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Influence of Classroom-Based Physical Activity Breaks on Physical Activity and On-Task Behavior in Preschool Children

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Abstract

Purpose. The purpose of this study was to determine the influence of implementing physical activity breaks on moderate-to-vigorous physical activity and on-task behavior in preschool children. Method. Children enrolled in a public, federal-subsidized childcare center (n = 9) and a private, university-based childcare center (n = 12) participated in this within-subjects study. Data were collected on two days of typical instruction and two days that included the implementation of a 10-minute physical activity break. Moderate-to-vigorous physical activity was measured with accelerometers. Children's on-task behavior was observed and recorded as on-task or off-task (motor, noise or passive/other). Results. Paired-samples *t*-tests indicated that preschoolers in each sample accumulated significantly more total morning ($p < .01$) and indoor ($p < .01$) physical activity on days that provided a physical activity break. On-task behavior increased, although not significantly, after the physical activity break. Conclusion. Initial evidence suggests that the implementation of physical activity breaks in preschool settings increases physical activity participation.

Keywords: preschoolers, physical activity, time-on-task

1. Introduction

Participation in regular physical activity is important for the health and wellness of young children. National initiatives suggest that preschool children participate in at least 60 minutes of structured physical activity every day (National Association for Sport and Physical Education, 2009). According to a recent review, only 54% of preschoolers engage in 60 minutes of daily physical activity (Tucker, 2008). In a study of over 400 children in 24 preschools, results indicated that over 80% of the day is spent in sedentary activity and only 3.3% of time is spent in moderate-to-vigorous physical activity (MVPA) as measured by direct observation (Pate et al., 2008). Physical activity behaviors are established in childhood and remain relatively consistent through adolescence and into adulthood (Kelder et al., 1994; Pate et al., 1996). Thus, it is imperative that research focus upon effective strategies to encourage young children to establish and maintain healthy patterns of physical activity.

A recent strategy to increase daily physical activity is the implementation of structured, classroom-based physical activity breaks. A typical break consists of ten to fifteen minutes of activities designed to promote MVPA.

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This strategy is effective in significantly increasing physical activity levels of school-age children (Ernst & Pangrazi, 1999; Mahar et al., 2006; Scruggs et al., 2003; Stewart et al., 2004). A specific program designed to increase physical activity in the classroom is the Take 10! program that integrates physical activity into the elementary school curriculum. In a recent review, Kibbe et al. (2011) provide consistent evidence that the Take 10! program is effective in increasing physical activity levels in children enrolled in kindergarten through fifth grade in a variety of samples in different countries. A recent case study showed that the incorporation of structured physical activity breaks increased MVPA for preschoolers and accounted for 60-90% of time spent in MVPA at preschool (Wadsworth, Robinson, Beckham & Webster, 2012). The findings emphasize the effectiveness and feasibility of providing classroom-based, structured opportunities for physical activity.

For classroom-based physical activity participation to become a priority of early childhood curriculum, it is important to provide research-based evidence that physical activity enhances academic learning. The Centers for Disease Control and Prevention (2010) reviewed studies that examined the association between classroom-based physical activity and academic performance in elementary school-age children. Results indicated that eight of nine published studies found positive effects of physical activity on outcomes such as academic achievement and classroom behavior. Donnelly & Lambourne (2011) provide further support of the link between physical activity and positive cognitive and academic outcomes in elementary school-age children. One behavioral outcome that has received empirical attention is the effect of physical activity on attention (i.e. on-task behavior) in the classroom. Studies in elementary school-age children have found an increase in on-task behavior in the classroom after participation in a physical activity break (Jarrett et al., 1998; Mahar 2011; Mahar et al., 2006). However, time on-task in relation to physical activity breaks have not been examined in preschool populations.

Thus, the primary purpose of the present study is to determine the effect of classroom-based physical activity breaks on physical activity and on-task behavior of preschool children. One factor associated with participation in physical activity is the level of motor skill competence of children. The preschool years are a critical time for gross motor skill development. Preschool children that demonstrate higher motor skill competence are the most physically active (Fisher et al., 2005; Graf et al., 2004, Robinson et al., 2012) compared to their less skilled peers. Thus, it is especially important to ensure that interventions designed to increase physical activity levels are similarly effective for all children, regardless of skill level. Therefore, the secondary purpose of this study is to determine if low and high skilled children participate similarly during the physical activity break.

2.0 Methods

2.1 Participants and setting

This study included preschool children from two early childhood centers. In Sample 1, participants included 9 African American preschoolers (4 females, 5 males, *M* age = 4.1 years) from a subsidized early childcare center located in a rural town in the southeast United States. Opportunities for daily physical activity include two, 30-minute sessions in the morning and afternoon on the playground. In Sample 2, participants included 12 preschoolers (3 females, 9 males, *M* age = 5.1 years) from a university-based early learning center located in the same town as Sample 1. The sample consisted of 6 Caucasian, 5 Asian, and 1 African American child. Opportunities for daily physical activity were identical to Sample 1. Both centers were accredited by the National Association for the Education of Young Children at the time of this study.

2.2 Classroom-based physical activity breaks

The goal of classroom-based physical activity breaks was to provide children with an opportunity to increase daily physical activity. The physical activity break lasted for 10 minutes and was implemented into the daily schedule at each preschool. The break included age-appropriate activities and did not require any equipment. A trained researcher in the area of physical activity and early childhood motor development implemented all breaks at each center. The physical activity breaks consisted of a one minute and fifteen second warm-up and cool-down activity and 7 minutes and 30 seconds of structured movement activities. Gross motor skills are defined as movements that require the activation of "…the large, force-producing muscles of the trunk, arms, and legs (Clark, 1994 p. 245). The activity breaks promoted the development of gross motor skills. The activities included bunny hops, scissor jumps, jumping jacks, up and downs, and balancing on one leg (see Table 1 for descriptions). These activities are developmentally and age-appropriate for preschool children. At the direction of the researcher, children engaged in each activity for 30 seconds before switching to the next activity. This was repeated until each activity was performed five times.

Table 1: Descriptions of each activity

Jumping Jacks	Stand with feet together and hands at side. In one action, jump and spread legs apart and your arms in a horizontal plane above your head and clap your hands.
Bunny Hops	Stand with feet together and slightly bent at the knees, hop repetitively like a bunny. If the children want, let them hold their arms and hands in front of them to imitate a bunny.
Ups & Downs	Sit on your bottom with your legs extended. Reach down with your hands and touch your toes. Sit back up, pull your knees up and quickly stand up. Reach over your head. Then quickly sit back down. Repeat.
Scissor Jumps	Stand with your legs spread apart in front of one another, like a pair of opened scissors. Jump and switch the leg position, moving the leg in the back to the front.
Balancing Act	Balance on one foot like a flamingo, then switch and balance on the other foot.

2.3 Physical activity participation

Physical activity was measured with the Actical accelerometer (Mini-Mitter Co., Inc. Bend, OR, USA). The Actical is a small (28x27x10mm) and light weight (17g) device that measures acceleration in all directions via an omnidirectional sensor and is validated for use in the preschool population (Pfeiffer et al., 2006). Each accelerometer was calibrated to each child based on height, weight, sex, and age according to manual guidelines. Children wore the accelerometers on the right hip (anterior to the iliac crest) that was secured with an elastic belt worn around the waist. The epoch length was set to 15-second intervals and is recommended for use in preschool children (Cliff et al., 2009). For Sample 1, the average wear time of accelerometers was 142.73 and 137.67 minutes, on days of typical instruction and when the physical activity breaks were provided, respectively. For Sample 2, the average wear time of accelerometers was 143.57 and 153.17 minutes, on days of typical instruction and when the physical activity breaks were provided, respectively. The average wear time for Sample 1 and 2 represent the average minutes that preschoolers at each center wore the devices. Specifically, accelerometers were placed by a researcher on the children at 8:45 a.m. or upon arrival at each center. For data analyses, all preschoolers had to be present at least 30 minutes before and after the scheduled physical activity break. The time span ensured that they were present for all phases of the study (i.e., on- and off-task observation prior to and following the physical activity break). To define intensity of physical activity, cut points were 715 counts/15 seconds for moderate and 1411 counts/15 seconds for vigorous physical activity (Pfeiffer et al., 2006). The amount of time spent in moderate and vigorous physical activity was combined for one measure of minutes spent in MVPA.

2.4 On-task behavior

Two researchers were trained to observe and classify children's behavior as on- or off-task according to an established protocol (Mahar et al., 2006). Researchers attended a two-hour training session and inter- and intra-rater reliability was established (>90%). Researchers practiced observing in each classroom one week prior to data collection. This served as an acclimation period for the researchers, teachers, and students. One researcher observed and recorded behavior immediately before and after the 10 minute time period designated for the physical activity break, regardless of whether a break was provided. This was to ensure that observation occurred during a similar time of day on all days of data collection. The researcher listened to a prerecorded mp3 audio file to follow the observation protocol. The researcher systematically observed behavior during a 10-second interval and recorded behavior during a 5-second interval. This protocol yields four observations per minute and each child was observed for four minutes. 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, motor off-task, noise off-task, or passive/other off-task

2.5 Motor assessment

Children completed the Test of Gross Motor Development-2nd edition (TGMD-2; Ulrich, 2000). The TGMD-2 assesses 12 motor skills separated into two subscales: object control (striking, throwing, catching, kicking, dribbling, and underhand rolling a ball) and locomotor skills (running, galloping, sliding, leaping, hopping, and jumping). A researcher demonstrated the proper execution of the skill and children completed one practice and two formal trials.

All trials of the TGMD-2 were videotaped and coded through video analysis. Intra-rater reliability (>90%) was established between two researchers. Each skill was evaluated on three to five performance criteria. A score of zero was given for each trial if a criterion was not performed. A score of one was given for each trial if a criterion was performed. Each subscale yielded a raw score that was converted to a standard score. The standard scores from both subscales were summed and converted to a percentile score that indicated overall performance on the TGMD-2.

2.6 Research procedures

Institutional Review Board approval, parental consent, and child assent were obtained prior to data collection. Height and weight were measured for the purpose of calibrating the accelerometers. Children were familiar with the protocol for attaching and wearing the accelerometers due to previous research at each center. Data collection occurred on Tuesdays and Thursdays over a two-week period. The present study was a within-subjects design. Children participated in both conditions (physical activity breaks; typical instruction). There were four days of formal data collection at each center. Physical activity breaks were implemented on two days. On the other two days, the preschoolers engaged in typical instruction. The order of the conditions of physical activity breaks or typical instruction were counter-balanced.

In Sample 1, the physical activity breaks and the observation protocol for on-task behavior were conducted separately for the three- (n = 5) and four-year old (n =4) classrooms. At the start of the study, children were randomly placed in an observation order. Each child was observed for one minute then the researcher rotated to the next child to determine on-task behavior. This occurred until each child had been coded for on-task behavior for a total of 4 minutes. Depending on the number of children present for any given day, observation ranged from 15-25 minutes before and after the 10 minute break period. The typical start time of the pre-break observation period was 9:21 a.m. and 10:20 a.m. for the three- and four-year old class, respectively. The typical post-break observation start time was 9:51 a.m. and 10:56 a.m. for the three- and four-year old class, respectively. No observation of children's behavior occurred during the 10 minute time period, regardless of whether a physical activity break was provided or not.

In Sample 2, the physical activity breaks and the observation protocol were conducted for the entire classroom (n = 12). At the start of the study, 8 children were randomly chosen and placed in an observation order to measure on-task behavior. Each child was observed for one minute then the researcher rotated to the next child. This occurred until each child had been coded for a total of 4 minutes. Only 8 children were selected to limit the observation period to 32 minutes. This was to ensure that children were still engaged in classroom activities during the post-observation period. The typical start time of the pre-break observation period was 9:13 a.m. The typical post-break observation period start time was 9:57 a.m. No observation of children's behavior occurred during the 10 minute time period, regardless of whether a physical activity break was provided. In both samples, the same children were observed in the same order during pre- and post- break observation periods, on every day of data collection. Teachers and children were unaware to which children were being observed at any given time.

2.7 Data-analysis

Descriptive statistics were generated for the sample and on-task behavior. There were two main physical activity outcomes. The mean number of minutes spent in MVPA for the total morning and during the 10 minute break period (i.e. indoor physical activity). Paired-samples *t*-tests were calculated for each sample to determine if significant differences existed for MVPA during the total morning and the 10 minute break. A paired samples *t*-test was calculated for all children, regardless of center attended, to determine on-task behavior during post-observation following typical instruction and participation in a physical activity break. All significance levels for the *t*-tests were adjusted to $p = .01$ (.05/5) using the Bonferonni correction factor. To determine the relationship between TGMD-2 performance and MVPA during the physical activity break, children from each sample were combined due to the small sample size at each center. This procedure is justified since each sample engaged in a similar amount of MVPA during the physical activity breaks (3.54 and 4.34 minutes for Samples 1 and 2, respectively). Since the range of percentile scores is 0 to 100, it is an ordinal variable and a Spearman's Rho correlation was calculated between each child's mean number of minutes spent in MVPA during the physical activity breaks and their TGMD-2 percentile score. All statistical procedures were conducted using the Statistical Package for the Social Sciences (SPSS version 18.0).

3. Results

3.1 Physical activity engagement

In Sample 1, children engaged in significantly more total morning (M = 4.5 min.; SD = 2.7 min.; $t(8) = -5.08$, $p = .001$) and indoor MVPA (M = 3.5min.; SD = 2.1min; $t(8) = -4.97$, $p = .001$) on days that physical activity breaks were implemented compared to days of typical instruction (total morning M =.29; SD = .43; indoor M = 0). In Sample 2, children engaged in significantly more total morning (M = 11.6 min.; SD = 4.4 min.; $t(11) = -4.73$, $p = .001$) and indoor MVPA (M = 4.3 min.; SD = 1.8 min.; $t(11) = -8.43$, $p < .001$) on days that physical activity breaks were implemented compared to days of typical instruction (total morning M = 6.5; SD = 2.8; indoor M = .06; SD = .18). See Figure 1 for a graphical representation.

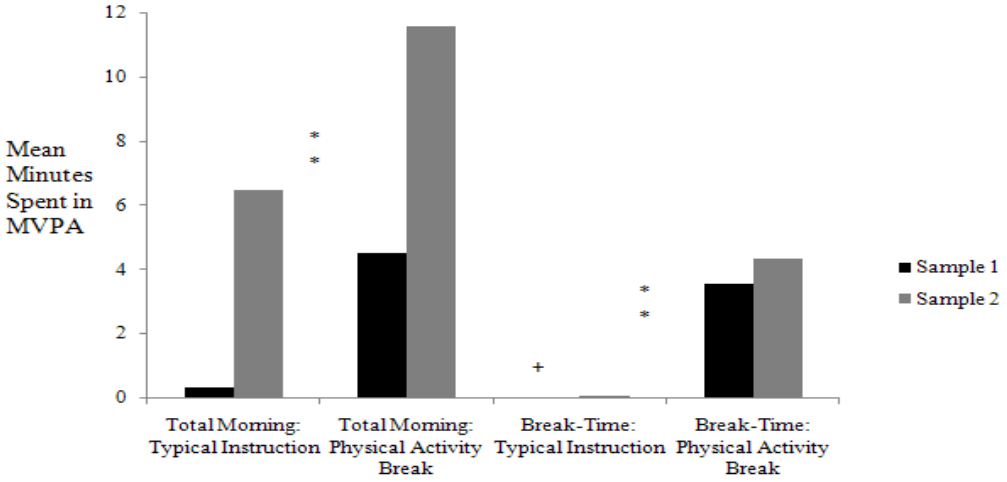

Figure 1. Mean total and Indoor MVPA for days with and without physical activity breaks. * indicates significance ($p < .0125$). Significant differences were found for each sample.

+ represents the value of 0 for Sample 1.

3.2 On-task behavior

See Table 2 for the mean percentage of time each sample spent in on-task behavior during the pre- and post-observation periods. Results are separated by days that each sample received typical instruction or a physical activity break. Due to low sample size, statistical analyses were performed on the combined sample of children for both centers to examine pre- and post- changes of on-task behavior. On average, children spent an average of 62.3% (SD = 7.8) of the post-observation period in on-task behavior on days of typical instruction and 77.7% (SD = 5.03) on days a physical activity break was implemented. A paired samples t-test indicates that this difference was not statistically significant ($t(5) = -2.68$, $p = .04$).

Table 2: Mean percentage of each observation period spent in on-task behavior.

	Typical Instruction	
	Pre-Observation	Post-Observation
Sample 1	61.9%	55.5%
Sample 2	73.1%	75.8%
	Physical Activity Break	
	Pre-Observation	Post-Observation
Sample 1	61.9%	70.6%
Sample 2	86.3%	91.8%

Motor skill competence and MVPA during physical activity breaks. The Spearman's Rho correlation between TGMD-2 percentile score and minutes spent in MVPA during the physical activity breaks was not significant (r_s (20) = .06, p = .787). Thus, children's level of motor skill competence did not affect their participation in the physical activity breaks.

4.0 Discussion

Increasing children's participation in physical activity is a national health priority. The strategy of implementing classroom-based physical activity breaks is effective in increasing physical activity in elementary school children (Ernst & Pangrazi, 1999; Scruggs et al., 2003; Stewart et al., 2004). For this study, preschoolers significantly increased their total morning and indoor MVPA on days that a 10 minute physical activity break was implemented compared to typical instruction.

We provide preliminary evidence that physical activity breaks increased physical activity of preschool children at two different types of childcare centers. Children from the subsidized childcare center (Sample 1) engaged in an average of 3.54 minutes of MVPA during the 10 minute physical activity break. Similarly, children from the university-based center (Sample 2) engaged in an average of 4.34 minutes of MVPA during the same time period. Even though these increases are only a few minutes, they still represent 35.4% and 43.4% increases in physical activity during the planned 10-minute activity break compared to days of typical instruction. Physical activity breaks provide an additional opportunity for children to meet the recommended 60 minutes of daily physical activity. It is also recommended that preschool children are not sedentary for more than 60 minutes at a time (National Association for Sport and Physical Education, 2009). Physical activity breaks during the typical day can help preschool children meet this recommendation.

The literature suggests that the type of center (i.e. commercial, church-based, Head Start) attended explains 14.2-46% of the variance in physical activity (Finn et al., 2002; Pate et al., 2004; Pate et al., 2008). Worobey, Worobey, and Adler (2005) provided evidence that children attending a university-based childcare center were two and a half times more active than children attending a Head Start center. The findings from this present study provide evidence of this disparity in physical activity levels of children enrolled at different centers. Children attending the subsidized childcare center averaged less than one minute of MVPA for the total morning during typical instruction. A likely explanation for this finding is that although the written policy of this center requires that children are provided at least 30 minutes of physical activity in the morning, based on observations this policy is not typically followed. Children did not go outside for free play on any of the days of data collection despite that the weather was suitable for outdoor play. Based on observations, this is typical of this childcare center.

When asked, childcare providers cited weather and the process of clothing children for outdoor play as a barrier to going outside. As such, the implementation of classroom-based physical activity breaks may be especially important in this region of the country where the weather is an obstacle (i.e., extreme heat in the summer or frigid temperatures in the winter). In contrast, children attending the university-based center averaged 6.46 minutes of MVPA for the total morning during typical instruction. On each day of data collection, children at this center were provided at least 45 minutes of free play on an outdoor playground. This is typical of this center and children are regularly provided opportunities to engage in physical activity.

However, despite the opportunity for unstructured physical activity, the amount of MVPA children engaged in was still relatively low. This provides initial support for the importance of providing planned and structured physical activity opportunities for preschoolers and the need for more research to fully understand the role of a childcare center (i.e., environment) to promote physical activity behavior.

Although not significant, we provide preliminary evidence that on-task behavior may increase in preschool children following participation in a physical activity break compared to days of typical instruction. However, due to the low sample size, results should be interpreted with caution and future research is needed. One concern of the implementation of physical activity breaks is that children will not be able to quickly and efficiently transition from being active to engage in academic activities. Our study provides initial evidence that this is not the case, as time on-task did not decrease after a physical activity break, and children can transition from physical activity to academic instruction.

The results of this study indicate that motor skill competence was not related to MVPA participation during the physical activity breaks. This is important because previous research indicates that preschoolers who demonstrate low motor competence are not as physically active as their peers who demonstrate high motor competence (Fisher et al., 2005; Graf et al., 2004; Robinson et al., 2012). As preschool children transition into elementary school, physical education programs will provide motor skill instruction. However, prior to elementary school, preschool children are often not exposed to high-quality instruction that promotes motor skill development. Thus, it is imperative that strategies to increase physical activity are effective for all children, regardless of skill level, especially during the preschool years when high-quality motor skill instruction is often not emphasized or available.

There were a few limitations of the present study. The sample size at each center was relatively small. However, significant differences were still found suggesting the salience of the findings. Another limitation is that physical activity was only measured during the morning hours. It is possible that children accumulated more physical activity during the afternoon and/or outside of the childcare center that was not captured in the present study. This limitation prevents speculation on how much participation in a physical activity break contributes to meeting the 60 minutes of daily physical activity recommendation.

Given that research has demonstrated that children attending different types of child care centers participate in varying levels of physical activity, a strength of our study is that it included samples of children from a subsidized and a private childcare center. We provided initial evidence that regardless of center attended, physical activity increased significantly due to implementation of a physical activity break. In addition, the sample characteristics were very different between the two centers. In Sample 1, all children were African American of low socio-economic status. In Sample 2, the majority of children were Caucasian or Asian from middle to high socio-economic status. Thus, classroom-based physical activity breaks increased MVPA across diverse samples of preschool children. Another strength is the use of accelerometers to objectively measure physical activity. Accelerometers measure the duration and frequency of physical activity and provide an outcome measure of average number of minutes spent at specific intensities of physical activity. This is important because previous research on physical activity breaks have used pedometers (Mahar et al., 2006; Scruggs et al., 2003). While pedometers are a valid and reliable measure of physical activity, only the total volume of physical activity is reported.

There are many potential directions of future research. Research should continue to examine the effect of physical activity breaks on physical activity and on-task behavior in a larger sample of children across the early childhood years. A potential research direction is to determine the effect of implementing more than one physical activity break during the typical day. Multiple physical activity breaks would provide additional opportunities for children to meet the recommended 60 minutes of daily physical activity. It is also important to determine if physical activity breaks can increase motor skill competence. The purpose of movement programs in preschool settings is not only to provide opportunities to engage in structured physical activity, but also to develop motor skills. Further research is needed to determine if overweight and obese children engage similarly in physical activity breaks compared to their normal weight peers. This is especially important if physical activity breaks are to be considered as part of a strategy to prevent or reduce obesity rates in pediatric populations. Future research is needed to determine the feasibility of classroom teachers to implement physical activity breaks in preschool classrooms. In conclusion, we provide initial evidence that classroom-based physical activity breaks increases physical activity levels of preschool children independent of motor skill competence.

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