Impact of an 8-week active play intervention on child developmental outcomes

by

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ABSTRACT

Background: Play is an essential component of early childhood education and is included in American preschool children's current physical activity guidelines. However, there is a lack of evidence about the effect of active play interventions on preschoolers' developmental outcomes. Therefore, the primary aim of this study was to examine the impact an 8-week teacher-guided active play intervention on physical activity levels, body composition, fundamental motor skills, and on-task behavior in preschoolers attending two private preschool centers located in the southeastern region of the United States. The secondary aim was to examine the feasibility and fidelity of the 8-week teacher-guided active play intervention.

Methods: Participants were recruited from two local private preschool centers, and were randomly assigned to either the intervention or the control group. All measures were assessed at baseline (Weeks 0), post-intervention (Weeks 9 – 11), and retention (Weeks 30 – 33). During the school days, physical activity was assessed with an Actigraph GTX3 (Pensacola, FL) accelerometer worn on the non-dominant wrist. Researchers assessed percentage of time spent participating in physical activity inside (IPA) and outside (OPA). Bioelectrical impedance was used to assess body composition (fat mass (FM) and fat-free mass (FFM)). Fundamental Motor Skills (FMS, stationary skills (SS), locomotor skills (LS), object manipulation skills (OMS), and gross motor quartile (GMQ)) were assessed using the Peabody Developmental Motor Scales, 2nd edition. A modified momentary time sampling technique evaluated On-task behavior. Lead teachers completed weekly checklists and Likert-style surveys to assess implementation fidelity, automaticity, and the habit formation level. The first author conducted informal interviews with the lead teachers to further evaluate intervention fidelity.

Results: From baseline to post-intervention, there were significant group differences for IPA (*F* (1,40) = 13.59, p <.001, η_p^2 = .254), but not for OPA (*F* (1,40) = 1.16, p = .288, η_p^2 = .028). Similarly, from baseline to retention, there were significant group differences for IPA (F (1,33)16.84, <.001, .994), but not for OPA. Furthermore, there were significant increases in FM (*F* (1.626,63.432) = 15.048, p < .001, η_p^2 = .278), FFM (*F* (1,640, 63.962) = 68.531, p < .001, η_p^2 = .637) from baseline to retention for both groups. In addition, the intervention was successful at improving GMQ acutely (*F* (1,46) = 5.037, p = .030, η_p^2 = .099), but improvements were not maintained at retention. The active play intervention did not show significant effects for On-task behavior. Teachers reported a mean difficulty of 1.35 for inside and 1.4 for outside activities. There were no statistically significant differences for indoor (χ^2(5)=5.50, p = 3.58) or outdoor automaticity (χ^2(6) = 9.363 p = .141).

Conclusions: The results of this study indicate that this type of intervention is feasible and a pathway to improving gross motor skills and IPA in young children. However, while teachers seem to understand the importance of physical activity, it still comes second to "academic" material. Future studies should target teacher beliefs and attitudes regarding play and movement specifically.

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LIST OF ABBREVIATIONS

PA – Physical Activity

COVID-19 – Coronavirus Disease

FMS – Fundamental Motor Skills

SDT – Self-determination Theory

SCT – Social-cognitive Theory

SEM – Social-ecological Models

BMI – Body Mass Index

FM – Fat Mass

FFM – Fat-free Mass

IPA – Inside Physical Activity

OPA – Outside Physical Activity

PDMS-2 – Peabody Developmental Motor Scales, 2nd Edition

SS – Stationary Skills

LS – Locomotor Skills

OMS – Object Manipulation Skills

GMQ – Gross Motor Quartile

TOT – Time-on-task

TOF – Time off-task

TGMD-2 – Test of Gross Motor Development, 2nd Edition

NCLB – No Child Left Behind

ESSA – Every student Succeeds Act

NAEYC – National Association for Education of Young Children

AAP – American Academy of Pediatrics

CHAPTER I

INTRODUCTION

Jean Piaget theorized that children are active learners and expand their knowledge by building upon the foundations of previous learning (Piaget, 2013; Piaget & Inhelder, 2008; So, 1964). Some scholars have even stated that according to the theories of Piaget, the aim of education should be autonomy and constructivism (Kamii, 1984). Kamii (1984) further stated that children learn best in an environment where their thoughts and ideas are valued and respected. One pathway through which teachers can achieve an autonomy-supportive environment is by incorporating play. Although defining play can be challenging; however, some authors have compiled common play properties. Brown and Vaughan (2009) noted that play is often: purposeless, voluntary, intrinsically motivated, timeless, and improvisational. Several organizations have stressed the importance of play in preschool settings (Friedman et al., 2021; Yogman et al., 2018) as play impacts multiple areas of development, and we learn and gain skills through play (Brown & Vaughan, 2009; Elkind, 2007).

Previous research shows that play impacts cognitive growth (Fink, 1976; Moore & Russ, 2008) and socio-emotional skills (Ashiabi, 2007). Further, research has shown that incorporating active play may improve self-regulation, indirectly impacting academic achievement (Becker et al., 2014). Self-regulation refers to the ability to control or direct one's attention, thoughts, emotions, and actions (McClelland & Cameron, 2012; McClelland et al., 2010; Schunk & Zimmerman, 1997). Play in preschool settings has also resulted in beneficial outcomes in other areas of development. For example, Derman et al. (2020) found that a math-based play intervention could significantly improve social skills, fine motor skills, and cognitive development. Additionally, Han et al. (2010) found that adding play to an already successful vocabulary intervention resulted in significantly greater improvements for at-risk preschoolers.

Active play is defined as a form of physical activity (PA) that increases energy expenditure, requires gross motor skills, and is enjoyable (Truelove et al., 2017). Due to the importance of PA and play, it may be beneficial to combine these two areas to determine the impact of PA and active play interventions on preschoolers' development and PA levels. Current evidence suggests preschool-aged children spend approximately 80% of their day in sedentary behaviors (Brown et al., 2009). Additionally, it is estimated that prior to the Coronavirus disease (COVID-19) quarantine, about 50% of American preschoolers met the updated PA guidelines (Pate et al., 2015). These estimates are troublesome, considering preliminary evidence of PA levels during COVID-19 quarantine shows significant decreases in PA and increases in sedentary behaviors for most populations, including children (Stockwell et al., 2021; Tulchin-Francis et al., 2021). Further data shows that PA levels for children in high-come countries were more impacted than their counterparts from low- and middle-income countries (Okely et al., 2021). The low levels of PA are alarming due to the well-established relationship between physical inactivity and health (Cote et al., 2013; Katzmarzyk et al., 2004; Power et al., 1997; Ross et al., 2015).

Physical Activity Benefits

The current PA guidelines stipulate that preschool-aged children should aim to be physically active throughout the day and participate in active play, including various activity levels and types of PA (U.S. Department of Health and Human Services, 2018). It is suggested that preschool-aged children should be active for at least three hours each day and include light, moderate, and vigorous physical activities. These recommendations are consistent with guidelines from Canada (Canadian Society for Exercise Physiology, 2012), the United Kingdom (UK Chief Medical Officers, 2019), and Australia (Australian Government, 2014). Although any amount of PA is beneficial, the suggested guidelines are minimum recommendations associated with the health benefits of PA.

Physical inactivity is a known risk factor for several chronic diseases, such as cardiovascular disease (Cote et al., 2013; Ross et al., 2015), adult obesity (Power et al., 1997), and insulin resistance (Katzmarzyk et al., 2004). Weaver et al. (2021) found that a sample of American children with a mean age of 8.7 years, significantly accelerated their Body Mass Index z-score during COVID-19 lockdowns. Furthermore, most obese children remain obese across several decades (Gordon-Larsen et al., 2010) and have an increased risk of developing cardiovascular disease (Morrison et al., 2007). These trends call for interventions to decrease the risk of obesity and sedentary behaviors particularly in young children. Furthermore, current evidence suggests that in addition to improving the risk of childhood obesity, greater amounts of PA are associated with improved measures of bone and skeletal health, psychosocial health, cognitive development, and motor skill development during the early childhood years (0-4 years) (Timmons et al., 2012).

Relationships of Physical Activity and Other Developmental Areas

PA is associated with beneficial effects on motor skills (Burns et al., 2017; Fisher et al., 2005; Nilsen et al., 2020; Wasenius et al., 2018; Zeng et al., 2017), cognitive development (Carson et al., 2016; Draper et al., 2012; Veldman et al., 2019; Zeng et al., 2017), and executive function (Mulvey et al., 2018; van der Niet et al., 2015). It is further evident that fundamental motor skills (FMS), a child's ability to hop, run, skip, balance, leap, kick, catch, and bounce, may serve as the foundation upon which all other skills are built (Clark & Metcalfe, 2002), and are predictive of lifetime PA levels (Kantomaa et al., 2013; Stodden et al., 2008). Moreover, there is evidence that FMS are deficient in children with obesity and are likely a barrier to children's participation in PA (Cliff et al., 2012). In addition to the relationship to PA, mastery of FMS are thought to contribute to a child's physical, cognitive, and social development (Payne & Isaacs, 2017). Due to the beneficial outcomes of PA on developmental outcomes and considering how much time children spend in school, preschools and childcare centers are ideal for PA programming.

Theory Based Interventions

PA as a complex human behavior involving the individual and the environment.. Thus, several theories serve as the foundation for understanding PA participation. Self-determination theory (SDT) suggests individuals are motivated to grow and change by three psychological needs: competence, relatedness, and autonomy (Ryan & Deci, 2000a, 2000b; Ryan et al., 1997). When these three psychological needs are met, individuals are more self-determined and intrinsically motivated. Fostering intrinsic motivation is vital as it is associated with long-term exercise participation. As such, interventions should aim to increase an individual's competence in an activity and provide an opportunity for relatedness and be autonomy supportive. Autonomy-supportive interventions aim to minimize external incentives, avoid controlling language, and provide and respect the choices of the individuals (Black & Deci, 2000; Hauser-Cram, 1998). High autonomy supportive environments are associated with increased PA levels (Wadsworth et al., 2013), as well as increased perceived competence and greater motor skill retention (Robinson & Goodway, 2009; Robinson et al., 2009; Valentini & Rudisill, 2004).

In addition to the constructs of SDT, it is also important to consider social-cognitive theory (SCT) and social-ecological models (SEM) when implementing PA interventions in school settings. SCT proposes that human behavior is explained by a dynamic, triadic, and reciprocal relationship between personal, behavioral, and environmental influences (Bandura, 1986). Current evidence suggests that personal factors, specifically self-efficacy and self-regulation, strongly predict PA behaviors in adults and children (Petosa et al., 2003; Ramirez et al., 2012; Strauss et al., 2001). Additionally, self-regulation skills proliferate during early childhood (McClelland & Cameron, 2012). Although personal factors, including self-efficacy and self-regulation, play a vital role in personal change (Bandura, 2004), the environment is a key determinant of behavior. SCT describes the impact of the social and physical environment on behavior; however, it does not explain the interactions between multiple levels of the environment. The SEM describes the complex interplay between the individual, interpersonal relationships, the community, and societal factors impacting behavior (Clinical and Translational Science Awards Consortium, 2016). Research examining SEM in school-based PA studies found that higher-level policies that are implemented at the societal (government) and community (school) level trickle down and influence the relationship and the individual level (Langille & Rodgers, 2010). However, the extent to which such policies are implemented depends on the overall culture of a school and the support available for PA opportunities (Langille & Rodgers, 2010).

PA interventions in preschool settings have primarily focused on increasing PA through activity breaks or active lessons. Thus far, PA interventions in preschool settings have been shown to improve PA levels (Alhassan et al., 2016; Alhassan et al., 2019; Pate et al., 2016; Vazou et al., 2021; E. K. Webster et al., 2015), on-task behavior (E. K. Webster et al., 2015), and motor skills (Bellows et al., 2013). However, even though childhood obesity is a persistent problem in early childhood, few PA interventions examine preschoolers' body composition, and

PA interventions often neglect the idea of play. For children, particularly preschool-aged children, PA is often in the form of play, which is why it is essential to consider.

Active Play Interventions

Active play interventions have resulted in similar outcomes compared to PA interventions, such as improvements in PA levels (Goldfield et al., 2016) and FMS (Adamo et al., 2016; Roach & Keats, 2018). One 6-week active play intervention found no effect on activity levels. However, this intervention was only implemented once a week for 60-minute periods, which may not have been a large enough dose to impact PA levels (O'Dwyer et al., 2013). Currently, only one active play intervention examining body composition could be identified. Goldfield and colleagues (2016) found that a 6-month active play intervention did not result in significant changes in body composition between groups; however, the intervention group did see reductions in body fat percentage and fat mass (Goldfield et al., 2016). Overall, active play interventions are one under-researched area (O'Dwyer et al., 2013), particularly in the United States, as most of the interventions are implemented in Canada (Adamo et al., 2016; Goldfield et al., 2016), England (O'Dwyer et al., 2013), and Australia (Hardy et al., 2010). In Australia, a state-wide health initiative, Munch & Move, was designed to promote PA, healthy eating, and reduce screen time in preschool settings through a play-based approach (NSW Government, 2020). Results showed a greater number of childcare settings meeting the recommendations of PA for at least 25% of operating hours after five years of implementing Munch & Move (Innes-Hughes et al., 2019). Furthermore, Munch & Move has successfully improved FMS in children aged 3-5 (Hardy et al., 2010). Despite these promising outcomes, researchers have yet to examine the Munch & Move initiative's effect on PA levels, body composition, and time-on-task.

Statement of Problem

While the research indicates active play interventions are successful at improving PA levels and FMS, less is understood about the impact such interventions have on body composition and time-on-task. Moreover, when examining the literature regarding PA interventions in preschoolers, most studies have only examined body mass index (BMI) and not changes in fat mass (FM) or fat-free mass (FFM). Active play interventions are under-researched (O'Dwyer et al., 2013), particularly in the United States. Therefore, this study aimed to examine the impact of an 8-week teacher-guided active play intervention on PA levels, body composition, motor skill scores, and on-task behavior in preschoolers attending two private preschool centers in the southeastern region the United States.

Research Questions and Hypotheses

Research Question 1

Does an 8-week active play intervention significantly increase total PA during the school day (as measured by a wrist-worn accelerometer at baseline, post-intervention, and follow-up)? School day represents the time that the participant is at the preschool (7:30 am – 5:30 pm).

Hypothesis 1

H1a: Children enrolled in the active play intervention will have significantly greater amounts of total inside and outside PA while at school, than those in the control group.

H1b: Children in the active play intervention will have significant increases in total inside (IPA) and outside (OPA) activity levels from baseline to post-intervetion and baseline to retention. Outcome variables will be time spent in total IPA and OPA.

Research Question 2

Does an 8-week active play intervention significantly affect preschoolers' fat-mass and fat-free mass (measured by the Tanita DC 430-U scale bioelectrical impedance analysis (BIA) at baseline, post-intervention, and follow-up)?

Hypothesis 2

H2: Children enrolled in the active play intervention will maintain fat mass (FM) and increase fat-free mass (FFM) compared to those in the control group.

Research Question 3

Does an 8-week active play intervention significantly improve fundamental motor skills measured by stationary, locomotion, and object manipulation subsections of the Peabody Developmental Motor Scales, 2nd edition (PDMS-2) at baseline, post-intervention, and follow-up?

Hypothesis 3

H3: Children enrolled in the active play intervention will have significant improvements in fundamental motor skill scores compared to those in the control group from baseline to post-intervetion and baseline to retention. Outcome variables included stationary (SS), locomotor (LS), object manipulation (OMS) skills, and gross motor quartile (GMQ).

Research Question 4

Does an 8-week active play intervention increase time-on-task compared to a sedentary-based academic lesson? Time on-task (TOT)will be measured by behavior observations during baseline, mid-intervention, post-intervention, and follow-up for the intervention participants.

Hypothesis 4

H4: Children's TOT will increase following an active play activity and decrease following a traditional sedentary-based academic activity. Outcome variables included time-on-task (TOT) and time off-task (TOF)

Limitations

The following were the limitations of the current study:

1. This study was only implemented in two preschools. As such, it was limited to the geographical, racial, and socioeconomic status of the centers.
2. This study was limited to the preschool centers. Although we acknowledge that the home environment may impact children's PA, this study did not actively intervene in the home environment.

Delimitations

The following were delimitations of the current study:

1. Participants enrolled in two local preschools in 3–4-year-old classrooms in the southeastern region of the United States.
2. Participants were limited to those who could complete all assessments.
3. Dependent measures were PA levels, body composition, PDMS-2 motor scores (locomotion, object manipulation, grasping, visual-motor integration), and time on task.

Summary

Current evidence indicates a concerning trend in preschool PA levels (Pate et al., 2015; Tulchin-Francis et al., 2021). Furthermore, it is evident that PA participation, specifically in early childhood, is related to favorable outcomes in adiposity, bone and skeletal health, psychosocial health, cognitive development, cardiometabolic health, and motor skill measures development (Timmons et al., 2012). However, studies examining PA's effect on preschoolers' body composition have primarily relied on BMI as an outcome measure. Most interventions aimed at improving PA levels in preschoolers have examined the effect on PA levels or FMS outcomes; few have examined the impact on other areas of development and often negate aspects of play. As play is an important aspect of child development, some researchers have begun examining active play interventions' effects on areas of child development.

The few studies examining the effects of active play interventions on preschoolers have found similar results to those of PA interventions, resulting in improvements in PA levels (Goldfield et al., 2016) and FMS (Adamo et al., 2016; Hardy et al., 2010; Roach & Keats, 2018). Less is understood about active play interventions' effects on body composition and time-on-task. Additionally, it is not fully understood the impact an active play intervention would have on PA levels and FMS in preschoolers in the United States. Thus, this study aims to fill the current literature gaps by examining the effects of an 8-week teacher-guided active play intervention on PA levels, body composition, motor skill scores, and on-task behavior in preschoolers attending in two private preschool centers located in the southeastern region of the United States.

This chapter summarized the background, problem statement, research questions, hypotheses, limitations, and delimitations. Chapter two includes a review of related literature concerning PA, developmental cascades, and active play interventions. Chapter three presents the proposed methodology for this study, including study design, participants, procedures, measures, and the statistical analyses needed to determine the study results. Chapters four and five provide the results and discussion of the study.

CHAPTER II

LITERATURE REVIEW

Physical activity (PA) and sedentary behaviors are established in early childhood and continue into adulthood (Biddle et al., 2010; Telama, 2009). As approximately 61% of 3-to-5-year-olds were enrolled in school in 2019 (National Center for Education Statistics, 2021), preschool centers provide an ecologically relevant context to target children for PA programming. The current PA guidelines for Americans stipulate that preschool-aged children should be active throughout the day, and caregivers should encourage active play of various intensities and types (U.S. Department of Health and Human Services, 2018). The guidelines for Americans do not state a specific time amount of active play but suggest a reasonable target of 3 hours per day. The current guidelines are consistent with other countries (Australian Government, 2014; Canadian Society for Exercise Physiology, 2012; UK Chief Medical Officers, 2019), in addition to the Institute of Medicine, now titled the National Academies of Science, advises preschool-aged children participant in at least 15 minutes of activity an hour (Institute of Medicine, 2011). Unfortunately, evidence suggests that less than half of children meet these recommendations (Pate et al., 2015). In fact, preschool-aged children spend more than 80% of their day sedentary (Brown et al., 2009), and sedentary behavior patterns initiated in preschool not only continue throughout childhood (Pate et al., 1996), but increase during adolescence (Troiano et al., 2008).

Thus, researchers have begun examining methods to incorporate more PA into the preschool day, such as activity breaks (Alhassan et al., 2016; Pate et al., 2016; E. K. Webster et al., 2015), active lessons (Alhassan et al., 2019; Pate et al., 2016; Vazou et al., 2021), and active play (Adamo et al., 2016; Goldfield et al., 2016; Hardy et al., 2010; O'Dwyer et al., 2013; Roach

& Keats, 2018). This chapter aims to critically examine the current research for PA in preschoolers and highlight the importance of active play interventions. This review is organized to present the current literature surrounding PA benefits and PA interventions and provide background information on play, followed by reviewing the current literature surrounding active play interventions in preschool settings.

Physical Activity Benefits

Physical Activity and Health

PA has traditionally been defined as any bodily movement produced by skeletal muscle that increases energy expenditure above resting levels (Caspersen et al., 1985). This standardized definition does not fully capture the complexity of PA. Thus, some researchers have proposed PA is better defined as a complex and multidimensional behavior that involves human movement, resulting in physiological attributes including increased energy expenditure and improved physical fitness (Gabriel et al., 2012). PA participation reduces the risk of several chronic diseases such as obesity, cardiovascular disease, and diabetes (Cote et al., 2013; Ross et al., 2015). In early childhood, PA is associated with improved measures of bone and skeletal health (Janz et al., 2010; Timmons et al., 2012), cognitive development (Carson et al., 2016; Zeng et al., 2017), motor skill development (Nilsen et al., 2020; Timmons et al., 2012; Zeng et al., 2017), and obesity status (Prentice-Dunn & Prentice-Dunn, 2012).

Childhood obesity is defined as a BMI at or above the age-and-gender-specific 95th percentile (Katzmarzyk et al., 2004). The current prevalence of childhood obesity in the United States is 17% (Ogden et al., 2014) and approximately 14% for preschool-aged children (Hales et al., 2017). These rates are concerning as research has found that obesity established in early childhood continues across several decades (Gordon-Larsen et al., 2010). Furthermore, children diagnosed as obese have a greater risk of developing several chronic diseases, including cardiovascular disease (Cote et al., 2013; Ross et al., 2015), adult obesity (Power et al., 1997), and insulin resistance (Katzmarzyk et al., 2004). Furthermore, children diagnosed as obese have a 14.6 times greater risk of developing cardiovascular disease as an adult (Morrison et al., 2007). It is further evident that obesity plays a central role in insulin resistance syndrome, which includes type 2 diabetes mellitus (Steinberger & Daniels, 2003). Type 2 diabetes mellitus was once considered rare in children and adolescents; however, in recent years there has been increasing evidence of the disease worldwide (Arslanian, 2002; Reinehr, 2013). Thus, childhood obesity prevention and reductions are imperative to reduce the risk for chronic disease.

Silva-Santos and colleagues (2021) found that after a year of follow-up, children who participated in greater amounts of moderate-to-vigorous PA are more likely to see increased motor competence and BMI decreases. Additionally, the current literature suggests that greater amounts of moderate-to-vigorous PA are significantly related to reduced risk of body fat percentage (Collings et al., 2013) and higher fat-free mass index (Leppänen et al., 2017; Leppänen et al., 2016). Furthermore, Leppänen and colleagues (2017) found that greater moderate-to-vigorous PA at the age of 4.5 years was associated with higher scores for cardiorespiratory fitness, lower body muscular strength, and motor fitness; indicating participation in PA provides more than health benefits alone. Despite these promising outcomes, studies examining the effect of PA on preschoolers' body composition have primarily relied on BMI (Timmons et al., 2012).

Physical Activity and Developmental Cascades

Due to the complexity of human behavior, such as PA, improvements in one area can impact others. Thus, improvements in PA could lead to a cascading effect that provides beneficial outcomes for other areas of development.

Fundamental Motor Skills

Fundamental motor skills (FMS) are the building blocks for learning specialized movement sequences required for participation in PA and complex sports actions (Clark & Metcalfe, 2002; Gallahue, 2011; Lubans et al., 2010). FMS are developed in childhood and include locomotor skills (hopping, running, skipping, balancing, leaping), object manipulation skills (catching, kicking), and stability (bouncing) (Lubans et al., 2010). FMS competency is low in several countries (Brian et al., 2019; Erwin & Castelli, 2008; Hardy et al., 2013). This is concerning considering greater FMS competency is associated with greater amounts of PA in children and adolescents (Lubans et al., 2010). Additionally, there is evidence that motor competence tracks through childhood into adolescence, and children with higher levels of motor competence are less likely to see declines in PA levels (Barnett et al., 2009; Lopes et al., 2011). Furthermore, motor delays in early childhood could lead to lower PA levels throughout the lifetime, increasing risks for chronic health diseases (Kantomaa et al., 2013; Stodden et al., 2008). Further evidence shows FMS are deficient in children with obesity and likely a barrier to children's participation in PA (Cliff et al., 2012). Mastery of FMS is also thought to contribute to a child's physical, cognitive, and social development (Payne & Isaacs, 2017; Zeng et al., 2017). Thus, researchers have examined ways to improve FMS in childhood. One meta-analysis found that school- or community-based programs incorporating developmentally appropriate FMS learning experiences significantly improved FMS when implemented by trained professionals or teachers (Morgan et al., 2013).

Due to the relationship between FMS and PA, researchers have examined the effect PA interventions have on the development of FMS. Burns et al. (2017) examined the effect of a 12-week PA intervention on FMS development in kindergarten through sixth grade students from low-income families. This intervention showed significant improvements in Test of Gross Motor Development, 2nd edition (TGMD-2) scores at follow-up compared to baseline, with younger children showing greater improvements compared to older children (Burns et al., 2017). There is further evidence that implementing PA interventions in preschool settings significantly improves locomotor skills, regardless of whether children receive additional PA opportunities at home (Wasenius et al., 2018). Additionally, researchers have found that combining FMS and PA into an intervention may be a successful pathway to increase moderate-to-vigorous PA in males and females (Wadsworth et al., 2020). Overall, research indicates that FMS leads to improvements in PA, and when targeted as part of a PA intervention, results in improvements in both FMS and PA, but more research is needed (Van Capelle et al., 2017).

Executive Function and Self-Regulation

Executive function has been defined as a higher-level cognitive function that manages other more basic cognitive functions (Alvarez & Emory, 2006; Baddeley, 1986), as well as the regulation of emotions and attention (Bell & Deater-Deckard, 2007; Blair & Diamond, 2008; Lewis et al., 2008), and the need to complete goal-directed behaviors. Three constructs make up executive function: cognitive flexibility, working memory, and inhibitory control (Diamond, 2013). Cognitive flexibility, which refers to the ability to adapt and adjust to changing demands or priorities (Cañas et al., 2003; Diamond, 2013), builds upon working memory as well as inhibitory control and is evident later in the developmental process (Davidson et al., 2006; Garon et al., 2008). Working memory involves retaining information in the mind and continuing to encode even if the information is not perceptually present. Finally, inhibitory control involves controlling one's attention, behavior, thoughts, and emotions (Diamond, 2013). These core components help contribute to successful self-regulation (McClelland & Cameron, 2012). Self-regulation refers to the ability to control or direct one's attention, thoughts, emotions, and actions (McClelland & Cameron, 2012; McClelland et al., 2010; Schunk & Zimmerman, 1997). These skills are reported to rapidly develop during early childhood (McClelland & Cameron, 2012), and children who can self-regulate successfully have an easier time navigating social and learning environments (Blair & Diamond, 2008; McClelland et al., 2010).

Researchers consider there to be three distinct aspects of self-regulation, including cognitive, emotional, and behavioral regulation (Vasilopoulos & Ellefson, 2021). Cognitive regulation, or executive function, refers to a cognitive skill used to control thought and action to achieve a goal (Jacob & Parkinson, 2015). Emotional regulation is the management of emotional reactions to achieve a goal (Thompson, 1991). Behavioral regulation refers to inhibiting behavior and managing attention to achieve a goal (Vasilopoulos & Ellefson, 2021). Self-regulation skills have consistently been linked to academic achievement (McClelland et al., 2013; McClelland et al., 2007; Pagani et al., 2008). Moreover, greater amounts of PA across childhood predicts greater emotional regulation skills; furthermore, emotional regulation skills are related to better academic outcomes suggesting early intervention studies should focus on a child's attention, or time-on-task (Vasilopoulos & Ellefson, 2021). Furthermore, improved academic engagement, or time-on-task, is related to improvements in academic achievement (Greenwood et al., 2002). Since the passing of laws such as “No Child Left Behind” (NCLB) and "Every Student Succeeds

Act" (ESSA), school systems have focused on improving academic standards (Black, 2017) and school systems might be reluctant to focus on PA and possibly take time away from learning and preparing for tests. Indeed, this focus has led to a trickle-down effect, resulting in a shift in preschool curriculum to emphasize basic academic skills assessed under these laws (Pérez, 2018). In school-aged children, this shift in focus on "academic skills" has contributed to increases in sedentary behavior (Bryan et al., 2013). Research indicates a similar trend for preschool-aged children (Copeland et al., 2012). Thus, school-based activity interventions have examined the impact activity has on academic outcomes. Current evidence suggests PA in the classroom is related to improvements in academic performance and on-task behaviors (Ahamed et al., 2007; Chomitz et al., 2009; Erwin et al., 2016; Mahar et al., 2006; E. K. Webster et al., 2015). Additionally, Wadsworth and colleagues (2014) found that a motor skill intervention in a high autonomy supportive environment significantly improved preschoolers' time-on-task and greater amounts of moderate-to-vigorous PA. In preschoolers, more active play is associated with better self-regulation, which was related to improvements in reading and math assessments (Becker et al., 2014). In addition to beneficial academic outcomes, self-regulation skills are essential when understanding exercise behavior and motivation for adults (Gell & Wadsworth, 2015; Hallam & Petosa, 2004; Umstattd et al., 2008; Wadsworth & Hallam, 2010). For these reasons, learning environments must promote PA and movement for educational benefits in addition to health benefits. In preschool settings, this is often accomplished through play.

Physical Activity Interventions

Behavior Change Theories

Researchers have suggested that interventions based on sound behavior theory are imperative to improve the effectiveness of PA interventions (Baranowski et al., 1998). Several theories and models have been proposed to explain PA behavior. Theories often focus on individual and environmental factors in behavior change. Three theories and one model will be further discussed below.

Self-Determination Theory

Self-Determination Theory (SDT) was developed to understand human motivation and personality and highlights the importance of personal development and behavioral self-regulation (Ryan & Deci, 2000a, 2000b; Ryan et al., 1997). This theory suggests that three psychological needs motivate individuals to grow and change: competence, relatedness, and autonomy. Additionally, SDT proposes that motivation exists on a continuum between amotivation, external motivation, and intrinsic motivation. Intrinsic motivation is defined as doing an activity for inherent satisfaction rather than an external regulator, whereas extrinsic motivation is defined as doing an activity for some external outcome (Ryan & Deci, 2000a). Additionally, extrinsic motivation can be internal (integrated regulation) or external (external regulation). Where an individual falls on this motivation continuum varies in degree of self-determination and is affected by the satisfaction of the three needs (Ryan & Deci, 2000b). Research indicates that autonomy-supportive environments lead to greater intrinsic motivation (Ryan & Patrick, 2009; Teixeira et al., 2012), which is associated with regular exercise behavior (Oman & McAuley, 1993; Richard et al., 1997) and academic success (Ryan & Deci, 2016). Furthermore, there is evidence that high autonomy-supportive environments are associated with higher levels of PA in preschoolers (Hastie et al., 2013; Wadsworth et al., 2014). Thus, creating autonomy-supportive environments is vital for PA interventions and academic motivation (Ryan & Deci, 2016). Classrooms and interventions can create autonomy-supportive environments by minimizing external incentives, avoiding controlling language, as well as providing and respecting the choices of the individuals (Black & Deci, 2000; Hauser-Cram, 1998).

Social Cognitive Theory

Social Cognitive Theory (SCT) was first proposed by Albert Bandura (Bandura, 1986). SCT contends that human behavior is explained by a dynamic, triadic, and reciprocal model between personal, behavioral, and environmental influences. The literature suggests that an adult's self-efficacy and self-regulation strongly predict exercise behavior (Petosa et al., 2003). Likewise, when examining SCT constructs in children, researchers have found that the tenets of SCT predict children's PA behaviors (Ramirez et al., 2012), such as a child's self-efficacy (Strauss et al., 2001). Furthermore, self-regulation skills, which are important for regular exercise participation (Ahn et al., 2016), grow rapidly during early childhood (McClelland & Cameron, 2012). Even though personal factors, including self-efficacy and self-regulation, play a vital role in personal change (Bandura, 2004), they alone do not impact change. Behavioral (e.g., goals) and environmental factors (e.g., social support and barriers) also impact behavior change (Ramirez et al., 2012). Schools and childcare centers present unique environments that greatly influence a child's behavior (Bower et al., 2008; Larson et al., 2011). Moreover, children aged 3-5 years are reported to spend an average of 21 hours a week in primary care (National Center for Education Statistics, 2016). Thus, it is crucial to consider both individual and environmental factors when attempting to improve PA behaviors in children.

Social Ecological Model

The social-ecological model (SEM) was developed to understand how the complex interplay between individual, relationship, community, and societal factors impacts behaviors

(Bronfenbrenner, 1977, 1989). There are bidirectional relationships between each level, indicating that an individual can impact the environment as much as an environment can impact an individual. As schools have become integral settings to promote health behaviors (Pate et al., 2000; Sallis et al., 1998), ecological perspectives have been utilized to understand political and environmental factors that shape the individual (Biddle et al., 2010). Research examining SEM in school-based PA studies found higher-level policies that are implemented at the societal (government) and community (school) level trickle down and influence the relationship and individual level (Langille & Rodgers, 2010). However, the extent to which such policies are implemented depends on the overall culture of a school and the support available for PA opportunities (Langille & Rodgers, 2010). Therefore, when implementing PA interventions, it is important to remember both the individual and the environment.

Habit Formation Theory

According to the SEM, adopting health behaviors are easier when environments conducive to change are created (Gardner, 2015). An alternative mechanism to enacting self-regulatory control interventions is establishing automatic behavioral control through habit formation. According to Habit Formation Theory, habits form through the repetition of a behavior in the presence of salient, event-based cues (Adriaanse et al., 2011). This reinforces a mental context-behavior association so that the context becomes sufficient to activate the association, which in turn triggers an impulse to perform the habitual behavior potentially without intention, cognitive effort, or awareness (Verplanken & Aarts, 1999). As habits guide action rapidly and efficiently (Verplanken et al., 1997), the associated context behavior is more regulated by the environmental context than conscious intentions or deliberate, intentional processes and resistant to changes in motivation that may occur after an intervention period ceases (Verplanken & Wood, 2006). This automatic behavior, termed automaticity in habit formation, solidifies the behavior as a habit within context cues, as the behavior can occur without the individual's intent, awareness, or action. While intervention research on habitual PA is scarce, early results suggest that attending to specific conditions (contextual repetitions, cues) can expedite and improve the likelihood of habit formation (Verplanken & Wood, 2006). Further research has shown that habit formation is favorable for parents to modify a child's dietary intake. Parents described the formation of the habit as "automatic" and if the habit was disrupted by changing the environment (e.g. moving or traveling), the behavior was easily reinstated once returning to the context environment (Gardner et al., 2014). Furthermore, establishing habits around teachers' and parents' PA practices will provide program sustainability.

School-Based Physical Activity Interventions

PA interventions in preschool settings can be described into two main categories: activity breaks and active lessons. Activity breaks often involve 10 to 15-minute activities designed to promote MVPA. Activity Breaks require little planning, equipment, or time. Facilitation of this method requires teachers to pause instruction time and allow students to participate in PA. Activity breaks in school-aged children have increased PA and time-on-task (Murtagh et al., 2013; Pangrazi et al., 2003; Whitt-Glover et al., 2011). Similar results are found in studies implemented in preschool settings. Webster and colleagues (2015) examined the acute effects of a 10-minute teacher-implemented activity break on PA participation and time-on-task in preschoolers. The study lasted four days, activity breaks were conducted for two days, and typical instruction occurred on the other two days. Results indicated that activity breaks successfully increased PA and on-task behaviors acutely. A further study found that a 30-minute activity break, which consisted of 10-minutes of gross-motor PA and 20-minutes of unstructured activity, implemented five days a week for 6-months, resulted in a significant increase in time spent in light and moderate-to-vigorous PA (Alhassan et al., 2016). Bellows and colleagues (2013) examined the impact of 15–20-minute activity breaks implemented four days a week for 18 weeks at Head Start Centers on PA, weight status, and FMS. Results indicated that the intervention sufficiently improved FMS, measured with the PDMS-2; however, no significant effects were found for total steps or BMI. Although these studies show positive results, the potential disruption to the lesson may discourage teachers from incorporating movement into the classroom, and intervention may benefit from combining PA with academic lessons (C. A. Webster et al., 2015).

Active academic lessons are designed to incorporate PA into the required learning standards. In school-aged children, research has found improvements in PA (Donnelly et al., 2009; Mahar et al., 2006; Murtagh et al., 2013; Stewart et al., 2004), energy expenditure (Stewart et al., 2004), academic achievement (Donnelly et al., 2009), and on-task behavior (Grieco et al., 2016; Mahar et al., 2006). Similar results have been found in preschool-aged children. Alhassan and colleagues (2019) examined the impact of integrating PA into early learning standards. The intervention was implemented four days a week across 12 weeks. Teachers enrolled in the intervention trained on the intervention curriculum, which was designed to incorporate PA into Massachusetts Early Learning Standards. PA was assessed at three time points (baseline, six weeks, and 12 weeks) with accelerometry for seven days. This method resulted in a significant increase in time spent in moderate-to-vigorous PA. While Alhassan and colleagues incorporated activity into early learning standards, other researchers have examined the effect of incorporating learning into activity breaks. Vazou and colleagues (2021) examined the effect "Walkabouts" had on PA and classroom engagement in preschoolers through second graders. "Walkabouts" is a commercially available web-based program incorporating FMS into the academic curriculum from preschool through second grade. Teachers utilizing this resource can select and play videos to allow activity breaks reinforcing language art or math skills. Results of this 7-week intervention indicated that while "Walkabout" successfully increased PA levels in preschool students, it did not result in significant changes to attention or behavior control. Pate and colleagues (2016) implemented an intervention designed to provide structured PA inside, structured and unstructured PA outside, and integrated PA into lessons in preschool classes. This study indicated that the multicomponent PA intervention was successful in increasing PA (Pate et al., 2016).

Generally, PA interventions for preschoolers have a small-to-moderate effect ($g = .44$), with teacher-led interventions being more effective ($g = .66$) (Gordon et al., 2013). One possible explanation for these findings could be attributed to the stressors teachers face to focus on "academic skills" (Copeland et al., 2012) in addition to the burdens of PA interventions, such as lack of self-regulatory skills or habit formation to successfully implement these interventions long term (Bauer & Baumeister, 2011; Lally & Gardner, 2013). According to Habit Formation Theory, habits form through the repetition of behavior in the presence of salient, event-based cues (Adriaanse et al., 2011). These cues reinforce a mental context-behavior association so that the context becomes sufficient to activate the association, thereby triggering automatic behavior, or automaticity (Verplanken & Aarts, 1999). Unfortunately, the impact of teacher habit formation on child-level outcomes in active play interventions has yet to be investigated.

Overall, most of the PA interventions have only focused on PA as an outcome (Alhassan et al., 2016; Alhassan et al., 2019; Bellows et al., 2013; Pate et al., 2016; Vazou et al., 2021; E. K. Webster et al., 2015), few examine FMS (Bellows et al., 2013) or on-task behaviors (Vazou et al., 2021; E. K. Webster et al., 2015), or body composition. Furthermore, the PA intervention studies often neglect the idea of play, which, as previously discussed, is vital for children (Friedman et al., 2021; Yogman et al., 2018) and part of the PA recommendations for preschoolers (Australian Government, 2014; Canadian Society for Exercise Physiology, 2012; U.S. Department of Health and Human Services, 2018; UK Chief Medical Officers, 2019).

Importance of Play

The National Association for the Education of Young Children (NAEYC) and the American Academy of Pediatrics (AAP) stress the importance of play in preschool settings (Friedman et al., 2021; Yogman et al., 2018), stating that play is essential for all children, birth through age 8 (Friedman et al., 2021) as children learn and gain skills through play (Brown & Vaughan, 2009; Elkind, 2007).

Through play, children can communicate while building language skills (Durham et al., 2019; Weisberg et al., 2013) and develop math skills (Ramani & Eason, 2015), as development and learning are closely interrelated (Copple et al., 2009). Children who play can better understand the world around them and make sense of their experiences (Brown & Vaughan, 2009; Gosso & Carvalho, 2013). Furthermore, play can serve as a vehicle for physical (Derman et al., 2020) and cognitive development (Fink, 1976), as well as socio-emotional (Ashiabi, 2007) and executive function skills (Shaheen, 2014). There are five main types of play: physical play, play with objects, symbolic play, socio-dramatic play, and games with rules (Whitebread et al., 2012). Physical play in humans includes active play, rough-and-tumble play, and fine motor practice (Whitebread et al., 2012). Pellegrini and Smith (1998) found that physical play is related to a child's gross motor skill development and possibly cognitive and body composition benefits.

Though play can take many forms, it is often categorized as either adult-guided or child-directed, both of which present unique benefits for a child.

Adult-Guided and Child-Directed play

Adult-guided play, sometimes referred to as structured play (Hoffman, 1997) or teacher-guided play (Weisberg et al., 2016), refers to play activities that adults plan to reinforce learning goals (Bing-Jie, 2016; Weisberg et al., 2016). If a teacher or adult were to guide a play opportunity, they would actively participate in the play process by providing scaffolding, or open-ended questions, about play (Bing-Jie, 2016; Weisberg et al., 2016). The key to a successful adult-guided play session is the active participation of both the adult and child by adding scaffolding to child-directed play (Weisberg et al., 2016). The adult-guided play has been successful at improving shape knowledge (Fisher et al., 2013), language skills (Massey, 2013), and motor skills (Palma et al., 2014). Child-directed play, sometimes referred to as free play, is described as freely chosen, directed by the participants, and completed for its own purpose (Gray, 2011). Child-directed play is related to improvements in creativity (Howard-Jones et al., 2002), self-control (Chmelynski, 2006), and problem-solving (Brown & Vaughan, 2009).

Unfortunately, like PA, play has declined, particularly child-guided play (Gray, 2011). Furthermore, since NCLB and ESSA, more focus is on activities that promote academic results even as early as preschool, resulting in less time spent participating in play and PA (Yogman et al., 2018). Thus, researchers have been examining methods to incorporate more PA and play into schools.

Active Play Interventions

One pathway to incorporate more PA into schools is active play interventions. Active play is often defined as a type of PA focusing on teacher-led and child-directed activities that can be incorporated into the classroom curriculum or outdoor time (Tandon et al., 2019; Truelove et al., 2017). Active play interventions have resulted in similar results to those of PA interventions. One randomized controlled trial examined the effect of a 6-month guided active play intervention in 6 childcare centers in Canada on PA levels, FMS, and body composition (Adamo et al., 2016; Goldfield et al., 2016). Results indicated that a guided active play intervention effectively decreased sedentary behavior and increased overall PA and light PA measured via accelerometry (Goldfield et al., 2016). The active play intervention also improved FMS, which was assessed with the TGMD-2 (Adamo et al., 2016). Additionally, this active play intervention is one of the few that assessed body composition in addition to BMI. Results indicated that children in the active play intervention had significant reductions in body fat percentage and fat mass. However, there were no significant differences in fat-free mass, BMI, or BMI z-score (Goldfield et al., 2016). Roach and colleagues (2018) compared two 8-week interventions to child-directed free play to examine the effect different types of play have on FMS in American preschool-aged children. Three centers were randomly assigned to three conditions: free-play, skill-based stations, and guided active play. Results of the 8-week interventions revealed that children in skill-based and guided active play had significant improvements in FMS, measured by TGMD-2, compared to children in the free-play condition (Roach & Keats, 2018). Moghaddaszadeh and Belcastro (2021) examined the differences between a child-directed active play program and a guided active play program on PA and FMS (Moghaddaszadeh & Belcastro, 2021). This 7-week community-based study indicated that children enrolled in the guided active play program had improvements in energy expenditure, percentage of moderate to vigorous PA, and FMS, while children in the child-directed active play program did not (Moghaddaszadeh & Belcastro, 2021). In Australia, a New South Wales health initiative called *Munch & Move* has been shown to improve the ability of centers to meet PA recommendations (Innes-Hughes et al., 2019). Hardy et al. (2010) sought to evaluate the effectiveness of the *Munch & Move* initiative in improving FMS (Hardy et al., 2010). Twenty-nine preschools were randomized to either the intervention (n=15) or control (n=14). Baseline assessments took place in May/June 2008, and post-intervention assessments took place in November 2008. Results indicated that children in the intervention preschools saw significant improvements in locomotor, object control, and total FMS compared to the control group (Hardy et al., 2010). While findings support the current body of literature, which indicates teacher-guided active play improves FMS, the effect teacher-guided active play has on PA, body composition, or time-on-task is not fully understood. At the time of this review, few teacher-guided active play interventions have examined the effect active play interventions have on such outcomes. Few studies examine active play (O'Dwyer et al., 2013). In fact, one systematic review found only eleven unique studies on active play in preschoolers, nine of which took place in the United States (Truelove et al., 2017). Of these nine studies, only four were conducted in a childcare environment (Hudson et al., 2009; Logue & Harvey, 2009; Schary et al., 2012; Tandon et al., 2015). Furthermore, none of the studies conducted in the United States were experimental or examined the effects active play has on child development outcomes. Therefore, the purpose of this study was to examine the effect of an 8-week teacher-guided active play intervention, on PA, FMS, body composition, and on-task behaviors in two preschool centers located in the southeastern region of the United States.

Conclusions

PA interventions can improve FMS (Burns et al., 2017; Nilsen et al., 2020; Wasenius et al., 2018) and academic predictors such as cognitive development (Carson et al., 2016; Draper et al., 2012; Veldman et al., 2019), executive function (Mulvey et al., 2018; van der Niet et al., 2015), and academic engagement (Fedewa & Erwin, 2011; Mahar et al., 2006; E. K. Webster et al., 2015). Additionally, PA is one pathway to decrease the risk of obesity and associated diseases (Collings et al., 2013; Leppänen et al., 2017; Leppänen et al., 2016). The prevalence of childhood obesity is concerning due to the increased risk of adult obesity and other chronic diseases (Cote et al., 2013; Gordon-Larsen et al., 2010; Katzmarzyk et al., 2004; Power et al., 1997; Ross et al., 2015). Unfortunately, children spend most of their school day participating in sedentary behaviors (Brown et al., 2009). Therefore, researchers have examined ways to incorporate more PA into the school day.

PA interventions in preschool-aged children have found significant improvements in PA (Alhassan et al., 2016; Alhassan et al., 2019; Bellows et al., 2013; Pate et al., 2016; Vazou et al., 2021; E. K. Webster et al., 2015), FMS (Bellows et al., 2013), and academic engagement (Vazou et al., 2021; E. K. Webster et al., 2015). However, such interventions often negate body composition and the idea of play. Play is vital for physical (Derman et al., 2020) and cognitive development (Fink, 1976), as well as social and emotional health (Ashiabi, 2007) and executive function skills (Shaheen, 2014). As such, play has an essential role in preschool settings (Friedman et al., 2021; Yogman et al., 2018). The few studies examining active play interventions have significant improvements in PA, body composition, and FMS (Adamo et al., 2016; Goldfield et al., 2016; Roach & Keats, 2018). However, little research has examined teacher-guided active play interventions' impact on children in the United States. Additionally, when examining the limited body of literature, teacher-guided active play interventions seem to improve PA and FMS. However, less is understood about the effect on body composition and on-task behaviors. Therefore, this study aimed to examine the effect of an 8-week teacher-guided active play intervention on PA, FMS, body composition, and on-task behaviors in two preschool centers in the southeastern region of the United States.

This chapter presented a review of related literature concerning PA, developmental cascades, and active play interventions. Chapter three presents the proposed methodology for this study, including study design, participants, procedures, measures, and the statical analyses needed to determine the study results.

CHAPTER III

METHODOLOGY

Participants

The study was conducted in two preschool centers during the 2021-2022 school year. These centers provide all-day (6:30 am – 6:00 pm) childcare services for 6-week-old infants through four-year-old preschoolers. For the purpose of this study, only children in the 3- and 4-year-old classes were eligible for participation. An a priori sample size (Faul et al., 2009) indicated 44 participants (22 per group) were needed to achieve .80 power with an alpha level of .05 and effect size of .24. The effect size was derived from previous PA studies in preschool children (Gordon et al., 2013). Due to the potential loss of participants (i.e., moving, attendance, missing measurements), researchers planned to oversample at a rate of 1.2 for a total of 53 (approximately 27 per group). Out of 170 children in the 3-5 year old classes, 52 participants returned parental consent and were eligible to participate. This study was approved by the Human Subjects' Research Institutional Review Board at Auburn University under protocol number 10-217 MR 1009 (Appendix A). The associated clinical trial number is NCT0574491. Prior to data collection, researchers obtained parental consent and child assent. Participants and parents were informed that participation was voluntary, and participants may choose to withdraw at any time without any consequence. The consent form can be found in Appendix B.

Measurements

General Procedures

Prior to conducting baseline measures, preschool centers were randomly assigned to the intervention or comparison group. Baseline measures (height, weight, body composition, PA, FMS, and on-task behavior observations) were assessed during the first three weeks of the fall semester. Following the baseline assessment period, teachers in the intervention group received the active play resource kit, and the intervention was implemented for 8-weeks. Additionally, implementation fidelity was assessed throughout the intervention (Appendix C). After the 8-week intervention, researchers reassessed all baseline measures in the intervention and control groups. Intervention teachers were encouraged to continue the intervention over the course of the school year. At the end of the spring semester, researchers reassessed height, weight, body composition, PA, FMS, and on-task behavior observations for retention. A flow diagram of the progress through the randomized trial can be found in Figure 1 (Moher et al., 2001). Information regarding the study timeline and teacher responsibilities can also be found in Table 2. All measures are discussed in detail below.

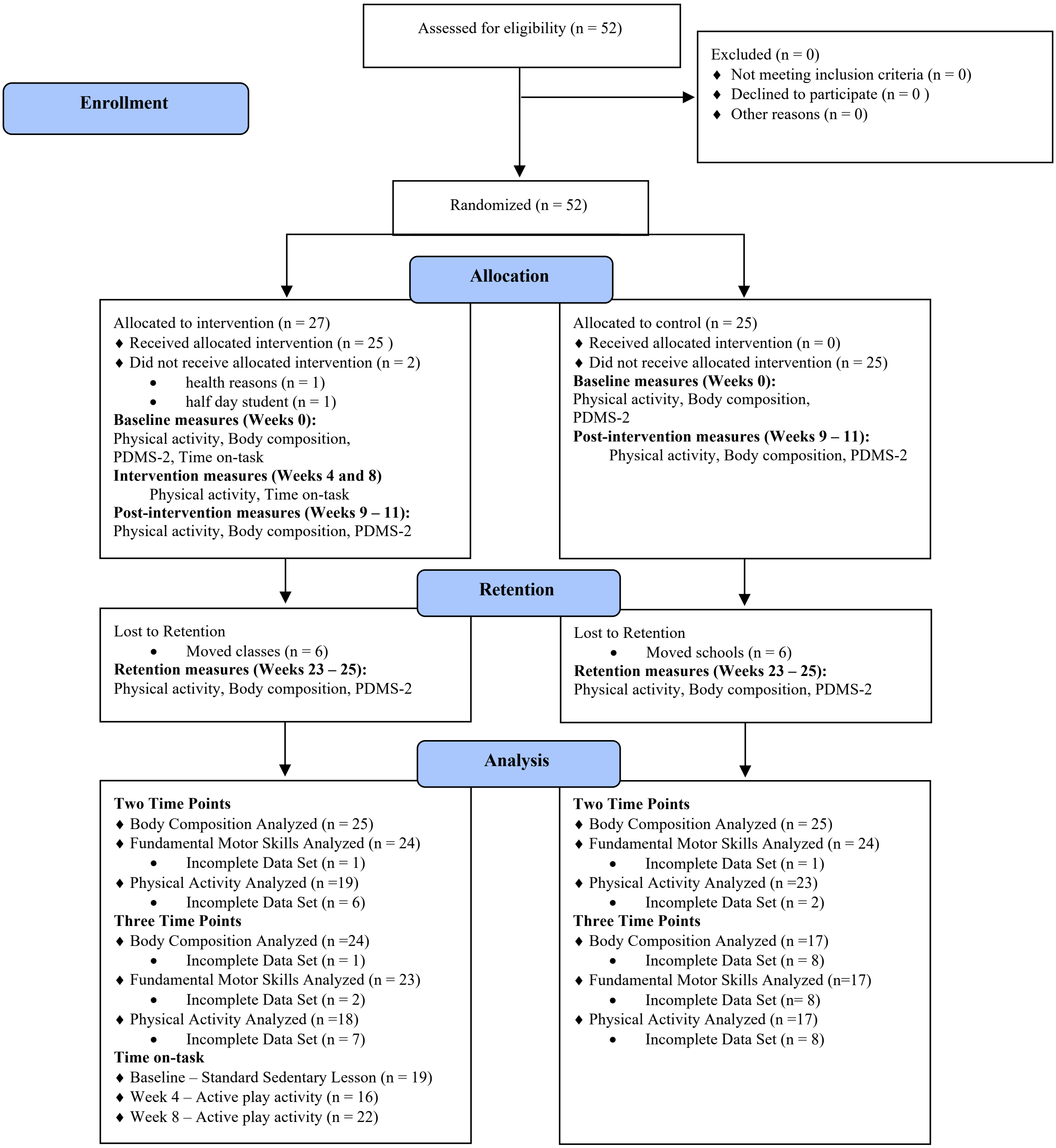


Figure 1. Complete Study – CONSORT Flow Diagram

Table 1 *Proposed Study Timeline and Teacher Responsibilities*

Time Period	Weeks	Measures	Intervention		Comparison	
			Inside	*Outside*	*Inside*	*Outside*
Baseline	0	Height, Weight, Body composition, PA, PDMS-2, on-task behavior	Continue with typical schedule			
Intervention	1-2	Intervention only: on-task behavior	Implemented *Munch & Move* active play	Observed researchers implementing outside activities aimed at improving locomotor and object manipulation skills	Continue with typical schedule	
	3-4			Implemented outside activities with researcher assistance		
	5-8			Implemented outside activities		
Post-intervention	9-11	Height, Weight, Body composition, PA, PDMS-2, on-task behavior	Encouraged to continue implementing active play activities		Continue with typical schedule	
Spring Semester	12-22		Encouraged to continue implementing active play activities		Continue with typical schedule	
Retention	23-25	Height, Weight, Body composition, PA, PDMS-2, on-task behavior	Encouraged to continue implementing active play activities		Continue with typical schedule	

Demographics

Demographic variables (i.e., biological sex and birthdate) were obtained from the preschool center at the beginning of data collection. Additionally, researchers recorded which participants engaged in extra movement opportunities offered by the childcare centers. Each center offered three main extra moment opportunities: a sports and fitness program, a martial arts-based activity program, and a dance program. The sports and fitness program costs $40.00 monthly and meets 30 minutes weekly. The martial arts-based activity program costs $65.00 monthly and meets 30 minutes weekly. The dance program costs $65.00 per student or $85.00 per family, plus an additional $30.00 program fee for each student. The dance program met for 45 minutes each week. These three opportunities were available at both centers and conducted during school hours.

Anthropometric Measures and Body Composition

Height, Weight, and BMI

Height was assessed at three-time points, baseline, post-intervention, and follow-up, according to standard procedure (Malina, 1995). Participants stood erect, without shoes, with their heads in the Frankfort horizontal plane. A portable stadiometer was used to measure height. All measurements were taken in duplicate and recorded to the nearest millimeter for height. If the disagreement between the two measures was greater than ten millimeters, a third measurement was taken, and the average of all three measures was used. Body mass was assessed simultaneously and with a digital scale (DC 430-U, Tanita Corporation. Tokyo, Japan). BMI was calculated, and obesity status was determined using age-and-gender-specific growth charts (National Center for Health Statistics, 2000).

Body Composition

Body composition was assessed by foot-to-foot bioelectrical impedance (BIA; DC 430-U, Tanita Corporation. Tokyo, Japan) at baseline, post-intervention, and follow-up. Measurements were conducted while the child was barefoot and standing upright. The foot-to-foot method of BIA is a reliable and accurate tool for the measurement of body composition in the pediatric population, with results showing strong significant correlations between BIA and dual-energy X-ray absorptiometry (DEXA) for Fat-mass (FM) ($r = 0.98$) and Fat-Free Mass (FFM) ($r = 0.98$) (Tyrrell et al., 2001). The outcome variables included in the analysis were FM and FFM.

Physical Activity

To assess PA, each participant wore an Actigraph GTX3 (Pensacola, FL) accelerometer on their non-dominant wrist for five school days during baseline (Weeks 0), post-intervention (Weeks 9 – 11), and retention (Weeks 30 – 33) assessment points. Research personnel attached the accelerometer each morning upon participant arrival and removed it before departure. Time on and off was documented for wear time adjustments. Data from the accelerometers was downloaded and analyzed in Actilife 6 (Version 6.13.4). Butte cut points (2014) in 10-second epochs were used to categorize activity into light or moderate/vigorous PA. Individual filters based on accelerometer time on and off were used for each participant.

Additionally, researchers examined the attendance records to determine the typical day length for each participant. If the monitor was worn for less than half of a child’s typical attendance time, that day was removed from the final analysis. The final analysis did not include participants with less than three days of monitoring. Furthermore, due to participants having different wear times (i.e., came to school late, left early), the percentages of time spent in total physically active inside (IPA) and outside (OPA) were utilized in the final analysis.

Fundamental Motor Skills

FMS were assessed at three-time points (baseline, post-intervention, and follow-up) with the Peabody Developmental Motor Scales, Second Edition (PDMS-2). This assessment is a norm- and criterion-referenced fine and gross motor skill test designed for children from birth through age five years. The PDMS-2 comprises six subtests (Reflexes, Stationary, Locomotion, Object Manipulation, Grasping, and Visual-Motor Integration). For this study, researchers utilized four subtests – locomotion, object manipulation, grasping, and visual-motor integration. Reliability and validity are reported in the test manual with high coefficients for content sampling (.89-.96), time sampling (.89-.94), and interrater reliability (.89-.96) (Folio & Fewell, 2000). Furthermore, content validity has been determined to be satisfactory (Folio & Fewell, 2000). Testing time of three subscales (locomotion, object manipulation, and stationarity) has been reported to take about 20-25 minutes to administer (Bellows et al., 2013). Raw scores for each subtest were calculated and converted to standardized scores.

Time -On-Task

Time-on-task, which is interrelated with executive function and predictive of future academic success, was assessed by direct observation using a version of momentary time sampling protocol (Mahar et al., 2006; Wadsworth et al., 2014; E. K. Webster et al., 2015). To determine time on task, a trained observer coded behavior as time-on-task or time off-task during the predetermined time interval (Cooper et al., 2007). On-task behavior was defined as verbal or motor behavior that followed the class rules and was appropriate to the learning situation.

Children's behavior was recorded on an observation sheet as one of the following: on-task (e.g., listening to the teacher read to the class), motor off-task (e.g., out of seat and not attending while teacher is reading), noise off-task (e.g., talking with others and not attending while teacher is reading), or passive/other off-task (e.g., staring into space or sleeping while teacher is reading). To assess if the active play intervention was successful at increasing time on task, researchers conducted behavior observations before and after a standard sedentary academic lesson and again with a teacher-guided active play opportunity. A standard sedentary academic lesson was defined as when teachers present learning material in a traditional way, such as circle or story time. A sample schedule can be found in Appendix D. The primary investigator met with teachers to determine when active play opportunities were being implemented into the daily schedule for on-task behavioral assessments.

Due to COVID-19 protocols, researchers were limited to 15-minute time frames. Thus, on-task behavior was observed for 15-minutes prior and at the conclusion of a standard sedentary based academic lesson, and again with a teacher-guided active play opportunity. Five students from each intervention class were randomly selected for behavior observation. These five participants were observed before and after an active and sedentary play opportunity. Teachers and children were not aware of who was being observed. Researchers conducted behavior observations twice for each assessment point (baseline, mid-intervention, post-intervention, and follow-up) for a total of 8 observation periods across the study. At subsequent observations, five participants were again randomly selected from eligible participants. During behavior observations, a prerecorded audio file prompted observers to systematically observe behavior for a 10-second interval and then record behavior during a 5-second interval. This protocol yields four observations per minute. After each minute, the researcher began observations on the next randomly selected child. This process continued for 5 minutes until each child was coded once, then the observation cycle was repeated three cycles (15 minutes) until each child was coded for three minutes. In total, each child was observed for 3 minutes before the sedentary academic lesson and active play opportunity and for 3 minutes following, coding each child for 6 minutes each time observed. Researchers recorded data using paper and pencil. See Appendix E for example data sheets. Percentage of time-on-task was used as the outcome variable.

Prior to collecting data, researchers conducting the behavior observations were trained in proper procedures by a trained observer. Additionally, these researchers established interobserver agreement (IOA) before collecting data. The goal for IOA was to be above 80% agreement. During data collection, the trained observers randomly coded 15-20% of observations together to maintain IOA. Should IOA fall below 80%, a follow-up training was scheduled.

Implementation Fidelity

Researchers assessed level of teacher implementation through a series of implementation fidelity measures. First, teachers in the intervention group were provided a weekly checklist that asked them to provide information about how many times during the week they implemented the intervention, which activities they provided, and how difficult implementation was for them. Second, the primary researcher conducted random weekly observations to determine the extent of implementation. See Appendix C for the checklist and weekly check-in questions.

Automaticity

To assess the level of habit formation in regards to offering active play opportunities the lead teacher completed a modified verision of the Self-Report Behavioral Automaticity Index (Gardner et al., 2012). The following questions were asked each week over the 8-week intervention: Incorporating the new active play into (indoor or outdoor) classroom time is something... I do without thinking; I do automatically; I do without having to consciously remember; I start doing before I realize I am doing it. These questions were a Likert scale with one - Strongly disagreeing; two - Disagree; three – Neither Agree nor Disagree; four – Agree; and five – Strongly Agree. Previous assessments shows that this four-item instrument has acceptable reliability (α comparisons across studies .68-.97), convergent validity and predicate validity (Gardner et al., 2012).

Experimental Conditions

The two preschool centers were randomly assigned to either the intervention or control group. Currently, the preschools in this study have two policies regarding PA and play. First, all children should be allowed 60 minutes of outside play time, weather permitting. This time is divided into two 30-minute periods, one in the morning and one in the afternoon. Second, teachers should implement one 15-minute structured PA. Both groups continued with their current 15-minute structured PA schedule and 60 minutes of outdoor play. Details on each condition are found below.

Intervention

The 8-week active play intervention consisted of both teacher-guided and child-directed play opportunities. In addition to the already scheduled 15-minute structured PA, children in the intervention group participated in an additional 15-minute indoor and 15-minute outdoor teacher-guided activity. Teachers were provided a binder with resources from *Munch & Move* (© State of New South Wales through the NSW Ministry of Health). In addition to a binder of active play examples, intervention teachers received a play equipment kit. This kit contained small equipment, such as balls and hoops, to help teachers successfully implement the active play activities. At the end of the intervention, teachers were encouraged to continue implementing the active play intervention in the spring semester.

Indoor Play

Teacher-guided indoor play opportunities were designed to promote PA and reinforce learning objectives. The goal was to implement a teacher-guided 15-minute activity each day in addition to the required policy of 15 minutes of PA indoors. The example binder provided teachers with concrete examples that could be tailored to fit classroom needs. Teachers could choose which activities they would like to implement when they would like to implement the play opportunity, and if they would like to implement more than one teacher-guided active play session; however, they were encouraged to implement activities from *Munch & Move* active play activities and Fundamental Motor Skills in Action (See Appendix F for example). The primary investigator assisted intervention classroom teachers in tailoring any activities for individual classroom needs. Indoor play activities were designed to be autonomy supportive by providing children the choice of how to complete activities (i.e., choosing which animal or how to cross the river). Additionally, teachers in the intervention group further supported the child’s autonomy through modeling activities, participating in activities, providing feedback, and avoiding controlling language.

Outdoor Play

Outdoor play opportunities were part of the already scheduled child-directed outdoor playtime. The intervention added a 15-minute teacher-guided game that focused on building fundamental motor skills. Teachers were encouraged to utilize the Fundamental Motor Skills with Franky and Friends resource (See Appendix G for example). This resource incorporates animals into locomotor and object control skills. For example, you learn to jump with Franky the frog, or kick from Holly the Horse. At the completion of 15-minutes, children were given complete autonomy on the choice of continuing the game or other activities.

Control

Classes assigned to the control condition continued with their typical schedule. Children in the control group continued to participate in outdoor play and structured PA. However, they did not participate in the additional teacher-guided active play opportunities or have access to the example binder until after follow-up analysis

Data analysis

General Data Analysis

All data were analyzed using statistical software (SPSS; Version 27). Descriptive statistics for all variables were calculated. Prior to conducting the proposed analysis, researchers analyzed the data to ensure the assumptions of the proposed analysis were met. If data violated these assumptions, a secondary analysis plan was utilized. Assumptions and procedures for interpreting results for each statistical test are discussed below. Table 2 presents a detailed list of research questions, measures, outcome variables, and proposed analyses.

Table 2 *Research Questions and Proposed Analyses*

Question	Independent variables	Outcome Variable	Proposed Analysis
Does an 8-week active play intervention significantly increase total physical activity during the school day (as measured by a wrist-worn accelerometer at baseline, post-intervention, and follow-up)?	Group (2) Time (3)	Time spent in light and moderate-to-vigorous physical activity	Mixed ANOVA
Does an 8-week active play intervention significantly affect preschoolers' fat-mass and fat-free mass (measured by bioelectrical impedance analysis (BIA) at baseline, post-intervention, and follow-up)?	Group (Intervention or Comparison) Time (3)	Fat mass and Fat-free mass	Mixed ANOVA
Does an 8-week active play intervention significantly improve fundamental motor skills measured by stationary, locomotion, and object manipulation, subsections of the Peabody Developmental Motor Scales, 2nd edition (PDMS-2) at baseline, post-intervention, and follow-up?	Group (2) Time (3)	Stationary, Locomotion, Object Manipulation, Gross Motor Quatile Scores	Mixed ANOVA
Does an 8-week active play intervention increase time-on-task compared to a sedentary-based academic lesson? Time on-task will be measured by behavior observations during baseline, mid-intervention, post-intervention, and follow-up for the intervention participants.	Time (2)	Time-on-task Time off-task	Paired Samples t-Test

Mixed ANOVA

Assumptions:

1. No significant outliers
2. Normality of the outcome variable
3. The variance of the outcome variable is equal between groups of between-subjects factors. (Homogeneity of variance)
4. The variance of differences between within-subjects groups should be equal (Assumption of sphericity)
5. The covariance matrices should be equal across the between-subjects factors (Homogeneity of covariances)

Researchers analyzed data again to determine simple main effects if a statistically significant interaction was found. If this condition was not met, researchers interpreted and reported the main effects for within and between subjects' tables. Partial eta squared was used to determine variance explained by group assignment.

Paired Samples *t* – Test

Assumptions:

1. Dependent variables are measured at the continuous level
2. Independent variable consists of two categorical, relatated groups, or mached pairs
3. No significant outliers in the differences between two related groups
4. The distribution of the differences in the dependent variable between the two related groups should be approximately normally distributed

Data Management Strategy

Collected data were saved in a password-protected Excel spreadsheet, and identifiers were removed for publication. All students were assigned a participant identification number to which only researchers with IRB approval for this study could access. All human subject procedures were followed for storing data.

CHAPTER IV

MANUSCRIPT I: FEASIBILITY AND EFFECTS OF AN 8-WEEK TEACHER-GUIDED ACTIVE PLAY INTERVENTION ON PRESCHOOLERS' PHYSICAL ACTIVITY LEVELS AND TIME ON-TASK

Abstract

Background: Play is an essential component of early childhood education and is included in American preschool children's current physical activity guidelines. The primary purpose of this study was to examine the feasibility and fidelity of an 8-week teacher-guided active play intervention in a preschool center in the southeastern region of the United States. The secondary aims of this study were to examine the effects of the 8-week active play intervention on time-on-task and physical activity levels.

Methods: Two preschool centers located in the southeastern region of the United States were randomly assigned to either the intervention or the control group. Weekly checklists and informal interviews were conducted to assess intervention fidelity. Teachers also completed weekly Likert-style surveys to assess automaticity and determine level of habit formation. A modified time sampling technique assessed time-on-task.. Wrist-worn accelerometers assessed physical activity during the school day.

Results: Teachers reported a mean difficulty of 1.35 for inside and 1.4 for outside activities. There were no statistically significant differences for indoor ($\chi^2(5)=5.50$, $p=3.58$) or outdoor automaticity ($\chi^2(6) = 9.363$ $p = .141$). The active play intervention did not show significant effects for time-on-task. From baseline to post-intervention, there were significant group differences for IPA ($F\,(1,40) = 13.59$, $p < .001$, $\eta_p^2 = .254$), but not for OPA ($F\,(1,40) =$

1.16, p = .288, η_p^2 = .028). Similarly, from baseline to retention, there were significant group differences for IPA (F (1,33)16.84, <.001, .994), but not for OPA.

Conclusions: The results of this study indicated that this type of intervention is feasible and increased IPA. However, while teachers seemed to understand the importance of physical activity, it still came second to "academic" material. Future studies should target teacher beliefs and attitudes regarding play and movement specifically.

Introduction

According to the National Association for the Education of Young Children (NAEYC) and the American Academy of Pediatrics (AAP), play is a vital component of preschool settings (Friedman et al., 2021; Yogman et al., 2018). The NAEYC even goes as far as to state that play is essential for all children, from birth through age 8 (Friedman et al., 2021), as evidence suggests children learn and gain skills through play (Brown & Vaughan, 2009; Elkind, 2007). Previous research has established that play benefits preschool children's physical, cognitive, emotional, and social development (Ashiabi, 2007; Derman et al., 2020; Fink, 1976; Ginsburg, 2007; Shaheen, 2014). When a child is playing, they are working to understand the world around them, and make sense of their personal experiences (Brown & Vaughan, 2009; Gosso & Carvalho, 2013). Research has suggested that play can serve as a vehicle for physical (Derman et al., 2020) and cognitive development (Fink, 1976), as well as socio-emotional (Ashiabi, 2007) and executive function skills (Shaheen, 2014) in preschool-aged children.

Play is incorporated into the current PA guidelines for American preschool-aged children and suggests children should participate in play throughout their day at various intensities and types. However, evidence suggests preschool-aged children spend approximately 80% of their day in sedentary behaviors (Brown et al., 2009). Additionally, it is estimated that, prior to the

COVID-19 quarantine, about 50% of American preschoolers met the updated PA guidelines (Pate et al., 2015). These estimates are troublesome, considering preliminary evidence of PA levels during COVID-19 quarantine shows significant decreases in PA and increases in sedentary behaviors for most populations, including children (Stockwell et al., 2021; Tulchin-Francis et al., 2021). Furthermore, the low levels of PA are alarming due to the well-established relationship between physical inactivity and health (Cote et al., 2013; Katzmarzyk et al., 2004; Power et al., 1997; Ross et al., 2015).

One pathway through which researchers have worked to improve PA and play in preschool settings is active play interventions. Most active play interventions have taken place in Canada, England, and Australia suggesting a gap in the literature regarding children in the United States. Overall, PA interventions for preschoolers have a small-to-moderate effect (g = .44), with teacher-led interventions more effective (g = .66; Gordon et al., 2013). This may be due to the burden of PA interventions and the long-term cognitive control and/or self-regulatory strategies necessary to enact these interventions. One of the more common barriers to PA interventions is the stressors teachers face due to laws such as "No Child Left Behind" and "Every Student Succeeds Act." Research indicates that more time is allocated to "academic" material in school-aged children, and less time is provided for PA and movement (Bryan et al., 2013). Alarmingly, these laws are leading to similar trends in preschool-aged children (Copeland et al., 2012) as preschool curriculums are shifting to emphasize basic academic skills that are assessed under these laws (Pérez, 2018). Interestingly, the current literature suggests that greater amounts of PA are associated with improvements in self-regulation skills (Vasilopoulos & Ellefson, 2021), which have been consistently linked to better academic achievement outcomes (McClelland et al., 2013; McClelland et al., 2007; Pagani et al., 2008). Furthermore, Vasilopoulos & Ellefson (2021) suggested early intervention studies should focus on children's attention or time-on-task , which is also related to academic achievement (Greenwood et al., 2002).

One possible pathway to overcoming these barriers to PA interventions is to enact teachers' self-regulatory control. An alternative mechanism to enacting self-regulatory control interventions is establishing automatic behavioral control through habit formation. According to Habit Formation Theory, habits form through the repetition of a behavior in the presence of salient, event-based cues (Adriaanse et al., 2011). This reinforces a mental context-behavior association so that the context becomes sufficient to activate the association, which in turn triggers an impulse to perform the habitual behavior potentially without intention, cognitive effort, or awareness (Verplanken & Aarts, 1999). As habits guide action rapidly and efficiently (Verplanken et al., 1997), the associated context behavior is more regulated by the environmental context than conscious intentions or deliberate, intentional processes and resistant to changes in motivation that may occur after an intervention period ceases (Verplanken & Wood, 2006). This automatic behavior, termed automaticity in habit formation, solidifies the behavior as a habit within context cues, as the behavior can occur without the individual's intent, awareness, or action. While intervention research on habitual PA is scarce, early results suggest that attending to specific conditions (contextual repetitions, cues) can expedite and improve the likelihood of habit formation (Verplanken & Wood, 2006). However, the impact of teacher habit formation on child-level outcomes in active play interventions has not been investigated.

Current evidence suggests that active play interventions are under-researched. As such, it is not fully understood if such interventions are feasible pathways to incorporate movement into the classroom. Furthermore, while these interventions' effects on preschoolers' PA levels seem promising, less is understood about how they impact time-on-task. Therefore, the primary purpose of this study was to examine the feasibility and fidelity of an 8-week teacher-guided active play intervention in a preschool center in the southeastern region of the United States. The secondary purposes of this study were to examine the effects of an 8-week active play intervention on time-on-task and PA. Researchers hypothesized that children enrolled in the intervention would have greater time-on-task following an active play activity than following a sedentary academic lesson. Furthermore, researchers hypothesized that children enrolled in the active play intervention would have significantly greater total PA while at school than those in the comparison group. It was further hypothesized that children in the active play intervention would significantly increase their total inside and outside PA levels across the intervention.

Method

Participants and Setting

Participants were recruited from the three to five-year-old classes at two local preschool centers. Each center was randomly assigned to either the intervention or control group. The intervention school consisted of five classes, and the control group consisted of four classes. A total of 27 children and ten teachers were enrolled in the intervention group, and 25 children and eight teachers were enrolled in the control group.

These centers open at 6:30 am and close at 6:00 pm. From 6:30 am – 8:15 am, children could engage in indoor free play at the centers. Breakfast is then served from 8:15 am – 8:30 am. morning move time, circle time, small group and centers, and morning outside time occur from 8:40 am – 12:00 pm. Lunch was served at 12:00 pm, and naps started at 12:30 pm. At 3:00 pm, all children were allowed an afternoon snack before the afternoon activities. Children participated in small groups, centers, and afternoon outside time from 3:15 pm – 5:00 pm. Any child who was present after 5:00 pm was provided a late afternoon snack and participated in indoor free play and centers until they were picked up. In addition to the usual schedule, parents could enroll their children in various extra movement opportunities for a fee. These opportunities included a sports and fitness program, a martial arts-based activity program, and a dance program.

This study was approved by the University's Institutional Review Board for Research Involving Human Subjects and conformed to the latest Declaration of Helsinki. The associated clinical trial number is NCT0574491. Parental consent and child assent were obtained prior to data collection.

Procedures

Intervention

The 8-week active play intervention asked teachers to add two teacher-guided play opportunities daily. In addition to the already scheduled 15-minute structured PA, children in the intervention group participated in an additional 15-minute indoor and 15-minute outdoor teacher-guided activity. Teachers were provided a binder with *resources for Munch & Move* (Reproduced by permission, NSW Health © 2020). A detailed description of the full *Munch & Move* initiative can be found in Hardy and colleagues' 2010 evaluation (Hardy et al., 2010). For this study, only the active play resources were utilized. These resources included active play activities and a cue card for FMS. Each FMS was associated with a different animal and had games teachers could implement inside and outside the classroom. For example, running was associated with a character named Freddy the Fox, and one game associated with running was "What time is it, Mr. Fox ." This game would have children stand on one side of the play area and ask the teacher what time it is. The teacher would give a number, and the children would count their steps. When the children got closer, the teacher would then say it is dinnertime and chase them back to the other side of the play area. If a teacher caught a child, they became the new Mr. Fox. This game reinforced running and allowed teachers to reinforce children's number skills. The FMS cue card provided teachers with a visual image for each skill and cue words to encourage proper movement. In addition to a binder of active play examples, intervention teachers received a play equipment kit. This kit contained small equipment, such as small balls, scarves, beanbags, kick balls, polyspots, and active reading books to assist teachers with successfully implementing the active play activities. At the end of the intervention, teachers were encouraged to continue implementing the active play intervention in the spring semester.

Teacher Training

Teachers were consulted about the proposed intervention and asked for feedback regarding intervention implementation. Teachers were introduced to the intervention through one-on-one training and provided a binder with intervention materials. Formal teacher training took place on an individual classroom level, and lasted approximately 12 minutes for each teacher. Since there were five classes, researchers spent roughly 60 minutes to complete all formal teacher training. This training consisted of a description of the intervention, the goals of the intervention, and the fundamentals of active play. Emphasis was placed on areas of the day where the activities could be consistently implemented each day to increase habit formation. A discussion between the lead author and teachers about the best indoor and outdoor implementation practices followed this training. During these individual discussions about the interventions, all teachers reported feeling comfortable with implementing the inside activities but asked for assistance in implementing the outside activities. Thus, for the first two weeks of the intervention, teachers implemented the inside activities, and the research group implemented ten 15-minute researcher-led outdoor active play opportunities for each classroom. During weeks 3 and 4, only the lead author was present to assist the teachers with implementing the outside activities. All teachers conducted inside and outside activities independently during the last four weeks of the 8-week intervention.

Throughout the intervention, members of the research team were available for follow-up questions and assistance. These discussions between the lead teacher and the first author lasted about 3 to 5 minutes each week. Information regarding the study timeline and teacher responsibilities is located in Figure 2.

Control

Classes assigned to the control condition continued with their typical schedule. Therefore, children in the control group continued participating in outdoor play and the scheduled, structured PA. However, they did not participate in the additional teacher-guided active play opportunities, and teachers did not have access to the intervention materials until the completion of retention analyses.

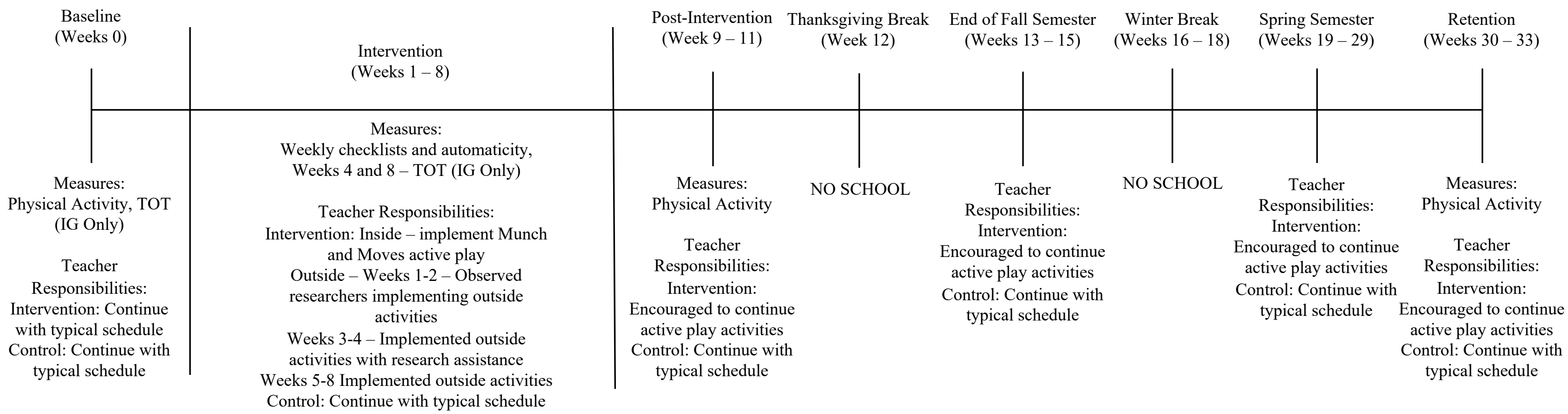


Figure 2. Study Timeline and Teacher Responsibilities

Measures

Weekly Checklists and Informal Interviews

To determine the degree of implementation, teachers provided information on which activities they completed indoors and outdoors each week. These checklists also allowed teachers to provide feedback on how difficult implementing the activities was over the past week. At the end of each week, the first author collected data forms and discussed with the teachers why an activity was medium or hard to implement or why they did not implement any activities. Difficulty levels were coded 1 for easy, 2 for medium, and 3 for hard.

Automaticity

Behavioral automaticity was assessed by the self-reported behavioral automaticity index and provides an indication of habit formation. The lead teacher would answer the following questions for indoor and outdoor activities each week: Incorporating the new active play into (indoor or outdoor) classroom time is something... I do without thinking; I do automatically; I do without having to consciously remember; I start doing before I realize I am doing it. These questions were a Likert scale with one - Strongly Disagree; two - Disagree; three – Neither Agree nor Disagree; four – Agree; and five – Strongly Agree (Gardner et al., 2012).

Time-On-Task

Direct observation assessed time-on-task using a version of the momentary time sampling protocol (Mahar et al., 2006; Wadsworth et al., 2014; Webster et al., 2015). Behavior observation occurred for 15 minutes before and after each lesson (standard sedentary-based academic less or teacher-guided active play). Researchers conducted behavior observations twice for each assessment point (baseline (weeks 0), mid-intervention (week 4), and post-intervention (week 8)) for a total of 6 observation periods across the study. To determine time-on-task, a trained observer coded behavior as time on or off-task during the predetermined time interval (Cooper et al., 2007). On-task behavior was defined as verbal or motor behavior that follows the class rules and is appropriate to the learning situation. Children's behavior was recorded on an observation sheet as one of the following: on-task (e.g., listening to the teacher read to the class), motor off-task (e.g., out of the seat and not attending while the teacher is reading), noise off-task (e.g., talking with others and not attending while the teacher is reading), or passive/other off-task (e.g., staring into space or sleeping while the teacher is reading). During behavior observations, a prerecorded audio file prompted observers to systematically observe behavior for a 10-second interval and then record behavior during a 5-second interval. This protocol yielded four observations per minute. After each minute, the researcher observes the next child. This process continued for 5 minutes until each child was coded once, then the observation cycle was repeated for three cycles for a total of (15 minutes) or until each child was coded for three minutes. Percentage of time-on-task (TOT) and off-task (TOF) were used as the outcome variables.

Researchers conducted behavior observations at three different time points to assess if the active play intervention was successful at increasing time-on-task. Baseline behavior observations were conducted before and after a standard sedentary academic lesson. Researchers then conducted two behavior observations twice (weeks 4 and 8) before and after a teacher-guided indoor active play opportunity during the intervention period. A standard sedentary academic lesson was defined as when teachers presented learning material in a traditional way, such as circle or story time. The first author met with teachers to determine when active play opportunities were implemented into the daily schedule for on-task behavioral assessments. Most teachers implemented the active play intervention in the morning during transition time. However, one classroom implemented the intervention activities indoors during the afternoon.

Prior to collecting data, researchers conducting the behavior observations were trained in proper procedures by a trained observer. Additionally, these researchers established interobserver agreement (IOA) before collecting data. The goal for IOA was above 80% agreement. During data collection, the trained observers randomly coded 15-20% of observations together to maintain IOA. If IOA fell below 80%, a follow-up training was scheduled. Researchers recorded an IOA of approximately 90.68% for determining on or off-task behavior and 88.72% for accuracy within coding subcategories of off-task behavior. No follow-up training was needed.

Physical Activity

To assess PA, each participant wore an Actigraph GTX3 (Pensacola, FL) accelerometer on their non-dominant wrist for five school days during baseline (Weeks 0), post-intervention (Weeks 9 – 11), and retention (Weeks 30 – 33) assessment points. Research personnel attached the accelerometer each morning upon participant arrival and removed it before departure. Time on and off was documented for wear time adjustments. Data from the accelerometers was downloaded and analyzed in Actilife 6 (Version 6.13.4). Butte cut points (2014) in 10-second epochs were used to categorize activity into light or moderate/vigorous PA. Individual filters based on accelerometer time on and off were used for each participant.

Additionally, researchers examined the attendance records to determine the typical day length for each participant. If the monitor was worn for less than half of a child's typical attendance time, that day was removed from the final analysis. Participants generally were at school for an average of 492 minutes (approximately 8 hours). If a child wore the monitor for fewer than 246 minutes (about 4 hours) during a day, the analyses excluded that day. The final analysis did not include participants with less than three days of monitoring. Furthermore, due to participants having different wear times (i.e., came to school late, left early), the percentages of time spent in total physically active inside (IPA) and outside (OPA) were utilized in the final analysis.

Statistical Analysis

Statistical software (SPSS; Version 28) was utilized for all analyses. A Freidman test determined significant differences in automaticity across eight weeks. Three paired samples t-test examined differences in TOT and TOF at the three-time points (baseline (Weeks 0), mid-intervention (Week 4), and post-intervention (Week 8)). Due to our hypotheses stating a direction, all t-tests utilized the one-sided p-value. Two separate mixed repeated measures ANOVAs assessed changes in PA. The group assignment was the between factor and time (baseline, post, and retention) as the within factor. Alpha level was set at .05 a priori.

Results

The goal of the intervention was to add two teacher-guided 15-minute active play segments, one indoor and one outdoor, each day. Before starting the intervention, the lead author followed-up with each teacher to determine the initial levels of acceptability of the intervention and answer questions. All teachers reported that the intervention fit within their classroom system for indoor activities but asked for assistance implementing the outside activities. Thus, for the first two weeks of the intervention, teachers implemented the inside activities, and the research group implemented all outside activities. During weeks 3 and 4, only the lead author was present to assist the teachers with implementing the outside activities. All teachers independently conducted inside and outside activities during the last four weeks of the 8-week intervention. Thus, the intervention was modified prior to implementation for the teacher to implement inside activities for 40 days and outside activities for 30 days. However, due to weather, there was a variation in the days the intervention could be implemented outside (33 – 36 days).

Table 3 provides information on levels of teacher implementation by class based on weekly check-ins. On average, teachers implemented the inside activities 56% of the time and outside activities 65% of the time. Teachers reported a mean difficulty of 1.35 for inside and 1.4 for outside activities. Across the 8-week intervention, teachers did not report great changes in difficulty. The most common times of the day that teachers implemented indoor activities was during the transition from morning group (songs, letter recognition, counting, and information to start their day) to small group table activities (fine motor skills such as cutting, writing, and crafts) and right before or during circle time (large group activities such as reading, interactive play, and curriculum instruction). Upon further examination of teacher reports, it was evident that the teachers preferred to implement locomotor activities, with Move Like an Animal being the most commonly implemented active play activity.

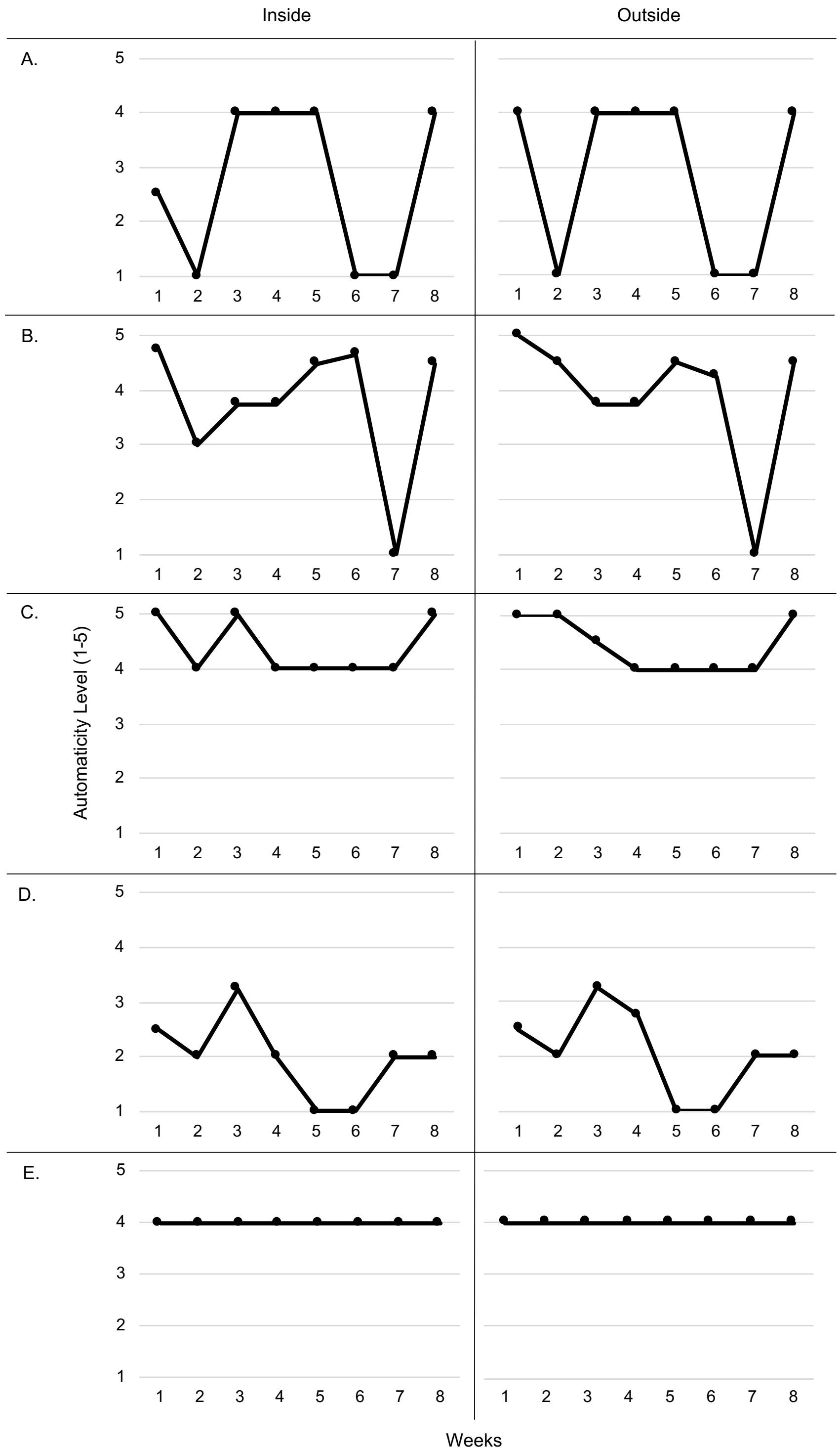
Table 3 *Classroom Fidelity*

	Inside	**Outside**
Class A	17 out of 40 (43%)	7 out of 33 (21%)
Class B	22 out of 40 (55%)	15 out of 34 (44%)
Class C	29 out of 40 (73%)	32 out of 35 (91%)
Class D	8 out of 40 (20%)	24 out of 35 (69%)
Class E	36 out of 40 (90%)	35 out of 36 (97%)

Notes: Classroom fidelity is based on teacher reports and informal interviews. If the teacher did not turn in a form that week, the first author discussed it with them to determine if the intervention was implemented during the week. Classes A and B were the youngest participants.

Teachers' mean automaticity for inside and outside across eight weeks can be found in Figure 3. A Freidman test determined differences in automaticity during the 8-week intervention. Indoors automaticity decreased from week one (mdn = 4) to week two (mdn = 3.5) and increased back for weeks 3 - 8 (mdns = 4). There were no statistically significant differences, $\chi^2(5)=5.50$, p =3.58 across the intervention. Outdoor automaticity increased from week one (Mdn = 4) to week 2 (4.25) and decreased back for weeks 3-8 (mnds=4). However, there were still no statistically significant differences $\chi^2(6) = 9.363$ $p = .141$.

Figure 3. Mean Automaticity



Time-On-Task

The baseline analysis for time-on-task included nineteen participants. Data are presented as mean ± standard deviation. At baseline, time-on-task decreased from 74.78 % ± 16.7 % before a traditional classroom activity to 63.38 % ± 25.86 % afterward. Similarly, participants saw an increase in off-task behavior from 25.22 % ± 16.7 % Before the traditional classroom activity to 36.62 % ±25.86 % after. At baseline, there was a significant decrease in Time on-task ($t(18) = 1.94$, $p < .034$, d = .445) and an increase in off-task behavior ($t(18) = -1.94$, $p < .034$, d = - .445) following a traditional classroom activity.

At mid-intervention, sixteen participants were included in the analysis. Time-on-task increased from 86.46 % ± 15.18 % to 89.32 ± 15.18 % following an active play activity. Likewise, there was a decrease in off-task behavior from 13.54 % ± 15.18 % before the active play activity to 10.68 % ± 15.81 % after. There were no statistically significant differences in time-on-task ($t(15) = -1.36$, $p = .097$, d = -.340) and off-task behavior ($t(15)= 1.36$, $p = .097$, d = .340) from before to after an active play activity.

Researchers conducted one additional behavior observation at the end of the 8-week intervention. Twenty-two participants were included in this analysis. Time-on-task decreased from 82.20 % ± 24.87 % prior to an active play session to 78.98 % ± 29.78 % afterward. Additionally, there was an increase in off-task behavior from 17.80 % ± 24.87 % prior to the active play activity to 21.02 % ± 29.78 % afterward. Similar to the results at mid-intervention, were no statistically significant differences in time-on-task ($t(21) = 596$, $p = .279$, d = .127) and off-task behavior ($t(21)= -.596$, $p = .279$, d = -.127).

Physical Activity

Mean, standard deviations, and percent change for IPA and OPA during the school day at each assessment point can be found in Table 4. Additionally, breakdowns of time spent in light, moderate, and vigorous PA are displayed at the bottom of Table 4. A graphical representation of changes in IPA and OPA across all time points can be found in Figure 3.

The first mixed ANOVA included two-time points (baseline, post-intervention) and two groups (intervention (n=19) and control (n=23)). There was homogeneity of variance, assessed by Leven's test of homogeneity variance ($p > .05$). Additionally, Box's test of equality of covariance matrices indicated that the assumption of homogeneity of covariance was met ($p = .328$). There were no statistically significant group-by-time interactions for IPA or OPA. Likewise, there were no significant main effects of time. There were significant group differences for IPA ($F(1,40) = 13.59$, $p < .001$, $\eta_p^2 = .254$), but not for OPA ($F(1,40) = 1.16$, $p = .288$, $\eta_p^2 = .028$). Showing that from baseline to post-intervention, the intervention group spent a significantly greater portion of their time participating in indoor PA. Furthermore, it is evident that at baseline, the intervention group was participating in a greater percentage of inside PA than the control group. From baseline to post-intervention, the intervention group saw a 1.63 % increase in IPA and a 4.88% decrease in OPA. In comparison, the control group saw a 0% increase in IPA and a 1.55% decrease in OPA.

The second analysis included three-time points (baseline, post-intervention, and retention) and two groups (intervention (n=18) and control (n=17)). There was a violation of homogeneity of variance for OPA at retention, based on Leven's test of homogeneity variance ($p > .05$). However, all other time points meet this assumption. There was homogeneity of covariance according to Box's test of equality of covariance matrices ($p = .012$). IPA violated the assumption of sphericity assessed ($\chi^2(2).747$, p=.009). Therefore, a Greenhouse-Geiser adjustment was utilized. There were no significant interactions between the group-by-time for IPA or OPA. Likewise, there was no significant effect for time for either dependent variable. There were significant group differences for IPA (F (1,33)16.84, p <.001, .994), but not for outside PA. From baseline to retention, the intervention group saw increases in IPA (4.4%) and OPA (1.59%). The control group saw a 3.9% increase in IPA from baseline to retention and saw a 0.07% decline in OPA.

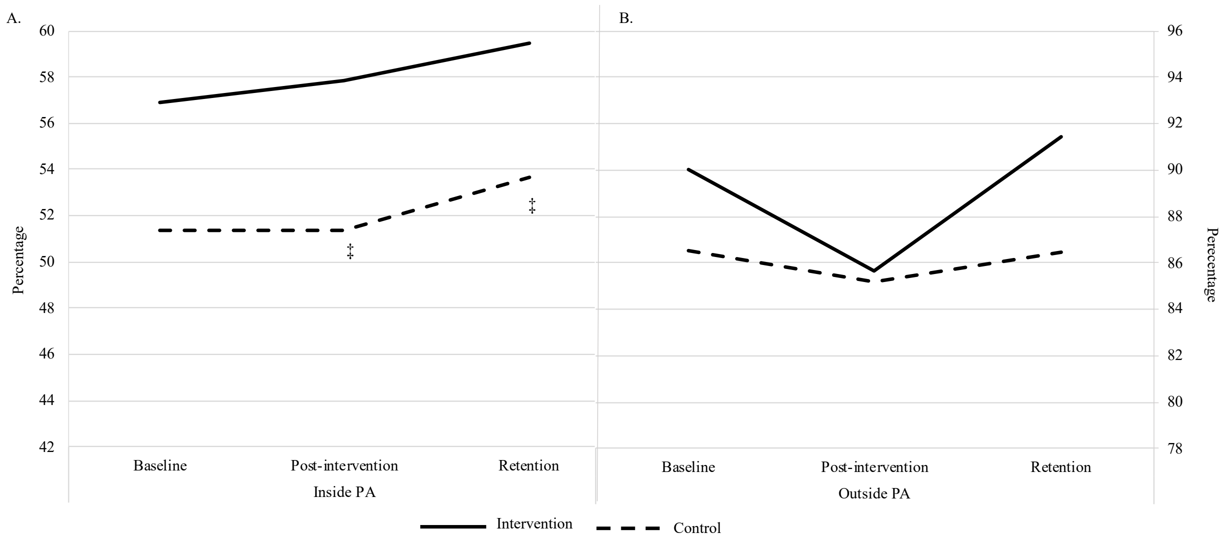
Researchers examined PA data to determine if participants met the PA recommendations of at least 15 minutes of activity every hour (Institute of Medicine, 2011) at baseline, post-test, and retention. Participants who had three days of PA were included and examined on each day. A closer examination of PA data at both baseline and post-intervention showed that, 68.4 % of the intervention group met the PA guidelines; this increased to 83.3% at retention. For the control group 26.09% at baseline, 26.01% at post-intervention, and 35.29 % at retention met the suggested recommendations for PA during the school day.

Table 4 *Physical Activity Data*

		Baseline		Post-intervention		Retention	
		Intervention (n = 19)	*Control (n = 23)*	*Intervention (n = 19)*	*Control (n = 23))*	*Intervention (n = 18)*	*Control (n = 17)*
IPA		56.92 % (± 6.77 %) [[53.38 – 60.45]]	51.36 % (± 8.25 %) [[48.14 – 54.57]]	57.85 (± 7.55) [1.63 %] [[54.91 – 60.79]]	51.36 (± 5.22) [0 %] [[48.68 – 54.57]]	59.45 (± 5.49) [4.4 %] [[56.71 – 62.18]]	53.67 (± 6.37) [3.9 %] [[50.84 – 56.48]]
OPA		90.02 % (± 8.82 %) [[86.09 – 95.74]]	86.54 % (± 11.55 %) [[82.15 – 90.92]]	85.63 % (± 10.75) [-4.88 %] [[80.62 – 90.63]]	85.20 % (± 10.80) [-1.55 %] [[80.65 – 89.74]]	91.45 (± 4.12) [1.59 %] [[87.51 – 95.40]]	86.48 (± 11.01) [-0.07 %] [[82.43 – 90.54]]
IPA	***Light***	34.81 % (± 7.10%)	31.14 % (± 5.44 %)	36.32 % (± 5.82 %) [4.34 %]	30.30 % (± 4.87 %) [-2.70]	38.77 % (± 4.02 %) [11.37 %] [[36.59 – 40.25]]	32.68 % (± 3.68 %) [4.95 %] [[30.65 – 34.41]]
	Moderate	22.04 % (± 3.42 %)	20.16 % (± 4.88 %)	20.10 % (± 5.18 %) [-8.80 %]	18.40 % (± 4.72 %) [-8.73 %]	20.61 % (± 3.59 %) [-6.49 %] [[18.34 – 22.38]]	20.93 % (± 4.93 %) [3.82 %] [[18.54 – 22.70]]
	Vigorous	-	-	1.20 % (± 5.26%)	-	-	-
OPA	***Light***	36.65 % (± 8.89 %)	44.92 % (± 14.41 %)	35.97 % (± 13.05 %) [-1.86 %]	46.52 % (± 11.45 %) [3.56 %]	39.05 % (± 8.32 %) [6.55 %] [[33.59 – 45.62]]	44.17 % (± 14.83 %) [-1.67 %] [[39.33 – 51.68]]
	Moderate	55.27 % (± 10.39 %)	41.61 % (± 16.63 %)	47.17 % (± 18.77 %) [-14.66 %]	39.85 % (± 14.04 %) [-4.23 %]	52.41 % (± 10.91 %) [-5.17 %] [[44.75 – 58.72]]	42.31 % (± 15.12 %) [1.68 %] [[33.46 – 47.82]]
	Vigorous	-	-	3.60 % (± 15.71%)	-	-	-

Notes: Mean (S.D.) [% Change from baseline], [[95% Confidence Interval]]. Inside physical activity (IPA), and outside physical activity (OPA) include Light, Moderate, and Vigorous physical activity (PA). A breakdown of intensities can be found at the bottom of the table.

Figure 4. Mean Changes in Physical Activity



Notes: A. Inside PA, B. Outside PA, ‡ significant group differences.

Discussion

The primary purpose of the current study aimed to determine the feasibility and fidelity of an 8-week active play intervention implemented by teachers. The secondary aims of this study were to examine the effects of an 8-week teacher-guided active play intervention on TOT, IPA, and OPA. Findings indicated that teachers found the activities easy to implement and integrate within their current schedule. Furthermore, teachers had high automaticity for both indoor and outdoor activities. Regarding implementation fidelity, teachers successfully implemented inside activities 56% of the time and outside activities 65% of the time.

Teachers' adherence to the intervention ranged from 43% - 90% indoors and 21% - 97% outdoors. Fidelity checks were assessed with teacher self-report weekly checklists and informal interviews. If a teacher lost their form or did not fill it out, the first author had a discussion with them to determine which days during the week active play activities were implemented. Therefore, these adherence numbers may be an underestimate. Despite this, our implementation fidelity is in line with previous teacher-led activity interventions. Specifically, Alhassan et al. (2022) reported that approximately 77.5% of their scheduled lessons were implemented; however, only 46.7% of the intervention lessons were implemented as designed. It is important to note that studies such as Alhassan et al. (2022), Howie et al. (2014), and Hardy et al. (2010) required several hours of training (100 – 480 minutes). In contrast, our study utilized minimal training (60 minutes for all teachers). Furthermore, with some of these studies, particularly Hardy et al. (Hardy et al., 2010), it was difficult to determine if the research group was present throughout the intervention to help implement the activities or if they allowed teachers to implement independently.

Teachers with less than average adherence to the intervention reported several barriers to implementation. In Classes A and B, which consisted of the youngest participants, teachers reported they struggled with implementing outdoor structured play due to issues (i.e., behavior issues, time) that arose when they tried to implement the activity. Class D noted that it was often difficult to take the time to implement inside activities when they had such a large class. This teacher also expressed that it was challenging to implement the intervention when they needed to ensure all the students were ready for Kindergarten, indicating that they prioritized “academic” learning to “play." Previous research indicates these views are not uncommon (Logue & Harvey, 2009), and teachers often do not equate active play with learning outcomes.

In the United States, views surrounding early childhood education and care have resulted in a fragmented system with wide ranges in quality and access (Kamerman & Gatenio-Gabel, 2007). Taking this into account with the increasing demands teachers face due to laws such as “No Child Left Behind” and “Every Student Succeeds Act,” more time is allocated to focusing on “academic” material, and less time is provided for activity and movement (Bryan et al., 2013). Interestingly the results of the current study indicated that an active play intervention does not significantly decrease time-on-task, as opposed to a traditional classroom activity which we found to result in a significant decrease in time-on-task and a significant increase in off-task behavior. Therefore, the findings of our study support the current body of literature, which indicates that allowing children to participate in movement does not negatively impact time-on-task (Spring et al., 2022; Webster et al., 2015). While teachers reported that the current active play intervention was easy to implement, some teachers struggled to develop the habit of implementation. Notably, the teachers in Classes C and E had consistent implementation and habitually implemented the intervention across the 8-week intervention. Whereas the teachers in A, B, and D did not ever develop the habit of implementing the intervention, which coincides with their fidelity reports. These findings suggest a need for better support of habit formation for all teachers. Research indicates that teachers who engage in healthy behaviors and have positive attitudes toward PA in schools are more likely to promote movement for the student (Centeio et al., 2023). Moreover, it is not an uncommon belief for teachers to feel that PA or play detracts from "academic time" (Logue & Harvey, 2009). Thus, it would be prudent for future training or professional development opportunities to specifically target teacher beliefs and attitudes towards active play and PA.

Despite striving to design a study to minimize additional burdens to the teachers by limiting training, it is apparent that knowledge gaps regarding active play still exist. These knowledge gaps in the current study led to variation in intervention implementation in specific classrooms, which is one possible explanation the results do not indicate significant changes in outdoor PA. However, with minimal training, the intervention group participated in significantly greater PA indoors than the control group. A closer examination of the PA data indicated that a greater percentage of children in the intervention group met the PA recommendations (Institute of Medicine, 2011) than those in the comparison group. Considering that current evidence suggests preschool-aged children spend approximately 80% of their day in sedentary behaviors (Brown et al., 2009), the results of our study indicate that active play interventions might be a successful pathway to foster more movement in preschoolers' days.

The current literature surrounding classroom-based PA or active play interventions has found similar results. Carroll et al. (2022) found that a teacher-guided and -led PA intervention could acutely benefit children's MVPA during indoor time. However, other studies have noted that such interventions are ineffective at improving PA levels (Alhassan et al., 2022; Stagnitti et al., 2011). The overall consensus is that these interventions are feasible, but are often limited due to fidelity. These findings further indicate the need for policy changes and research designs to help decrease teacher barriers and increase active play during the preschool day. Interestingly, those who reported the most barriers to implement the intervention had lower levels of automaticity and/or did not report automaticity. This intervention primarily used the preschool schedule as the "cue" or "reminder" to implement active play activities. The time of day or consistent timing of behavior is often the most powerful antecedent (Hagger, 2019). Anecdotally, teachers who reported higher levels of automaticity were consistent with implementing the active play intervention at the same time of day, whereas those who struggled with implementation varied in when they implemented the active play opportunities. This may suggest that focusing on habit formation could aid in consistently implementing PA opportunities and provides avenues for further investigation. The overall trend indicates that active play interventions can improve PA levels (Goldfield et al., 2016)

Limitations

One of the main limitations of this study is generalizability. The preschool centers where this intervention occurred are paid-for service centers, and results may differ for other centers. Furthermore, fidelity was limited by teacher self-report. Another limitation of this study is the failure to measure movement within 24 hours, thereby limiting the understating of how the intervention impacted school day PA. It is unknown if the intervention could affect PA levels at home.

Conclusions

This study aimed to determine the feasibility of an 8-week active play intervention. The results of this study indicated that this type of intervention is feasible and increases indoor PA. However, further training or professional development course specifically aimed to target early childhood teachers' beliefs and attitudes towards active play and PA may benefit active play opportunities (Centeio et al., 2023). Additionally, researchers, teachers, and policymakers should work in conjunction with each other to design curriculum and policies that allow the teachers to incorporate play into the learning objectives.In the future, it would be prudent to include a 24-hour measurement of activity and replicate this study in other preschools. Overall, the findings of this 8-week teacher-guided active play intervention indicate that it is a feasible pathway to increase PA without detracting from time-on-task in preschool settings and that habit formation for implementing active play may provide a feasible solution to sustainable programs.

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CHAPTER V

MANUSCRIPT II: IMPACT OF AN 8-WEEK ACTIVE PLAY INTERVENTION ON PRESCHOOLERS' BODY COMPOSITION AND FUNDAMENTAL MOTOR SKILLS

Abstract

This study examined the impact of an 8-week teacher-guided active play intervention on various child development outcomes. Participants were recruited from two local preschool centers which were randomly assigned to either the intervention or the control group. All measures were assessed at baseline (Weeks 0), post-intervention (Weeks 9 – 11), and retention (Weeks 30 – 33). Bioelectrical Impedance assessed body composition (fat mass (FM) and fat-free mass (FFM)). Fundamental Motor Skills (FMS, stationary skills (SS), locomotor skills (LS), object manipulation skills (OMS), and gross motor quartile (GMQ)) were assessed using the Peabody Developmental Motor Scales., 2nd edition. Results indicated a significant group-by-time interaction for GMQ (F (1,46) = 5.037, p = .030, η_p^2 = .099) from baseline to post-intervention indicating that the intervention group had better GMQ scores than the control group. Results indicated there were significant increases in FM (F (1.626,63.432) = 15.048, p < .001, η_p^2 = .278), FFM (F (1,640, 63.962) = 68.531, p < .001, η_p^2 = .637), SS (F (1.624, 61.713) = 46.706, p < .001, η_p^2 = .551), LS(F (1.340,50.913) = 11.984, p <.001, η_p^2 = .240), OMS (F (2,74) = 25.353, p < .001, η_p^2 = .400), and GMQ (F (2,74) = 23.747, p <.001, η_p^2 = .385) from baseline to retention for both groups. These results indicated that active play might successfully improve gross motor skills in young children.

Introduction

Maria Montessori once stated, "Play is the work of Children." Over the last several years, organizations including The National Association for the Education of Young Children (NAEYC) and the American Academy of Pediatrics (AAP), have stressed the importance of play in preschool settings (Friedman et al., 2021; Yogman et al., 2018) as play impacts multiple areas of development, and children learn and gain skills through play (Brown & Vaughan, 2009; Elkind, 2007). Play has been defined as apparently purposeless, voluntary, inherent attraction, freedom from time, diminished consciousness of self, improvisational potential, and continuation desire (Brown & Vaughan, 2009). Through play, children can communicate and learn to better understand the world around them (Brown & Vaughan, 2009; Durham et al., 2019; Gosso & Carvalho, 2013; Weisberg et al., 2013), all while serving as the vehicle for physical (Derman et al., 2020), cognitive (Fink, 1976), socio-emotional development (Ashiabi, 2007), and executive function (Shaheen, 2014). The consensus is that there are five main types of play: physical play, play with objects, symbolic play, socio-dramatic play, and games with rules (Whitebread et al., 2012). One form of physical play is active play (Whitebread et al., 2012).

Active play is often defined as a type of PA focusing on teacher-led and child-directed activities that can be incorporated into the classroom curriculum or outdoor time (Tandon et al., 2019; Truelove et al., 2017). Active play interventions have resulted in similar outcomes to PA interventions, such as increased PA levels (Goldfield et al., 2016; Truelove et al., 2017) and fundamental motor skills (Adamo et al., 2016; Roach & Keats, 2018). Currently, only one active play intervention examining body composition can be identified. Goldfield et al. (2016) found that a 6-month active play intervention did not result in significant changes in body composition between groups; however, the intervention group did see reductions in body fat percentage and fat mass. In Australia, a state-wide health initiative titled *Munch & Move* was designed to promote PA, healthy eating, and reduced screen time in preschool settings through a play-based approach (NSW Government, 2020). Innes-Hughes et al. (2019) reported a greater number of childcare settings meeting the recommendations of PA for at least 25% of operating hours after five years of implementing *Munch & Move*. Furthermore, *Munch & Move* successfully improved fundamental motor skills in children aged 3-5 (Hardy et al., 2010). Despite these promising outcomes, researchers have yet to examine the Munch & Move initiative's effect on body composition.

Overall, experimental studies examining the effects of active play interventions in preschool settings are under-researched. One systematic review found only eleven unique studies pertaining to active play in preschoolers, of which nine took place in the United States (Truelove et al., 2017), and none of the nine studies implemented an experimental study in the preschool setting. Additionally, despite research indicating active play interventions successfully improve fundamental motor skills, more needs to be understood about the impact such interventions have on body composition. Moreover, when examining the literature regarding preschoolers, most studies have only examined body mass index (BMI) and not changes in fat mass (FM) or fat-free mass (FFM). Therefore, this study aimed to examine the impact of an 8-week indoor and outdoor teacher-guided active play intervention on body composition and motor skill scores in preschoolers attending two private preschool centers in the southeastern region of the United States.

Methods

Participants were recruited from two local preschool centers. These centers provide all-day childcare services for 6-week-old infants through four-year-old preschoolers. Children in the 3- and 4-year-old classes were eligible for participation. An a priori sample size (Faul et al.,

2009) indicated 44 participants (22 per group) were needed to achieve .80 power with an alpha level of .05 and an effect size of .24, as previous research has found that teacher-implemented studies have an effect size of .24 (Gordon et al., 2013). Due to the potential loss of participants (i.e., moving, attendance, missing measurements), researchers planned to oversample at a rate of 1.2 for a total of 53 (approximately 27 per group). Prior to data collection, researchers obtained parental consent. Participants and parents were informed that participation was voluntary and that participants may choose to withdraw at any time without any consequence. Of 170 children in the 3-5-year-old classes in both centers, 52 participants returned parental consent and were eligible to participate. This study was approved by the Human Subjects' Research Institutional Review Board at Auburn University under protocol number 10-217 MR 1009. The associated clinical trial number is NCT05744791.

Measurements

General Procedures

Prior to any assessments, the preschool centers were randomly assigned to an intervention or control group using a random number generator. Baseline measures were assessed prior to the commencement of the study (Weeks 0). During this time, teachers in the intervention group were provided with an active play resource kit. After the 8-week intervention, researchers assessed post-intervention measures (Weeks 9 – 11) in the intervention and control groups. The following week was Thanksgiving break, and there was no school. During Weeks 13 – 15, teachers in the intervention group were encouraged to continue the intervention. Winter break took place from Week 16 to Week 18. Following this time, intervention teachers were encouraged to continue the intervention for the school year and were provided additional activities that corresponded with their weekly learning objectives (Weeks 18 – 28). Researchers assessed retention measures (Weeks 30 – 33). Researchers measured height, weight, body composition, and fundamental motor skills at each assessment point. Due to COVID-19 protocols, researchers were limited to 15-minute time frames when interacting with participants. To adhere to this protocol, a timer was started each time a new participant came into the assessment room. When the timer went off, the first author returned the participant to the classroom and pulled the next participant. It took approximately three 15-minute sessions to assess all measures for each participant. A flow diagram of the progress through the randomized trial can be found in Figure 5. Information regarding the study timeline and teacher responsibilities can be found in Table 5. All measures are discussed in detail below.

Demographics

Demographic variables (i.e., biological sex and birthdate) were obtained from the preschool center and parents at the beginning of data collection. Additionally, researchers recorded which participants engaged in extra movement opportunities offered by the childcare center. There were three main extra movement opportunities offered. These included a sports and fitness program, a martial arts-based activity program, and a dance program. The sports and fitness program costs $40.00 monthly and met 30 minutes weekly. The martial arts-based activity program costs $65.00 monthly and met 30 minutes weekly. The dance program costs $65.00 per student or $85.00 per family, plus an additional $30.00 program fee for each student. The dance program met for 45 minutes each week. These three opportunities were available at both centers and conducted during school hours.

Figure 5. CONSORT Flow Diagram

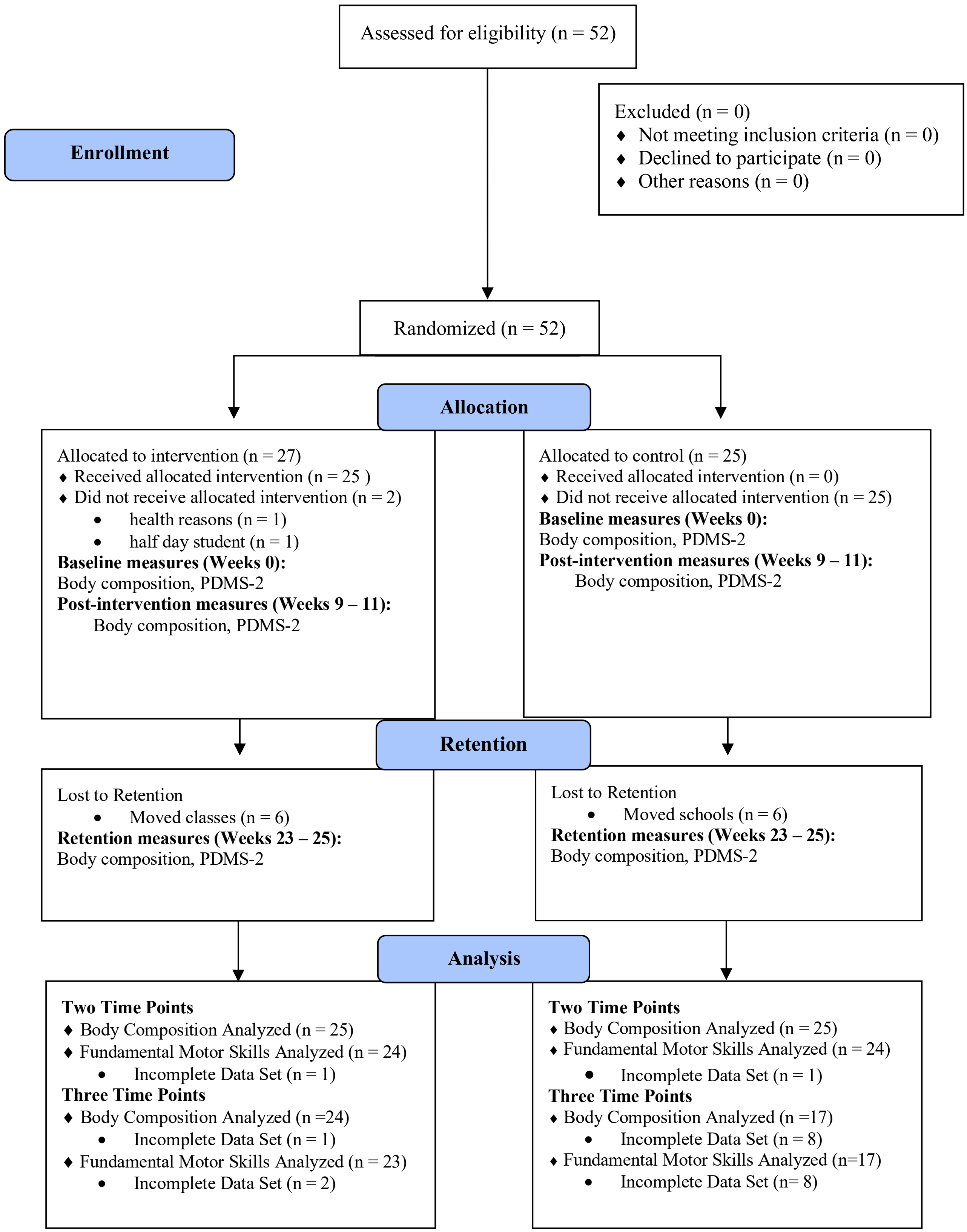


Table 5 *Study Timeline and Teacher Responsibilities*

Time	Weeks	Measures	Intervention *Inside*	Intervention *Outside*	Control *Inside*	Control *Outside*
Baseline	0	Height, Weight, Body composition, PDMS-2	Continue with the typical schedule			
Intervention	1 – 2	Intervention only	Implemented *Munch & Move* active play	Observed researchers implementing outside activities aimed at improving locomotor and object manipulation skills	Continue with the typical schedule.	
	3 – 4			Implemented outside activities with researcher assistance		
	5 – 8			Implemented outside activities		
Post-intervention	9 – 11	Height, Weight, Body composition, PDMS-2	Encouraged to continue implementing active play activities		Continue with the typical schedule	
Thanksgiving Break	12		NO SCHOOL			
End of Fall Semester	13 - 15		Encouraged to continue implementing active play activities		Continue with the typical schedule	
Winter Break	16 - 18		NO SCHOOL			
Spring Semester	19 – 29		Encouraged to continue implementing active play activities		Continue with the typical schedule	
Retention	30 – 33	Height, Weight, Body composition, PDMS-2	Encouraged to continue implementing active play activities		Continue with the typical schedule	

Anthropometric Measures and Body Composition

Height, Weight, and BMI

Height was assessed according to standard procedure (Malina, 1995). Participants stood erect, without shoes, with heads in the Frankfort horizontal plane. A portable stadiometer was used to measure height. Body mass was assessed simultaneously with a digital scale (D.C. 430-U, Tanita Corporation. Tokyo, Japan). BMI was calculated, and obesity status was determined using age-and-gender-specific growth charts (National Center for Health Statistics, 2000).

Body Composition

Body composition was assessed by foot-to-foot bioelectrical impedance simultaneously with body mass (BIA; D.C. 430-U, Tanita Corporation. Tokyo, Japan). This scale has a recommended minimum age of 5 years; however, previous work has measured fat mass (FM), fat-free mass (FFM), and fat percentage in preschool-age children (2–5 years) using similar Tanita scales (TBF-410GS (Dooley et al., 2020) and SC-331S (Webster et al., 2021)). Measurements were conducted early in the morning following breakfast while the child was barefoot and standing upright. The foot-to-foot method of BIA is a reliable and accurate tool for the measurement of body composition in the pediatric population, with results showing strong significant correlations between BIA and dual-energy X-ray absorptiometry (DEXA) for FM (r = 0.98) and FFM (r = 0.98) (Tyrrell et al., 2001). The outcome variables included in the analysis were FM and FFM.

Fundamental Motor Skills

Fundamental motor skills were assessed with the Peabody Developmental Motor Scales, Second Edition (PDMS-2). This assessment is a norm- and criterion-referenced fine and gross motor skill test designed for children from birth through age five years and 11 months. Reliability and validity are reported in the test manual with high coefficients for content sampling (.89-.96), time sampling (.89-.94), and interrater reliability (.89-.96) (Folio & Fewell, 2000). Furthermore, content validity has been determined to be satisfactory (Folio & Fewell, 2000). Testing time of three subscales (locomotion, object manipulation, and stationarity) has been reported to take about 20-25 minutes to administer (Bellows et al., 2013). The current study took approximately two 15-minute sessions for the first author to administer the PDMS-2.

This assessment tool consists of six subsections - two fine motor assessments (grasping and visual-motor integration) and four gross motor assessments (reflexes, stationary, locomotor, and object manipulation). Testing for each child is individualized based on developmental age-based milestones for five subtests (grasping, visual-motor integration, stationary, locomotor, and object manipulation). Only the appropriate gross motor assessments for our sample were administered for this study, which includes Stationary Skills (SS), Locomotor Skills (LS), and Object Manipulation Skills (OMS). Scores for each task were scored on three levels: performed the task correctly = 2, performed tasks partially = 1, and did not execute the developmental criteria correctly = 0. The sum of points comprises the raw scores for each subscale (Folio & Fewell, 2000). The raw score ranges for each subscale are 6-60 for Stationary Skills, 6-178 for Locomotion Skills, and 6-48 for Object Manipulation Skills. Using age-appropriate tables in the testing manual (Folio & Fewell, 2000), researchers converted the raw scores to standardized scores (0-20) and summed them to determine the gross motor quartile (GMQ), which had a range of 41 – 164.

Experimental Conditions

Both schools had a scheduled 15-minute structured PA indoors and 60 minutes of outdoor free play. Conditions are detailed below

Intervention

The 8-week active play intervention consisted of two additional teacher-guided play opportunities daily. In addition to the already scheduled 15-minute structured PA, children in the intervention group participated in an additional 15-minute indoor and 15-minute outdoor teacher-guided activity. Teachers were provided a binder with *resources from Munch & Move* (Reproduced by permission, NSW Health © 2020). *Munch & Move* was a health initiative designed for professional development for early childcare teachers to promote healthy eating, active play, and fundamental motor skills (Hardy et al., 2010). A detailed explanation of the program can be found in Hardy and colleagues' (2010) evaluation, but we only utilized active play activities for this study. Each activity was designed to incorporate different fundamental motor skills associated with an animal. For example, jumping was associated with "Franky the Fox," and one of the popular games was "Can you Cross the River." This game would have children form a line behind a drawn "river," Then, the teacher would demonstrate how to jump across the "river." As children improve their jumping skills, teachers could extend the width of the "river" to increase the challenge. In addition to the animal activities, various activities could be implemented indoors, incorporating various locomotor and object manipulation skills. For example, one activity was "Move like a…". Teachers implementing this activity would set up various animal pictures throughout the room. Each child would then have a turn picking an animal; the class would move like the selected animal. For example, if Timmy selected a horse, the teacher would state, "Timmy picked a horse. Let's all gallop like a horse." Then they would demonstrate to the children how to move around the room like a horse. Activities were designed to have a short warm-up, 10 minutes of the activity, and then a cool down. During outside time, teachers were encouraged to allow children to participate in child-directed play following the active play activity. Children were encouraged to keep playing if they were interested in continuing the active play activity; however, they were allowed to interact with the playground equipment if they did not express that interest. In addition to a binder of active play examples, intervention teachers received a play equipment kit. This kit contained small equipment, such as small balls, scarves, bean bags, kick balls, polyspots, and fundamental motor skills cue books to assist teachers in implementing active play activities. The fundamental motor skill cue books provided teachers with images of children completing FMS and cues on how to encourage the proper form and technique. Teachers were also asked to implement the activities at the same time each day to encourage consistent implementation of the intervention. At the end of the intervention, teachers were encouraged to continue implementing the active play intervention in the spring semester.

Before starting the intervention, the lead author checked in with each teacher to see if they felt comfortable implementing the activities and if there were any questions. Formal teacher training took place on an individual classroom level, it lasted approximately 12 minutes for each teacher. Since there were five classes, researchers spent roughly 60 minutes to complete all formal teacher training. This training consisted of a description of the intervention, the goals of the intervention, and the fundamentals of active play. Emphasis was placed on areas of the day where the activities could be consistently implemented each day to increase habit formation. Following the training, each classroom's first author and teacher discussed implementation practices. At this time, all teachers reported feeling comfortable with implementing the inside activity but asked for assistance on the outside. Therefore, a train-the-teacher model was utilized for outside activities. Throughout the first two weeks of the intervention, teachers implemented all inside activities, and the research group implemented 15-minute researcher-led outdoor active play opportunities. During weeks 3 and 4, only the lead author was present to assist the teachers with implementing the outside activities. All teachers conducted inside and outside activities independently during the last four weeks of the 8-week intervention. At the end of each week, the first author met with lead teachers in each classroom to discuss how the implementation went that week. These discussions lasted 3-5 minutes.

Control

Classes assigned to the control condition continued with their typical schedule. Children in the control group continued participating in outdoor play and the scheduled, structured indoor PA. However, the control group did not participate in the additional teacher-guided active play opportunities, and teachers did not have access to the intervention materials until the completion of retention analyses.

Data Analysis

All data were analyzed using statistical software (SPSS; Version 28). Descriptive statistics for all variables were calculated. Two separate mixed repeated measures ANOVAs assessed changes in Body Composition and Fundamental Motor Skills. Group served as the between factor, and time (baseline, post, and retention) served as the within factor. Alpha level was set at .05 a priori.

Results

Most of the baseline sample was female (54%) and Caucasian (78%). Our racial breakdown at baseline was 10% Black, 4% Asian, and 8% Other. Despite being offered additional movement opportunities, most of the sample did not participate in extracurricular activities (42%), followed closely by those participating in the sports and fitness program (40%). Furthermore, at baseline, most of our sample was classified as a healthy weight (82%), with 10% classified as overweight/obese and 4% being underweight. Demographic results can be found in Table 2. Mean and Standard deviations for body composition, FMS, and accompanying subscales at each assessment point can be found in Table 6. FMS percentages of participants classified as below average, average, and above average at each time point can be found in Table 7. Panel charts depicting changes in means across time for dependent measures can be found in Figures 6 and 7.

Table 6 *Demographic Variables*

	Baseline		Post-intervention		Retention	
	Intervention (n = 25)	*Control (n = 25)*	*Intervention (n = 25)*	*Control (n = 25)*	*Intervention (n = 24)*	*Control (n = 18)*
Height (cm)	101.14 (± 5.88) [[98.77 – 103.52]]	99.62 (± 5.94) [[97.24 – 101.99]]	102.57 (± 5.63) [1.41 %] [[100.22 – 104.92]]	101.09 (± 6.05) [1.48 %] [[98.74 – 103.44]]	103.94 (± 6.27) [2.77 %] [[101.50 – 106.38]]	104.01 (± 5.73) [4.41 %] [[101.21 = 106.80]]
Weight (kg)	15.46 (± 1.96) [[14.59 – 16.34]]	15.89 kg (± 2.38) [[15.02 – 16.77]]	15.94 (± 2.00) [3.10 %] [[15.04 – 16.84]]	16.26 (± 2.46) [2.33 %] [[15.36 – 17.16]]	16.70 (± 2.2) [8.02 %] [[15.76 – 17.65]]	13.14 (± 7.84) [-17.31 %] [[16.20 – 18.37]]
BMI (kg/m²)	15.08 (±.88) [[14.66 – 15.50]]	15.95 (± 1.19) [[15.53 – 16.37]]	15.12 (±.99) [0.27 %] [[14.70 – 15.54]]	15.84 (± 1.10) [-0.69 %] [[15.42 – 16.37]]	15.43(± 1.24) [2.32 %] [[14.96 – 15.91]]	15.92 (± 1.08) [-0.19 %] [[15.38 – 16.46]]
BMI%	37.12 (± 23.46 %) [[26.41 – 47.83]]	53.56 (± 29.48 %) [[42.85 – 64.27]]	39.04 (± 24.99) [5.17 %] [[27.99 – 50.08]]	53.24 (± 29.72) [-0.60 %] [[42.20 – 64.28]]	47.14 (± 28.42) [26.99 %] [[36.10 – 58.22]]	58.10 (± 25.99) [8.48 %] [[45.42 – 70.79]]
F%	19.36 (± 4.5 %) [[17.84 – 20.88]]	21.64 (± 2.85 %) [[20.12 – 23.16]]	20.06 (± 3.22) [3.62 %] [[18.88 – 21.25]]	21.17 (± 2.64) [-2.17 %] [[19.99 – 22.36]]	20.94 (± 3.31) [8.16 %] [[19.78 – 22.11]]	21.67 (± 2.21) [0.14 %] [[20.34 – 23.01]]
FM (kg)	3.03 (± .92) [[2.66 – 3.39]]	3.50 (± .91) [[3.13 – 3.87]]	3.21 (± .76) [5.94 %] [[2.88 – 3.54]]	3.47 (± .87) [-0.86 %] [[3.15 – 3.80]]	3.51 (± .89) [15.84 %] [[3.14 – 3.87]]	3.74 (± .86) [6.86 %] [[3.32 – 4.16]]
FFM (kg)	12.44 (± 1.37) [[11.84 – 13.04]]	12.40 (± 1.60) [[11.80 = 12.99]]	12.72 (± 1.51) [2.25 %] [[12.09 – 13.38]]	12.78 (± 1.70) [3.06 %] [[12.13 – 13.43]]	13.19 (± 1.65) [8.52 %] [[12.50 – 13.88]]	13.44 (± 1.73) [8.39 %] [[12.64 – 14.24]]
	Intervention (n = 24)	*Control (n = 24)*	*Intervention (n = 24)*	*Control (n = 24)*	*Intervention (n = 23)*	*Control (n = 17)*
SS	48.96 (± 5.90) [[46.51 – 51.32]]	48.00 (± 5.8) [[45.60 – 50.40]]	53.04 (± 4.27) [8.33 %] [[51.56 – 55.11]]	50.40 (± 4.48) [5.00 %] [[48.72 – 52.28]]	54.52 (± 3.37) [11.36 %] [[53.20 – 55.85]]	53.59 (± 2.79) [11.65 %] [[52.05 – 55.13]]
LS	152.63 (± 16.28) [[141.36 – 163.89]]	137.71 (± 35.19) [[126.44 – 148.97]]	160.68 (± 17.77) [5.27 %] [[155.28 – 169.06]]	154.12 (± 18.06) [11.92 %] [[148.97 – 162.29]]	162.30 (± 15.63) [6.34 %] [[154.05 – 170.56]]	154.18 (± 23.93) [11.96 %] [[144.57 – 164.63]]
OMS	34.67 (± 6.48) [[31.97 – 37.37]]	34.67 (± 6.66) [[31.97 – 37.37]]	39.28 (± 4.63) [13.30 %] [[37.40 – 41.52]]	36.92 (± 5.40) [6.49 %] [[35.10 – 39.23]]	39.13 (± 4.91) [12.86 %] [[37.19 – 41.07]]	39.22 (± 4.54) [13.12 %] [[37.10 – 41.61]]
GMQ	95.75 (± 12.28) [[90.99 – 100.51]]	98.71 (± 10.87) [[93.95 – 103.47]]	106.04 (± 9.41) [10.75 %] [[101.86 – 110.23]]	104. 93 (± 23.36) [6.30 %] [[100.40 = 108.77]]	100.70 (± 8.33) [5.17 %] [[96.85 – 104.54]]	101.00 (± 10.10) [2.34 %] [[96.53 – 105.48]]

Notes: Mean (S.D.) [% Change from baseline], [[95% Confidence Interval]], Stationary Skills (SS), Locomotor Skills (LS), and Object Manipulation Skills (OMS) are the mean of raw scores, which are then used to calculate Gross Motor Quartile (GMQ). There is no unit of measure for these four items. FMS Classifications

		Baseline		Post-intervention		Retention	
		Intervention	*Control*	*Intervention*	*Control*	*Intervention*	*Control*
	Below Average	29.2 %	16.7 %	-	8.3 %	-	-
SS	***Average***	45.2 %	66.7 %	70.8 %	70.8 %	88.3 %	66.7 %
	Above Average	16.7 %	16.7 %	29.2 %	20.8 %	16.7 %	33.3 %
	Below Average	20.8 %	8.3 %	8.3 %	8.3 %	16.7 %	11.1 %
LS	***Average***	70.8 %	87.5 %	50.0 %	70.8 %	62.5 %	83.3 %
	Above Average	8.3 %	4.2 %	41.7 %	20.3 %	20.8 %	5.6 %
	Below Average	41.7 %	25.0 %	4.2 %	12.5 %	20.8 %	16.7 %
OMS	***Average***	54.2 %	66.6 %	87.5 %	79.2 %	75.0 %	77.8 %
	Above Average	4.2 %	8.3 %	8.3 %	8.3 %	4.2 %	5.5 %
	Below Average	25.0 %	12.5 %	8.3 %	8.3 %	8.3 %	11.1 %
GMQ	***Average***	62.5 %	70.8 %	58.3 %	54.2 %	70.8 %	72.2 %
	Above Average	12.5 %	16.7 %	33.3 %	37.5 %	20.8 %	16.7 %

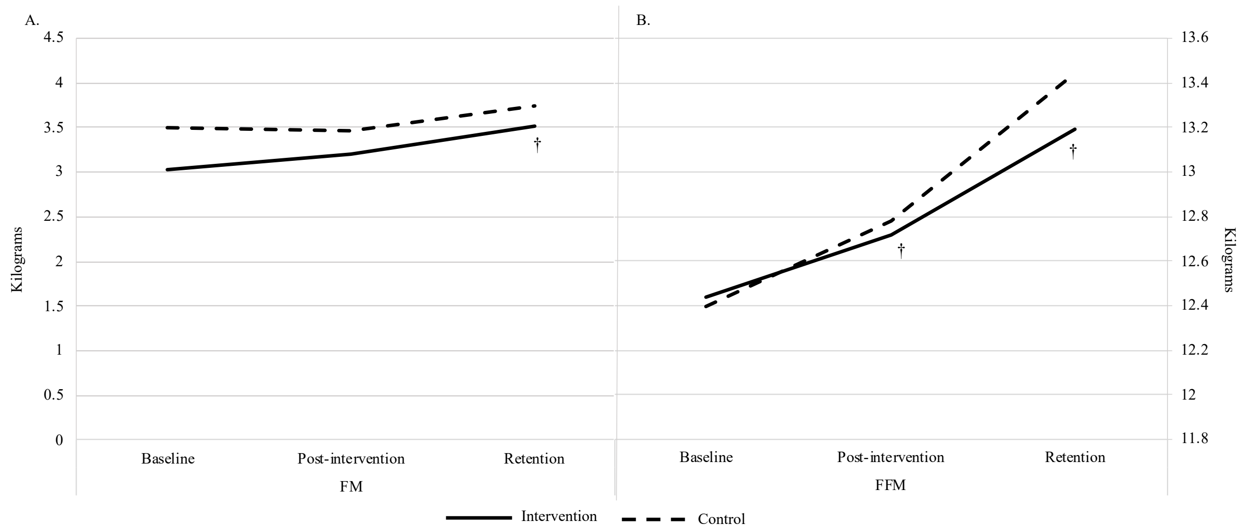
Notes: Mean (S.D.), Stationary Skills (SS), Locomotor Skills (LS), and Object Manipulation Skills (OMS) are the mean of raw scores, which are then used to calculate Gross Motor Quartile (GMQ). There is no unit of measure for these four items.

Body Composition

The first mixed ANOVA, which included two-time points (baseline, post-intervention) and two groups (intervention (n=25), control (n=25)) met the homogeneity of variance ($p > .05$) and homogeneity of covariance ($p = .017$) assumptions. Because there were only two-time points, Mulchy's test was not needed. Results indicated no significant interactions or group differences; however, there was a significant time effect for FFM (F (1,48) = 22.447, $p < .001$, $\eta_p^2 = .319$), showing significant increases across time for both groups. From baseline to post-intervention, the intervention group saw a 2.25% increase in FFM, and the control group saw a 3.06% increase in FFM.

The second mixed ANOVA included three-time points (baseline, post-intervention, retention) and two groups (intervention (n=24), control (n=17)). According to Levene's test, the variance was homogeneous ($p > .05$). Additionally, there was homogeneity of covariance ($p = .003$). According to Mulchy's test of sphericity, both FM (χ^2 (2) = .772, $p = .006$) and FFM (χ^2 (2) = .786, $p = .009$), there were violations in sphericity. In order to account for this, Greenhouse-Geisser correction was utilized. There were no significant interactions or group differences. There was a significant time effect for FM (F (1.626,63.432) = 15.048, $p < .001$, $\eta_p^2 = .278$) and FFM (F (1,640, 63.962) = 68.531, $p < .001$, $\eta_p^2 = .637$). From baseline to retention, both groups saw increases in FM and FFM. The intervention group saw a 15.84% increase in FM and an 8.52% increase in FFM. In comparison, the control group saw a 13.12% increase in FM and a 2.34% increase in FFM.

Figure 6. Mean Changes in Body Composition



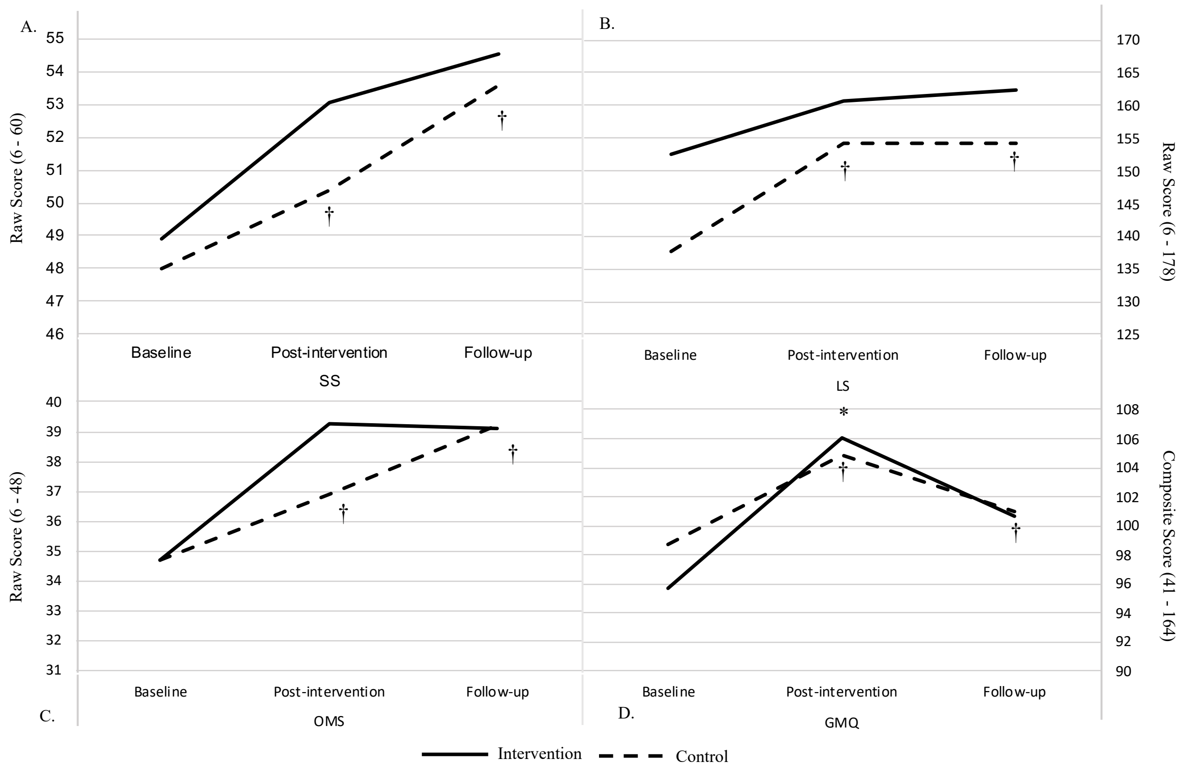
Notes. † Significant effect of time.

Fundamental Motor Skills

The first mixed ANOVA included two-time points (baseline, post-intervention) and two groups (intervention (n=24) and control (n=24)). This analysis did not violate the assumption of homogeneity of variance ($p > .05$), and Mulchy's test of sphericity was not needed; however, there was no homogeneity of covariance according to Box's M test ($p < .001$). There was a significant interaction effect for GMQ (F (1,46) = 5.037, $p = .030$, $\eta_p^2 = .099$); indicating that the 8-week intervention was successful at improving total gross motor skills. Additionally, there were significant increases in SS (F (1,46) = 40.890, p < .001, $\eta_p^2 = .471$), LS (F (1,46) = 18.994, $p < .001$, $\eta_p^2 = .292$), OMS (F (1,46) = 33.736, $p <.001$, $\eta_p^2 = .423$), and GMQ (F (1,46) = 67.493, $p < .001$, $\eta_p^2 = .595$) from baseline to post-intervention for both groups. The results did not indicate any significant group differences. From baseline to post-intervention, both groups saw increases in FMS. The intervention group saw an 8.33% increase in SS, a 5.27% increase in LS, a 13.30% increase in OMS, and a 10.75% increase in GMQ. The control group saw a 5.0% increase in SS, an 11.92% increase in LS, a 6.49% increase in OMS, and a 6.30% increase in GMQ.

The second analysis included three-time points (baseline, post-intervention, and retention) and two groups (intervention (n=23) and control (n=17). The assumption of homogeneity of variance was met ($p > .05$); however, there was a violation of homogeneity of covariance ($p < .001$). Additionally, the assumption of sphericity was violated for Stationary skills (χ^2 (2) =.768, p = .008) and locomotor skills (χ^2 (2) = .507, p < .001). Thus, a Greenhouse-Geisser correction was used. Results did not indicate any significant interactions or group differences. There were significant increases in SS (F (1.624, 61.713) = 46.706, $p < .001$, η_p^2 = .551), LS (F (1.340,50.913) = 11.984, $p <.001$, η_p^2 = .240), OMS (F (2,74) = 25.353, $p < .001$, η_p^2 = .400), and GMQ (F (2,74) = 23.747, $p <.001$, η_p^2 = .385) for both groups. The intervention group saw an 11.36% increase in SS, a 6.34% increase in LS, an 12.86% increase in OMS, and a 5.17% increase in GMQ. The control group saw an 11.65% increase in SS, an 11.96% increase in LS, an 13.12% increase in OMS, and a 2.34% increase in GMQ.

Figure 7. Mean Changes in Fundamental Motor Skills



Notes: † significant effect of time. * Significant interaction.

Discussion

This study aimed to examine the effects of an 8-week teacher-guided active play intervention on body composition and motor skill scores in preschoolers attending two private preschool centers in the southeastern region of the United States. Fundamental motor skills, specifically GMQ, showed a significant interaction effect from baseline to post-intervention, suggesting an 8-week active play intervention successfully improved FMS. The results of this study also indicated significant changes in body composition across the 33 weeks, regardless of group assignment.

This study indicated that the active play intervention improved FMS acutely. These findings support the results of Hardy et al. (2010), who found that the *Munch & Move* health intuitive improved fundamental motor skills across four months in children aged 3-5. Hardy et al. (2010) evaluated the effectiveness of the *Munch & Move* health intuitive in 28 Australian preschoolers. Hardy et al. (2010) was a randomized control trial that required intervention school staff to attend a full-day professional development workshop. Hardy and colleagues provided preschools with a manual and a small grant for support staff attending training or purchasing equipment, in addition, to contact a local health promotion professional to support the program delivery. At the completion of four months, Hardy et al. (2010) found that the intervention significantly improved locomotor, object control, and total FMS, as opposed to the current study, which only found the intervention significantly improved GMQ across eight weeks. Some possible explanations for these differences are the length of study and differences in assessment tools. We utilized the PDMS-2, whereas Hardy et al. (2010) utilized the Test of Gross Motor Development – 2. Despite these differences, our 8-week active play intervention was successful at improving GMQ acutely with only 10 minutes of formal training for each teacher and limited support. The overall trend indicates active play interventions can improve fundamental motor skills (Adamo et al., 2016; Roach & Keats, 2018).

To date, few active play interventions have examined the effects on body composition in preschoolers. We could only identify one other study which measured these outcomes. Goldfield et al. (2016) found that a 6-month active play intervention was effective at decreasing body fat percentage and FM in the intervention group; however, there were no significant differences between groups for FFM, BMI, or z-BMI. The current study did not find any group-by-time interactions; however, we did find there were significant changes in body composition over time.

Wadsworth et al. (2022) found that an FMS intervention might effectively reduce the risk of increasing FM in low-income preschoolers . Nonetheless, the current active play intervention did not show similar results. The difference in the intervention's length or total dose may be a factor (Goldfield et al., 2016; Wadsworth et al., 2022). Our study was only implemented for eight weeks instead of six months (Goldfield et al., 2016) or nine months (Wadsworth et al., 2022). It is possible that the timing of our intervention did not allow enough time to observe any physiological differences in body composition. Regardless, research indicates that childhood obesity is a public health crisis, with one in three children aged 2-5 years classified as obese (Skinner et al., 2018). Moreover, Lagstrom and colleagues (2008) found that weight gain at 2-3 years predicted weight status at 13 years. Ultimately, the changes in body composition in preschoolers are still not fully understood, and more research is needed. Future research would benefit from observing the changes in body composition across the school year. Furthermore, it would be beneficial to look at relationships between body composition and FMS as current literature indicates FMS might be deficit in obese children (Cliff et al., 2012).

One explanation for the results in the current study could be that, on average active play opportunities were offered 56% indoors and 65% outdoors across all the classrooms. Teachers in the four-year-old classroom consistently implemented the intervention (71.9%) compared to teachers in the three-year-old classroom (37.0%). Anecdotally, researchers noted that there was a big push to focus on academic material at the preschool centers during the intervention. Several teachers cited this as the reason for not fully implementing the intervention. Preschool teachers often share these views as they continue to have increased academic demands (Logue & Harvey, 2009). In the future, it would be vital for researchers and educators to work together on interventions that might be less burdensome by incorporating play and fundamental motor skills into the curriculum. Moreover, most of the sample was classified as healthy weight (intervention = 92%, control = 80%), 66.65 % of the sample was classified as average, and 14.6 % was classified as above average for baseline GMQ. While having children classified as healthy weight or competent in motor skills is a global goal, these baseline values could impact the study results. Future research would benefit from reproducing this intervention in more at-risk preschools to determine if this intervention is appropriate and successful for all preschoolers.

Limitations

While this study aimed to fill in the current literature gaps, it has limitations. One limitation of this study is that BIA measurements took place after breakfast. Few studies have measured BIA in children. However, adult guidelines stipulate that individuals should be 4-8 hours fasted (Kyle et al., 2004; National Institutes of Health, 1996). Deurenberg et al. (1988) determined that measuring BIA 2-4 hours after a meal overestimates FFM. While it is acceptable to follow these guidelines with children, there is an ethical question of preventing a child from eating when you are unsure of their last meal (Brantlov et al., 2017). While we acknowledge that it is a limitation to measure following a meal, we measured within an hour of eating.

Furthermore, all BIA measurements occurred following breakfast at baseline, post-intervention, and retention, thus attempting to control for any variability. Another limitation of this study is that some of our analyses violated the tests' assumptions. These violations limit our generalizability, interpretations, power, and ability to detect group differences. Finally, the current study failed to measure home environment impacts, such as extracurricular activities, diet, or sleep. While these factors are outside the scope of the current study, we acknowledge that they can impact our measures.

Conclusions

Eight-week active play intervention utilizing *Munch & Move* did significantly improve GMQ. Future studies would benefit from observing the changes in body composition, FMS, and PA throughout the year, as little is understood about these relationships in early childhood. It would benefit researchers, educators, and policymakers to develop a curriculum incorporating active play to reinforce fundamental motor skills and learning objectives.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD REQUEST for MODIFICATION

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

In MS Word, click in the white boxes and type your text; double-click checkboxes to check/uncheck.

- **Federal regulations require IRB approval before implementing proposed changes.**
- **Change means any change, in content or form, to the protocol, consent form, or any supportive materials (such as the Investigator's Brochure, questionnaires, surveys, advertisements, etc.). See Item 4 for more examples.**
- **Form must be populated using Adobe Acrobat / Pro 9 or greater standalone program (do not fill out in browser).). Handwritten forms will not be accepted.**

1. Today's Date	05/03/2021

2. Principal Investigator Name (PI):			
Principal Inves. (title):	Dr. Danielle Wadsworth	**Faculty PI (if PI is a student):**	
Department:	KINE	**Department:**	
Phone:	334-844-1836	**Phone:**	
AU E-mail:	wadswdd	**AU E-mail:**	
Contact person who should receive copies of IRB correspondence (Optional)			
Name:		**Department Head:**	Mary Rudisill
Phone:			
AU E-mail:			

3. AU IRB Protocol Identification			
3.a. Protocol Number	10-217 MR 1009		
3.b. Protocol Title	The influence of a planned movement and physical activity program on the physiological and psychology parameters in a pediatric population		
3.c. Current Status of Protocol—For active studies, check ONE box at left; provide numbers and dates where applicable			
	Study has not yet begun; no data has been entered collected		
	In progress If YES, number entered **Adverse events since last review**		
X	**Data analysis only**	**Approval Dates:**	From9/7/2020 To 9/7/2021
Funding Agency and Grant Number:		**AU Funding Information:**	

4. Types of Change

Mark all that apply, and describe the changes in item 5

X	**Change Key Personnel** Attach CITI forms for new personnel.
X	**Additional Sites or Change in Sites, including AU classrooms, etc.** Attach permission forms for new sites.
☐	**Change in methods for data storage/protection or location of data/consent documents**
☐	**Change in project purpose or project questions**
☐	**Change in population or recruitment** Attach new or revised recruitment materials as needed; both highlighted version & clean copy for IRB approval stamp
X	**Change in study procedures** Attach new or revised consent documents as needed; both highlighted version & clean copy for IRB approval stamp
X	**Change in data collection instruments/forms (surveys, data collection forms)** Attach new forms as needed; both highlighted version & clean copy for IRB approval stamp
☐	**Other** (BUAs, DUAs, etc.) Indicate the type of change in the space below, and provide details in Item 5.c. or 5.d. as applicable. Include a copy of all affected documents, with revisions highlighted as applicable. ▶

The Auburn University Institutional Review Board has approved this Document for use from 05/23/2021 to 09/06/2021
Protocol # 10-217 MR 1009

5. Description and Rationale

5.a. For each item marked in Question #4 describe the requested changes to your research protocol, with an explanation and/or rationale for each.
Additional pages may be attached if needed to provide a complete response.

- Both Ali Carroll and Katherine Spring are graduate students added to the study. CITI trainings are included.
- For this cohort we are working with Growing Room preschool centers in Opelika and Auburn. Letter of support is attached.
- Originally, this study trained teachers on how to incorporate physical activity breaks throughout the day. Our program has expanded to provide teachers supports to incorporate physical activity throughout the day through planned and structured physical activity and active play indoors and

The Auburn University Institutional Review Board has approved this Document for use from 05/23/2021 to 09/06/2021
Protocol # 10-217 MR 1009

April 23, 2021

To Whom it May Concern,

We are excited to collaborate with the School of Kinesiology and Dr. Wadsworth on promoting physical activity behaviors in our children at Growing Room. This collaboration will foster teachers' ability to incorporate physical activity practices throughout the day.

Parental consent forms will be sent home in weekly folders and/or registration packets. Children who provide parental consent and assent will be measured for fundamental motor skills, physical activity, body composition, executive function, and time on task. Teachers will also be asked to participate in orientation sessions and interviews to help foster physical activity practices. Dr. Wadsworth and her team will wear masks, as is the current COVID guidelines and limit classroom contact to 15 minutes. We will notify Dr. Wadsworth if these guidelines changes as these are fluid and may change with state mandates.

We are excited for this endeavor and look forward to fostering physical activity at Growing Room!

Sincerely,

APPENDIX B

INFORMED CONSENT

AUBURN UNIVERSITY
COLLEGE OF EDUCATION

Informed Parental Consent for a Research Study entitled:
"The influence of a planned movement and physical activity program on the physiological and psychology parameters in apediatric population."

Project Overview

Your child is invited to participate in a research study examining the effects of a planned movement program on physical activity, bodycomposition, fundamental motor skills, executive function, and time on-task. Your child was selected as a possible participant because they attend Growing Room preschool, and we are collaborating with Growing Room on this project. Since your child is aged 18 or younger, we must have your permission to include them in the study.

Details of the study are contained below:

General Information	Your child is invited to participate in a research study examining the effects of a planned movement program on physical activity, body composition, fundamental motor skills, executive achievement, and time on-task. The study will collect data on these parameters while your child is at preschool over the course of the school year.
Purpose	The purpose of this project is to determine the effects of a planned movement program on physical activity, body composition, fundamental motor skills, executive function, and time on-task.
Duration & Visits	We will assess body composition, executive function and fundamental motor skills at the beginning, middle and end of the school year. Estimated time for all three tests is 45 minutes and will occur at the preschool at the teacher's convenience. Physical Activity will be assessed throughout the school year with a wrist worn wearable device that looks like a watch. This device will be attached at the preschool and participants may wear the watch at home. This watch will be worn four times over the school year for a week at a time. Time on-task will be measured by observing your child in their classroom. This will occur at the same time your child is wearing the physical activity monitor.
Overview of Procedures	We are working with preschool teachers to include physical activity opportunities for children throughout the day. This will include physical activity breaks, movement integration during indoor instruction, structured outdoor physical activity, and physical activity transition breaks. Prior to the implementation of the movement program, we will assess body composition, executive function, and fundamental motor skills. We will also assess these measures at the middle and end of the school year. We will assess physical activity and time on-task throughout the year. Due to COVID precautions, all research staff will wear a mask while at the preschool and not have contact with your child for more than 15 minutes each time.
Risks	Risk of confidentiality breach. Risk of COVID-19.

Benefits	Your preschool center will receive a copy of the information that demonstrates the effectiveness and/or benefits of the program. This information will not have specific information about your child. In addition, each classroom will receive physical activity equipment to be used in the program. There is no cost to participate in the program and your child will not receive any incentive to participate.
Alternatives	The alternative is to not participate in this study. Please note that if you choose not to participate, your child will still participate in the movement program, we will just not collect data on your child.

Purpose

The purpose of this research study is to examine the effects of a planned movement program on physical activity, body composition, fundamental motor skills, executive achievement, and time on-task.

Eligibility

The Auburn University Institutional Review Board has approved this Document for use from ___05/23/2021_________to___09/06/2021__

To be eligible, your child must be:

1. Attend and be enrolled growing room preschool.

Your child must meet all requirements to be eligible for participation in this study.

Page 1 of 3 **Initials________**

What will be involved if your child participates? Total estimated time for this study is 3 hours over the course of the school year.

Baseline Testing (August) and Post-testing (April) – 45 minutes in August, 45 minutes in December and 45 minutes in April for a total time of 135 minutes. Testing will be broken up into 15 minutes increments or less.

Your child will be assessed for the following measurements:

1. <u>**Descriptive Information**</u> will include ***height, weight, sex, race,*** and ***date of birth.*** Height will be measured using astandard standiometer and weight will be measured with a standardized scale. Your child will step on a scale facingforward in socks or barefoot and will be measured for height to the nearest centimeter and weight to the nearest tenthof a pound. Your child will not be told their weight or height and will not be able to see their height or weight. We will ask for your child's date of birth, sex, and race at the end of this form. This information is used to program the physical activity monitor. It takes 5 minutes to complete each child's height and weight measurement.
2. <u>**Fundamental Motor Skills**</u> information will be collected using the ***Peabody Developmental Motor Scales 2nd Edition (PDMS-2)***. The test will examine your child's ability to crawl, walk, run, hop, catch, throw, and kick. Additionally, the test will measure your child's ability to complete tasks such as reaching and grasping, building with blocks, and copying designs. The PDMS-2 takes about 15 minutes to complete.
3. <u>**Executive Function**</u> information will be collected using the ***Head Toe Knees Shoulders Task***. This task requires inhibitory control, attention, and working memory. Your child will be asked to play a game where they must do the opposite of what the researcher

says. For example, if the researcher tells you child to touch their head, your child is expected to do the opposite and touch their toes. This test takes approximately 10 minutes.

4. **Body Composition** will be assessed with a foot-to-foot bioelectrical impedance scale. This scale determines how much of your child's weight is fat and/or muscle mass. Your child will step onto the scale barefoot and asked to stand as still as possible for 15 seconds. The scale will then calculate your child's body composition. Your child will not be told their body composition and will not be able to see their numbers. Research staff will assist your child with taking off and putting on socks and shoes.

Physical Activity and Time spent on-task will be assessed throughout the year (August, November, February, April).

1. **Physical Activity** will be assessed with a wrist worn accelerometer. An accelerometer measures how your child moves through space and is an objective measure of physical activity. The device is small and looks like a child's watch. Research staff will attachthe device on your child at the preschool and your child will wear the device for five days, four times over the course of the year. You will not have to charge the watch and your child can wear the watch while bathing.
2. **Time Spent On-Task** information will be collected by an independent observer and record the amount of time your child spends on-task (i.e. following directions or engaging in a task) or off-task (i.e. not following directions). This assessment is conducted by observing your child during preschool hours and recording the frequency of their behaviors.

Potential Risks.

1. There are no foreseeable risks or discomforts associated with these assessments or participating in the movement program.
2. Since we will be using human subjects and will not be collecting data anonymously, breach of confidentiality is always a risk.
3. Exposure to COVID-19.

"Note" Although injuries are not anticipated in this protocol, it is important for you to acknowledge that the investigators have no plans forcompensation in the event of an injury you experience.

Precautions

1. If your child requests to stop any assessments or does not want to participate they can do so.
2. Even though data will not be collected anonymously, it will be recorded anonymously, with the code list linking the participants keptconfidential in a locked filing cabinet until the end of the study when it will be destroyed. We will only provide aggregate data to thepreschool in terms of program effectiveness. Meaning, we will show how the program was effective in the proposed outcomes (bodycomposition, physical activity, time on-task and executive function) but we will show data as class aggregates.
3. Because we will meet in person there is a risk that your child may be exposed to COVID-19 and the possibility that they may contract the virus. For most people, COVID-19 causes only mild or moderate symptoms. For some, especially older adults and people with existing health problems, it can cause more severe illness. Current information suggests that about 1-3% of people who are infected with COVID-19 might die as a result. You will need to review the information on COVID-19 for Research Participants that is attachedto this consent document. To minimize your risk of exposure we will wear a mask while at the

preschool and limit our contact with your child to no longer than 15 minutes at a time. In addition, all research staff will screen themselves by Auburn University's health check and only report to the preschool if they receive an "all clear green" screen.

Initials________

Benefits:

Your preschool center will receive a copy of the information that demonstrates the effectiveness and/or benefits of the program. This information will not have specific information about your child. In addition, each classroom will receive physical activity equipment to be used in the program. There is no cost to participate in the program and your child will not receive any incentive to participate.

Your participation is completely voluntary. If you or your child changes their mind about participating, you can withdraw at any time during the study. If you choose to withdraw, you can request to have your data withdrawn. Your decision about whether or not to participate or stop participating will not jeopardize your future relations with Auburn University, the School of Kinesiology, or theExercise Adherence and Obesity Lab. Please note that if you decide to not participate your child will still participate in the movementprogram, but we will not collect data on your child.

Your privacy will be protected. Any information obtained in connection with this study will be maintained confidentially. This informationmay be published or presented at a professional meeting, but data will be presented in aggregate and your child's data cannot be identified.

If you have questions about this study, please ask them now or contact Danielle Wadsworth at wadswdd@auburn.edu. 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 INTHIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

Parent's signature	Printed Name	Date
Child's Name	Child's Date of Birth	Child's Sex
Child's Race		
Investigator obtaining consent	Printed Name	Date

The Auburn University Institutional Review Board has approved this Document for use from ___05/23/2021__________to___09/06/2021__________

Protocol # ___10-217_______MR__1009____

Information on COVID-19 For Research Participants (updated 05/27/2021)

Auburn University recognizes the essential role of research participants in the advancement of science and innovation for our university, community, state, nation, and beyond. Therefore, protection of those who volunteer to participate inAuburn University research is of utmost importance to our institution.

As you are likely aware, COVID-19 references the Coronavirus that is being spread around the world including in our country, state, and community. It is important that we provide you with basic information about COVID-19 and the risksassociated with the virus so that you can determine if you wish to participate or continue your participation in human research.

How is COVID-19 spread? COVID-19 is a respiratory virus that is spread by respiratory droplets, mainly from person-toperson. This can happen between people who are in close contact with one another. COVID-19 may also be spread byexposure to the virus in small droplets that can linger in the air. This kind of spread is referred to as airborne transmission. It is also possible that a person can get COVID-19 by touching a surface or object (such as a doorknob or counter surface) that has the virus on it, then touching their mouth, nose, or eyes.

Please visit the CDC's web page for more information on how COVID-19 spreads.

Can COVID-19 be prevented? Although there is no guarantee that infection from COVID-19 can be prevented, there areways to minimize the risk of exposure to the virus. For instance, stay 6 feet apart from others who don't live with you; get a COVID-19 vaccine when it is available to you; avoid crowds and poorly ventilated indoor spaces; use effective barriers between persons; wear personal protective equipment like masks, gloves, etc.; wash hands with soap and wateror use hand sanitizer after touching objects; disinfect objects touched by multiple individuals.

What are the risks of COVID-19? For most people, COVID-19 causes only mild or moderate symptoms, such as fever andcough. For some, especially older adults and people with existing health problems, it can cause more severe illness.
While everyone is still learning about this virus, current information suggests that about 1-3% of people who are infected with COVID-19 might die as a result.

Who is most at risk? Individuals over age 65 and those with chronic conditions such as cancer, diabetes, heart or lung orliver disease, severe obesity, and conditions that cause a person to be immunocompromised have the highest rate of severe disease and serious complications from infection.

What precautions should be taken? Based on the proposed research, precautions for the risk of COVID-19 will be addressed on a project by project basis. You will be provided with information about precautions for the project in which you may participate. Any site where research activities will occur that are not a part of Auburn University (offsitelocation) are expected to have standard procedures for addressing the risk of COVID-19. It is important for participantsto follow any precautions or procedures outlined by Auburn University and, when applicable, offsite locations. Further,participants will need to determine how best to address the risk of COVID-19 when traveling to and from research locations. The US Center for Disease Control and Prevention has issued recommendations on types of prevention measures you can use to reduce your risk of exposure and the spread of COVID-19.

Auburn University is continuing to monitor the latest information on COVID-19 to protect our students, employees, visitors, and community. Our research study teams will update participants as appropriate. *If you have specific questions or concerns about COVID-19 or your participation in research, please talk with your study team.* The name andcontact information for the study team leader, along with contact information for the Auburn University Institutional Review Board for Protection of Human Research Participants, can be found in the consent document provided to you bythe study team.

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APPENDIX C

IMPLEMENTATION FIDELITY

Weekly Checklists

Please indicate which activities you completed indoors and outdoors:

Date:	Indoors	Outdoors
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		

Overall please indicate how difficulty implementing the above activities was for you over the past week:

Monday:_ ____
Tuesday:_ ____
Wednesday: ____
Thursday: ____
Friday: ____

And outdoors:

Monday:_ ____
Tuesday:_ ____
Wednesday: ____
Thursday: ____
Friday: ____

Informal Interview Questions

1. (If teachers mark medium or hard for Implementation) I see you noted some difficulty implementing the activities, is there anything that would help make this process easier?
2. Are there any upcoming themes or events that you would like me to help plan play opportunities for?

APPENDIX D

SAMPLE SCHEDULE

K3A Daily Schedule

6:30am - 8:30am	Center Opens Children wash hands upon entering the classroom. Child Selected Opportunities: Class Library, Table Toys, Learning Centers Breakfast Served
8:30am - 8:35am	Wash hands,
Clean up Time 8:35am - 8:40am	"Boo Boo" Health Checks
8:40am - 8:45am	"Let's Get Moving" Gross Motor Activity
8:45am - 9:05am	Circle Time: Welcome Song, Pledge of Allegiance Review: Calendar, Today's Weather, Days of the Week, Counting Activity, Color Activity, Sign Language Review Weekly "Growing Up On Our Block" Components: Theme, Color, Number, Letter, Concept Character Education Activity Story Time and Class Talk about the concepts of print which includes: how to open a book, where to start reading, left to right progression, use of capital letters, author, illustrator, letters in words, words in sentences, and sentence structure.
9:05am -10:00am	Clean Up (sanitize all equipment used) Wash Hands, Prepare for Small Group Time • A Beka Work Time • Activity Block: Art Activity or Food Experience • Learning Center Opportunities Use Restroom, Wash Hands, Prepare for Outside Time
10:00am – 10:30am	"Healthy Me" Structured Outside Activity OR *Indoor Large Muscle Development Outdoor Play Experience OR *Indoor Large Muscle Development
11:15am – 11:30am	Wash hands and prepare for lunch Character Education Literacy Time...Big Books and
More 11:30am – 12:00pm	Family-Style Dining: Lunch
12:00pm – 2:00pm	Nap Time (Quiet Listening Music)
2:00pm – 2:45pm	Wake up from nap, Wash hands for snack, and Eat snack
2:45pm – 3:00pm	Wash Hands and Prepare for Small Group Time
3:00pm – 3:45pm	Small Group Time (wash hands between activities and sanitize between use of all equipment) • Math Skills Activity • Science Activity • Learning Center Opportunities Clean Up, Wash Hands and Prepare for Outside Time

3:45pm – 4:15pm "Healthy Me" Structured Outside Activity OR *Indoor Large Muscle Development

Outdoor Play Experiences OR *Indoor Large Muscle Development

Wash Hands and Prepare for

4:15pm- 5:00pm Literacy and Language Activity/Planned Afternoon Extended Activities

5:00pm – 6:00pm Wash hands and Enjoy snack

Planned Afternoon Extended Activities

Prepare to go Home

APPENDIX E

ON-TASK RECORDING FORM

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

MINUTES 1-5

Sub.	**Interval**	**On-task**	**Off-task**			**Notes**
1	1	Yes	M	N	P/O	
	2	Yes	M	N	P/O	
m/f	3	Yes	M	N	P/O	
	4	Yes	M	N	P/O	
2	5	Yes	M	N	P/O	
	6	Yes	M	N	P/O	
m/f	7	Yes	M	N	P/O	
	8	Yes	M	N	P/O	
3	9	Yes	M	N	P/O	
	10	Yes	M	N	P/O	
m/f	11	Yes	M	N	P/O	
	12	Yes	M	N	P/O	
4	13	Yes	M	N	P/O	
	14	Yes	M	N	P/O	
m/f	15	Yes	M	N	P/O	
	16	Yes	M	N	P/O	
5	17	Yes	M	N	P/O	
	18	Yes	M	N	P/O	
m/f	19	Yes	M	N	P/O	
	20	Yes	M	N	P/O	

RETURN TO SUBJECT 1 AND CONTINUE OBSERVATION

MINUTES 6-10

Sub.	**Interval**	**On-task**	**Off-task**			**Notes**
1	1	Yes	M	N	P/O	
	2	Yes	M	N	P/O	
m/f	3	Yes	M	N	P/O	
	4	Yes	M	N	P/O	
2	5	Yes	M	N	P/O	
	6	Yes	M	N	P/O	
m/f	7	Yes	M	N	P/O	
	8	Yes	M	N	P/O	
3	9	Yes	M	N	P/O	
	10	Yes	M	N	P/O	
m/f	11	Yes	M	N	P/O	
	12	Yes	M	N	P/O	
4	13	Yes	M	N	P/O	
	14	Yes	M	N	P/O	
m/f	15	Yes	M	N	P/O	
	16	Yes	M	N	P/O	
5	17	Yes	M	N	P/O	
	18	Yes	M	N	P/O	
m/f	19	Yes	M	N	P/O	
	20	Yes	M	N	P/O	

RETURN TO SUBJECT 1 AND CONTINUE OBSERVATION

MINUTES 11-15

Sub.	Interval	On-task	Off-task			Notes
1	1	Yes	M	N	P/O	
	2	Yes	M	N	P/O	
m/f	3	Yes	M	N	P/O	
	4	Yes	M	N	P/O	
2	5	Yes	M	N	P/O	
	6	Yes	M	N	P/O	
m/f	7	Yes	M	N	P/O	
	8	Yes	M	N	P/O	
3	9	Yes	M	N	P/O	
	10	Yes	M	N	P/O	
m/f	11	Yes	M	N	P/O	
	12	Yes	M	N	P/O	
4	13	Yes	M	N	P/O	
	14	Yes	M	N	P/O	
m/f	15	Yes	M	N	P/O	
	16	Yes	M	N	P/O	
5	17	Yes	M	N	P/O	
	18	Yes	M	N	P/O	
m/f	19	Yes	M	N	P/O	
	20	Yes	M	N	P/O	

RETURN TO SUBJECT 1 AND CONTINUE OBSERVATION
OBSERVATION COMPLETE
COMPLETE SUMMARIZATION FORM

On-Task Summary Form

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

TI or MC

Date: ________________

Classroom: __________

Coder: ______________

Notes:

Reminders for coding behavior

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

Definitions

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

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

APPENDIX F

INDOOR ACTIVE PLAY EXAMPLE

Skills developed: Running, hopping, galloping (depending upon instruction)

Equipment: no equipment required

Space required: Room to make a circle and chase around the outside

What to do:

1. Organize the children to sit in a circle.
2. All children perform a movement such as clapping, stretching, or wiggling.
3. One person is chosen to walk around the circle tapping each person gently on their back.
4. As they tap a person they say "duck". The say "duck, duck" (a number of times) and then tap someone and say "goose"
5. The person who is tapped when they say "goose" becomes the chaser. They chase the other person around the circle and try to tag them.
6. The person being chased must get back to where the person who was "goose" was sitting without being tagged.
7. The activity continues until all children have had a go at being the chaser.

Make the activity harder:

- Introduce different chasing skills (hopping, skipping, galloping).

Teaching points

- Make sure the children are spaced out evenly in the activity area.
- In a small area, restrict players to walking.
- Demonstrate how to run, emphasize the leg and arm movements.

Aim to give every player a turn

APPENDIX G

OUTSIDE ACTIVE PLAY EXAMPLE

Who can Strike like Milly the Monkey?

Equipment

- Balloons
- String
- A rolled up newspaper or cardboard tube

Game Set Up

- Hang a line of string across the room or outdoor space above the height of the children
- Blow up balloons and hang each one along the string so they dangle at waist height

Activity

Who can strike the balloon?

- Slow
- With their bare hand
- Loudly
- Fast
- With a bat
- Softly

Teaching cues

1. Stand side on to the ball
2. Bring the bat back, away from the ball
3. Watch the ball with both eyes
4. Swing forward through the ball and all the way to your other shoulder
5. Make sure you twist your hips