johnson. He graduated and moved the contact person to Danielle Wadsworth.

c. What is the latest date (month and year) you now expect all identifiable data to be destroyed?
(Identifiable data includes videotapes, photographs, code lists, etc.)

DATE: 03/08/2023 ☐ **Not Applicable – no identifiable data has been or will be collected.**

11. Attach a copy of all "stamped" IRB-approved documents used during the previous year.
(Information letters, Informed Consents, Parental Permissions, flyers etc.).

12. If you plan to recruit participants, or collect human subject data during the renewal period, attach a new copy of the consent document, information letter, or any flyers you will use during the extension.

(*Be sure to review the ORC website for current consent document guidelines and updated contact information: http://www.auburn.edu/research/vpr/ohs/sample.htm* .)

Version Date (date document created): 03/07/2020

Appendix C: Letter to Custodial Caregiver

AUBURN COUNCIL ON HUMAN RELATIONS, INC.
CHILD DEVELOPMENT PROGRAM
P.O. BOX 3770/950
Shelton Mill Road Auburn, AL 36831-3770
Phone (334) 821-8336 • Fax (334) 826-6397 • Email
alma.golston@achr.com

FAMILY NOTICE!

DARDEN'S EXCITING CONTINUED HEAD START PARTNERSHIP WITH AUBURN UNIVERSITY, SCHOOL OF KINESIOLOGY
07/20/2020

With the agreement of our Parent Policy Council at ACHR, Darden Head Start Center children and staff will be participating in a special physical activity program at Darden Center, starting in the middle of August.

In this program, children will have the opportunity to gain higher levels of physical activity during their indoor classroom time. The Auburn University School of Kinesiology will be working with teachers to provide activities into their indoor classroom content. University students who are studying in the field of Kinesiology (study of human movement) will be present to help during this project. Children's teachers will lead them in these activities.

In order for any data to be collected on your child during this project, we need a signed parent/guardian permission form. Your child can gain health benefits from participating in these activities. Data gathered will be used to advance Auburn University's knowledge of young children's physical activity levels through teacher involvement, and how to best encourage children to participate in physical activities. To protect children's privacy, names of the children are not used in research findings.

All children will have the opportunity to participate. If you wish to allow your child's data to be included in this research, please read and sign the attached permission form and return it to Darden Center. We cannot start until we receive permission forms.

Appendix D: Child Informed Consent Form

Auburn University
SCHOOL OF KINESIOLOGY

INFORMED CONSENT FOR DETERMINING THE EFFECTIVENESS OF THE PRESCHOOL MOTOR DEVELOPMENT PROGRAM- ACHR- DARDEN HEAD START CENTER

We invite your child to participate in the Darden Head Start Center Motor Development Program. We are interested in determining the effects motor development programming has on the children's motor skill development, self-perceptions, physical activity and fitness level, mastery motivation, home environment, social and emotional behavior, and cognitive skills. The assessments measure actual motor skill performance (measured by the Test of Gross Motor Development), motor proficiency (measured by the Bruininks' Qseretsky Test of Motor Proficiency), and throwing speed (measured with a velocity speed radar detector), perceptions of physical competence and body image (measured by the Pictorial Scale of Perceived Competence and Acceptance), physical activity level (measured using the System of Observing Fitness Instruction Time, and accelerometers), mastery motivation (measured by the Dimensions of Mastery Questionnaire- 17), home environment (measured with items from the National Children and Youth Fitness Study and the Youth Risk Behavior Survey), social and emotional skills to young children (by accessing and reviewing Head Start Devereux Assessment data and classroom videos) and cognitive skills (measured through the completion of a series of reasoning tasks). Additionally, descriptive information, including height, weight, Body Mass Index, sex, race, and date of birth, will be collected. The assessments will be used for future programming as it relates to Motor Development Programs as well as provide specific instructional information about the progress of your child. All lessons will be video recorded to code the time that children spend practicing. Following is an explanation of each assessment:

Self-perceptions will be assessed with two instruments. *The Pictorial Scale of Perceived Competence and Acceptance* for preschool children will be used to assess perceived competence and acceptance. This assessment consists of 26 items presented on pictorial plates each of which contains two separate pictures, side by side, one of which depicts a child who is skilled, and the other of which depicts a child who is not so skilled. The child's task is to first select the picture that is most like him/herself. Then, after making this choice, the child focuses on that picture and indicates whether he or she is just a little bit like that child or a lot like that child. *Body Perceptions* will also 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".

The *Dimensions of Mastery Questionnaire-17* is used to measure mastery motivation for children from infancy through elementary school-age. This assessment consists of 36 age- appropriate statements about how children perceive their behavior. Children verbally respond to questions regarding their behavior on a scale of 1 'not at all typical' to 4 'very typical'. Children answer questions related to their persistence on motor skills, cognitive tasks, interacting with other children, interacting with adults, and pleasure in learning/mastering skills. Motor skill program teachers will complete a pen and paper version of the Dimensions of Mastery Questionnaire-17.

The *Test of Gross Motor Development* is a measure of fundamental motor skill competence in children ages 3- to 10- years. The 12-item test includes 6 locomotor skills (running, jumping, hopping, leaping, galloping, and sliding) and 6 object-control skills (rolling, throwing, catching, striking, bouncing, and kicking).

 Parent/Guardian initials__

301 Wire Road, Auburn, AL 36849-5323; Telephone 334-844-4483; Fax 334"844-1467
www.auburn.edu/kine

The *Bruininks-Oseretsky Test of Motor Proficiency* as an instrument used to measure children's gross and fine motor skills. Specifically the assessment measures: Fine Motor Precision - 7 items (e.g., cutting out a circle, connecting dots); Fine Motor Integration - 8 items (e.g., copying a star, copying a square); Manual Dexterity-5 items (e.g., transferring pennies, sorting cards, stringing blocks), Bilateral Coordination - 7 items (e.g., tapping foot and finger, jumping jacks); Balance-9 items (e.g., walking forward on a line, standing on one leg on a balance beam); Running Speed and Agility - 5 items (e.g., shuttle run, one-legged side hop); Upper-Limb Coordination - 7 items (e.g., throwing a ball at a target, catching a tossed ball); Strength - 5 items (e.g., standing long jump, sit-ups). In addition, children's overhand throwing speed will be measured using a *Velocity Speed Radar Detector.*

The *System of Observing Fitness Instruction Time is* an observational measure used to determine how intense a child is engaged in physical activity. Physical activity intensity level is recorded every 20 seconds. Child physical activity levels are coded on a scale of '1' to '5' corresponding to *the* student's body position: lying down, sitting, standing, walking, or very active.

Accelerometers will be used to assess children's physical activity throughout their day at the childcare center. accelerometers will be attached to the waistband of each child by an investigator prior to participation in the motor development program and/or start of the school day. These devices are small and lightweight (28 x 27 x1 0 mm x 17 g). The accelerometers will measure the body's movement in both the vertical (i.e., up and down) and horizontal (i.e., side to side) direction.

Home environment will be measured using a series of single items designed to measure hypothesized social and physical environmental determinants of physical activity behavior. These will include access to sporting and/or fitness equipment at home (one question on a Likert type scale), access to play areas (two questions on a Likert type scale), and safety (one question on a Likert type scale). These items were modified from measures used in the National Children and Youth Fitness Study and the Youth Risk Behavior Survey.

Social and emotional behavior will be measured by accessing Head Start Devereux Assessment data and video-recorded classroom observations. The Devereux Childhood Assessment (DECA) Preschool Program, 2nd Edition is an assessment used by preschool educators to assist them in teaching social and emotional skills to young children. There are 37 items on the rating scale, each describing a specific behavior. For each child, the teacher indicates the frequency of the behavior's occurrence based on experience with the child. The DECA is currently used within Head Start as a screening tool to identify children who may need additional support in their social and emotional development. Also, the DECA is currently administered several times each year within all Head Start programs, including Darden Head Start in Opelika. The researchers intend to access existing DECA data collected by Darden Head Start over the course of a year for the purpose of monitoring children's social and emotional progress while being exposed to a movement/physical activity program. Accessing Head Start video-recorded classroom observations of instruction will be used to observe children within their classroom settings for the purpose of noting their academic and social behavior before and following the lessons. Currently, Head Start classrooms are equipped with recording devices and classroom activities are recorded for program purposes. The researcher will observe children's behaviors (from the video) before and after their participation in the program. The researchers will watch the recordings and note the frequency of behaviors associated with attention to task, compliance, accuracy of responses to questions, verbal aggression, and physical aggression.

Cognitive Skills will be measured both before and following your child's participation in the movement/ physical activity program and will be assessed through a series of developmentally appropriate cognitive assessments (i.e., The NIH Toolbox cognitive assessments normed for children as young as 3). These include the following: (a) Flanker test takes 4 minutes to administer and measures inhibitory control (how well do children ignore irrelevant stimuli); (b) Processing Speed test takes 3 minutes to administer and measures how quickly can children identify if stimuli are similar or different;

Parent/Guardian initials ____

(c) Dimensional Change Card Sort test takes 4 minutes to complete and measures how well can children shift from one category to another; (d) List Sorting Working Memory test takes 3 minutes to administer and measures how well children can organize a list of animals and food in size order from memory. Cognitive tests will also include: (e) Motor Skill Match test, that takes 4 minutes to complete and measures how quickly can children identify a specific movement skill out of other movements (e.g., kick vs. run, jump, throw); (f) Head, Shoulders, Knees, and Toes test takes 2 minutes to complete and measures how well children can do what they hear and inhibit what they see (e.g., hear head, see shoulders). Parents and teachers of participants will be asked to complete the Children's Independent Learning Development Checklist (5-10 minutes to complete) that will help provide information about the participants' cognitive development.

Descriptive Information including height, weight, Body Mass Index, sex, race, number of siblings, birth order, and date of birth will be gathered for your child. Height will be measured using a standard tape measure. Children will be asked to stand with their back against a wall and height will be measured to the nearest centimeter. Children will also stand on a standard scale to measure their weight to the nearest kilogram. Body Mass Index, a measure of overweight and obesity, will be calculated from the height and weight measures using the formula height divided by weight^2• Parents/guardians will be asked to report their child's sex, race, and date of birth.

There are no foreseeable risks or discomforts associated with completing the Test of Gross Motor Development, completing the Bruininks-Oseretsky Test of Motor Proficiency, reporting self-perceptions, observing physical activity with the System of Observing Fitness Instruction Time, reporting Dimensions of Mastery Questionnaire-17, wearing accelerometers, completing the home environment questionnaire, accessing the DECA data and observing social and emotional behavior, using the velocity speed radar detector to measure speed of throw, and completing the cognitive tasks.

Please note that any child who expresses a desire to quit the assessments will be allowed to stop immediately. Participants will also be told that they can remain in the Motor Development Intervention Program without completing the assessments. To preserve confidentiality, the children's performance and responses will be reported as group results only. I am informing you that any information obtained from the assessments may be used in any way thought best for education and publication. Unless otherwise notified by you, I plan to present the results of this program assessment at a scientific conference and publish the results in an appropriate journal. In any presentation or publication, the data will remain anonymous.

Your decision whether or not to allow your child to participate will not jeopardize his/her future relations with Auburn University, the School of Kinesiology, or Darden Head Start Center. Your child's performance or responses will in no way affect your child's standing in the childcare center. At the conclusion of the assessments, a summary of group results will be made available to all interested parents and. educators. Should you have any questions or desire further information, please contact: Dr. Mary Rudisill at (334) 844-1458 (phone) rudisme@auburn.edu (email). You will be provided a copy of this form to keep.

For more information regarding your rights as a research participant 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@aubum.edu

HAVING READ THE INFORMATION PROVIDED YOU MUST DECIDE WHETHER OR NOT TO ALLOW YOUR CHILD TO PARTICIPATE. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO ALLOW YOUR CHILD'S PARTICIPATION IN THE STUDY.

Child's Name_____

Parent/Guardian Signature_____Date _____

Investigator Signature_____ Date _____

Appendix E: Teacher Informed Consent Form

AUBURN UNIVERSITY

SCHOOL OF KINESIOLOGY

INFORMED CONSENT

for a Research Study entitled

"Examining Head Start Teachers' Perceptions, Barriers, and Facilitators of Implementing a Mastery Motivational Climate Physical Education Program"

You are invited to participate in a research study to examine your perceptions of mastery motivational climate physical education programs and how they impact different behaviors of your students on the playground and in the classroom. The study is being conducted by Mr. Jerraco Johnson, a Doctoral Candidate in the School of Kinesiology of Auburn University. You were selected as a possible participant because you have been witness a mastery motivational climate physical education program over the last year and you are age 18 or older.

What will be involved if you participate? If you decide to participate in this research study, you will be asked to participate in a interview, fill out a demographic survey and a questionnaire about physical activity, as well as wear a physical activity monitor for 1 week. This interview will ask you about your understanding of the intent of the program, the effectiveness of the program, and your perceptions of children's behaviors on the playground and in the classroom on program and non-program days. The interview will be scheduled during the spring and summer of 2019. The interview will be conducted by Mr. Jerraco Johnson. Your interview will be audio recorded for later analysis. Your total time commitment for the interview will be approximately 30 minutes. The interviews will be scheduled based on your return of this consent form. Additionally, on the same date as your interview, you will be asked to complete a short survey about your demographics, and a short questionnaire about your knowledge, attitude, and beliefs of physical activity. Your total time commitment for this study is approximately 1 hour.

Are there any risks or discomforts? The risks associated with participating in this study are minimal. Confidentially could be a risk. To minimize the risk of confidentiality, you may withdraw from participation in the study at any time (see below). You will also be given a pseudonym to ensure that you are not identifiable in any records or published material. Additionally, to minimize the risk of breach of confidentiality, we will keep your data safe and your will be given a participant ID number. No one will know which ID number is assigned to you except for me, Jerraco Johnson. All of the interview audio and the notes will be destroyed after the findings are published on or no later than August of 2021.

Are there any benefits to yourself or others? If you participate in this study, you can expect to contribute to the knowledge base of best instructional practices for physical education for preschool children, which in turn could benefit health behaviors of young children.

301 Wire Road, Auburn, AL 36849-5323; Telephone: 334-844-4483; Fax: 334-844-1467

AUBURN UNIVERSITY

SCHOOL OF KINESIOLOGY

Participant's initials _____

Will you receive compensation for participating? There is no compensation for participation.

Are there any costs? There is no any cost for your participation.

If you change your mind about participating, you can withdraw at any time during the study. Your participation is completely voluntary. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, the School of Kinesiology, and Jerraco Johnson. Your classes participation in the program will not be impacted by your decision to the participation.

Your privacy will be protected. Any information obtained in connection with this study will remain *confidential*. Information obtained through your participation may be published in a professional journal or presented at a professional meeting. In any presentation or publication real names will not be use, that is the data will be confidential.

If you have questions about this study, *please ask them now or* contact Mr. Jerraco Johnson at jljj0042@auburn.edu or 309-798-7338. A copy of this document will be given to you to keep.

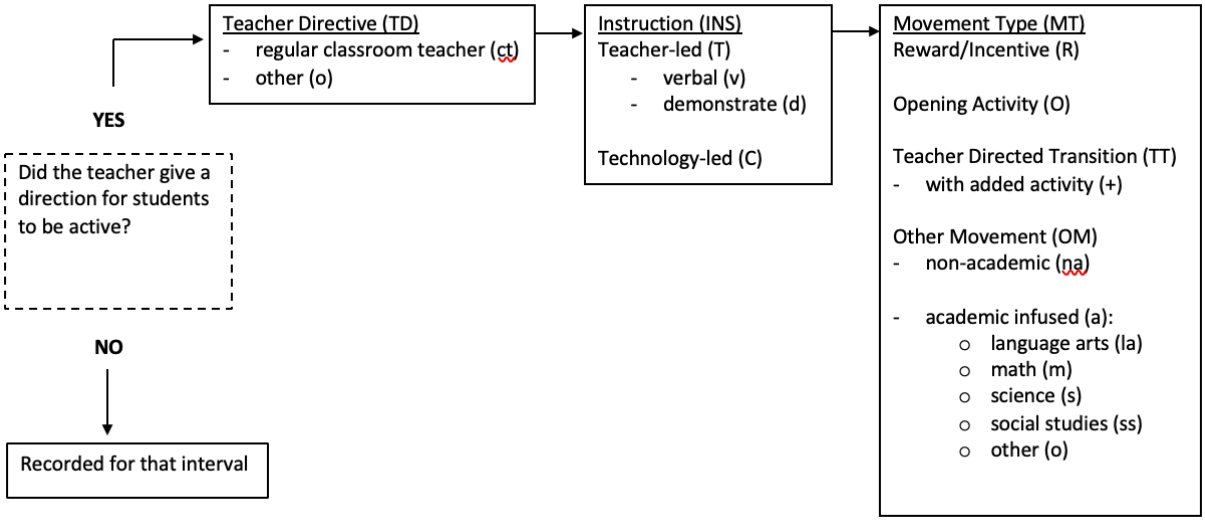
If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

_____	_____
Participant's signature Date	Investigator obtaining consent Date
_____	_____
Printed Name	Printed Name
	_____
	Co-Investigator Date
Participant's initials _____	_____
	Printed Name

301 Wire Road, Auburn, AL 36849-5323; Telephone: 334-844-4483; Fax: 334-844-1467

Appendix F: Stage 1 of the SOSMART Decision Flow Chart



Appendix G: Stage 1 of the SOSMART Variables and Definitions

Variable	Operational definition
Teacher involvement	
Teacher direct	
Classroom teacher	Teacher gave an explicit direction for students to be active.
No	There was no teacher direction for students to be active occurred.
Instruction	
Teacher-led	The teacher led the activity.
Technology-led	The teacher used technology (i.e., YouTube videos, electronic media like GoNoodle or JustDance) to lead the activity. The adult did NOT actually lead the activity.
Movement type	
Reward/incentive	Movement was provided by the teacher as an obvious (explicitly stated) reward for providing a correct response or behavior in class.
Opening activity	Movement was directed by the teacher *within the first 10 minutes of the official start of the school day*, followed by a class response resulting in student activity. (This may include a school-wide morning exercise on the news show, etc.).
Teacher-directed transition	The teacher gave a direction for students to be active resulting in students moving from Point A to Point B (i.e., desks to carpet) or between finishing one task and getting ready for next task (i.e., putting away supplies and/or transitioning from one instructional content to another instructional content). This includes housekeeping tasks and procedures (picking up/putting away supplies (pencils/ paper, tissues, snacks), using restroom) when the teacher has students walk from Point A to Point B.
Other movement	*Nonacademic*: Movement directed by the teacher *within a lesson* or *between lessons*, followed by a class response resulting in student activity that *does NOT include academic content* (often called "brain breaks" or "exercise breaks").
	Academic-infused (a): Movement directed by the teacher *within a lesson* or *between lessons*, followed by a class response resulting in student activity *that DOES review/ teach academic content.*

Appendix H: SOSMART Coding Sheet

*Note that student response (SR) was not utilized or coded during this study.

School: _____ # Students: _____ Observer: _____
Teacher Name: _____ # Assistants: _____ Observation Date: _____
Grade: _____ Class time: _____ Coding start: _____AM/PM
_____AM/PM to _____AM/PM Coding stop: _____AM/PM

		Intervals											Intervals								
		1	2	3	4	5	6	7	8	9			1	2	3	4	5	6	7	8	9
TI	TD										TI	TD									
	INS											INS									
	MT											MT									
SR	SA										SR	SA									
	R											R									

		Intervals											Intervals								
		1	2	3	4	5	6	7	8	9			1	2	3	4	5	6	7	8	9
TI	TD										TI	TD									
	INS											INS									
	MT											MT									
SR	SA										SR	SA									
	R											R									

Was a *pre-packaged* curriculum used? ____Yes ____ No If so, which one? _____

Did you *create* a curriculum to use? ____Yes ____No

Is this part of a larger intervention? ____Yes ____ No If so, which one? _____

Appendix I: Stage 1 of the SOSMART Scoring Summary Sheet

Category	Code	Number of category intervals	Total number of intervals for observation period	Percentage of occurrence: $\frac{\#category\ int}{total\ observation\ int} x100$	Frequency of events
Teacher Direct (TD) Classroom Teacher	CT				
Other	O				
None	N				
Instruction (INS) Teacher-led	T				
Technology-led	C				
Movement Type (MT) Reward/Incentive	R				
Opening Activity	O				
Teacher Directed Transition	TT				
Other Movement (non-academic)	OMna				
Other Movement (academic)	OMa				