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Feasibility and effectiveness of two built environmental interventions on physical activity among 3–5-year-old preschoolers

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Abstract

Purpose: The purpose was to examine the feasibility and preliminary effectiveness of two built environmental interventions with Head Start preschool children to increase minutes and intensity and total physical activity (PA).

Design and Methods: A prospective, quasi-experimental, repeated measures design was conducted in two Head Start centers. Centers were randomly assigned to one of two intervention arms. Intervention Arm I added portable play equipment to the school environment; Arm II introduced portable play equipment plus PA education for staff and children. PA was measured during school using accelerometers and by observation using SOPLAY. The data were analyzed using repeated measures ANOVA.

Results: Ninety-seven children and eight staff were enrolled; valid PA data were available for 56 children (58%). Minutes of PA were highest at baseline in both groups and declined over the intervention. PA in Arm I decreased 22 min from weeks one to three and 12 min ($p < .001$) from weeks 3 to 6. In Arm II, PA declined 33 min from weeks one to three and 20 min ($p < .001$) from weeks 3 to 6.

Practice Implications: Nurses work to maintain and improve health at multiple levels of influence and are in strategic positions to educate and support PA to maintain and improve the health of all ages. School-based PA interventions have been reported with varying success. The feasibility of this study provides insight into the challenges in planning and conducting school-based interventions including enrollment, attrition, and accelerometer wear-time compliance. Despite our interventions, there was no positive response to either intervention, with PA declining at each time period in both groups. However, baseline PA was significantly higher than in previous studies. Schools can provide children with opportunities to accumulate PA.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

Keywords

child health; child; preschool; environment; intervention; motor activity; physical activity; school health

1 | WHAT IS CURRENTLY KNOWN?

Obesity and overweight are a continuing public health issue in the United States (U.S.), including among children. Physical activity (PA) behaviors are an important component for health and habits are often formed during childhood. Increasing PA to sufficient levels recommended for health is critical. Although individually focused PA interventions have had moderate success in increasing PA short-term, long-term maintenance has been difficult, indicating that broader socio-ecological approaches such as environmental interventions may be useful (Glanz, Rimer, & Viswanath, 2015).

2 | WHAT DOES THIS ARTICLE ADD?

School-based PA environmental interventions have had varying success, and few have focused on pre-school children. This study addresses this by determining the feasibility and preliminary testing of two simple environmental interventions to increase PA among children ages 3–5-years old. The interventions included portable outdoor play equipment and added play equipment combined with education. In this study, neither intervention increased PA, but issues of feasibility were identified that provide direction for others.

3 | INTRODUCTION

In the United States (U.S.), 32% of children are overweight or obese, with rates projected to rise (Kumar & Kelly, 2017; Ogden, Carroll, Fryar, & Flegal, 2015). In the past 30 years, childhood obesity rates have doubled among children between the ages of 2 and 5-years-old and tripled among youth ages 6–11-years old and 12–19-years (Ogden et al., 2015). Childhood obesity is a strong predictor of overweight and obesity in adolescents and adulthood (Kumar & Kelly, 2017). Evidence suggests that excess weight gained before 5 years of age will likely carry into later childhood (Geserick et al., 2018). Among preschool-aged children 2–5 years old specifically, almost 23% are overweight or obese with minority children having higher rates compared with whites or Asians (Kumar & Kelly, 2017). With 59% of 3–5-year-olds in full or half day childcare in center-based settings such as day care, private preschools, or Head Start centers each year (Rathbun & Zhang, 2016), effective interventions to increase PA can have an important impact on overall health and slowing childhood obesity. However, little attention has focused on obesity and PA interventions in the preschool age group (Cruz et al., 2016).

The result of an imbalance between energy intake and energy expenditure, insufficient PA is a major contributor to obesity (Kumar & Kelly, 2017). Increasing PA in young children is an effective strategy to prevent childhood obesity and improve health. Recommended amounts are an accumulation of 60 min or more of PA every day (Centers for Disease Control, 2015). More specifically, the National Association for Sport and Physical Education (NASPE)

recommends the accumulation of at least 120 min of PA every day for preschool children, including 60 min of structured PA and 60 of unstructured activity and bouts of the activity of 15 min or more per hr (Henderson, Grode, O'Connell, & Schwartz, 2015; U.S. Department of Health and Human Services [USDHHS], 2018).

However, preschool children may not be getting the recommended daily amount or intensity (Tucker et al., 2017). Measuring PA objectively via accelerometers, results from two studies found U.S. preschool children spent more than 60 percent of the time in light activity (Hnatiuk, Salmon, Hinkley, Okely, & Trost, 2014), and more than 6 hr each day being sedentary with only about 15 min per day in moderate-to-vigorous PA (MVPA; Katapally & Muhajarine, 2015). Results from two studies with data from children attending Head Start indicated that children played outdoors only about 36–37 min per school day whether enrolled in either a half or full day program (Henderson et al., 2015) and spent most of their time at school in sedentary and light PA with less than 1 min per hr in MVPA (Tucker et al., 2017).

Multiple factors influence PA and obesity. Environmental influences on PA are one critical factor in childhood obesity (Henderson et al., 2015; Katapally & Muhajarine, 2015). Unsupportive environments may contribute to insufficient activity (Showell et al., 2017). Socio-ecologic models posit that broader social and environmental determinants influence health and health behavior (Kumar & Kelly, 2017). Because children spend a large portion of their day in schools, the school built environment is an essential element that can be leveraged, leading to increased activity (Henderson et al., 2015; Hesketh et al., 2017). However, research specifically focused on effective interventions to increase preschooler's PA is still lacking. The purpose of this study was to examine the feasibility and preliminary effectiveness of two built environmental interventions with Head Start preschool children to increase time in minutes, intensity, and total PA per school day and to describe the children's playground and context for PA during recess.

4 | METHODS

4.1 | Design and sample

The research design for this study was a quasi-experimental, repeated measures design to determine the recruitment and intervention feasibility and preliminary effectiveness of two interventions. Both intervention arms included the same environmental intervention but Arm II included the addition of an educational component (i.e., Environmental Plus intervention). Out of four purposively selected Head Start centers of similar size and demographic composition in Mississippi, two were randomly chosen for the study. Enrollment in one Head Start center was 80 children and the second one had 200. Each of the two selected schools was randomly assigned to one of the two intervention arms; no control school was included because of study budget, although children served as their own control because of the repeated measures design. Interventions and data collection occurred over 6 weeks.

Male and female preschoolers were eligible to participate in the study if they were between the ages of 3–5 years, enrolled in one of the selected Head Start centers, and had a parent or legal guardian who consented to participation. The childcare providers in the Head Start

center receiving the Environmental Plus intervention (Arm II) were also eligible to participate. Although the purpose of the study was to determine feasibility and preliminary effectiveness, we conducted a power analysis via G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). The analysis indicated a needed sample size of 44 preschool participants in each group with an alpha of .05 and a moderate effect to determine the effect of the intervention on the outcome.

4.2 | Interventions

The intervention groups were an environmental only (Arm I) and a combination of environmental and educational intervention (Environment Plus, Arm II). The experimental intervention at one Head Start center (Arm I) consisted of adding portable play equipment to indoor and outdoor play areas. Examples of portable play equipment used included various colored and sizes of balls, hula hoops, cones to maneuver balls around, and tunnels through which to crawl. All equipment was selected on the basis of evidence and recommendations from child experts and previous literature (Cardon, Labarque, Smits, & De Bourdeaudhuij, 2009; Cosco, Moore, & Smith, 2014). The second Head Start center (Arm II) received the same portable play equipment. At both schools, the new equipment was introduced by the research team and school staff was trained on how to use it. The staff made the equipment available to children on the playground each day weather permitting.

In addition, the staff and children in Arm II received education and training on the educational materials from a member of the research team on the first day of each time period. The staff was responsible for administering the educational games and materials of the intervention during the study. The educational intervention included verbal and written information for staff and children and demonstrations of active games to staff.

The interactive games and coloring sheets for the children were based on *Let's Move*, a comprehensive initiative to combat childhood obesity launched by former first lady Michelle Obama and continuing under the Partnership of a Healthier America (<https://www.ahealthieramerica.org/articles/let-s-move-84>) and Nemours Health & Prevention Service (<https://classroom.kidshealth.org/index.jsp?Grade=cc&Section=hhfl>). Examples of activities and handouts include Move to Me Maze (coloring, work with adult to complete maze, and mimic the Sesame Street characters activity as move through the maze), Food Cards (color & name the fruit or vegetable or make two sets & match), and Sesame Super Stretch Chart (color & perform the illustrated stretch) and are available in the Healthy Habits for Life guide (Sesame Workshop, 2017). The educational content was designed by child development and education experts and thus have good content validity. The resources also align with the National Health Education Standards (Centers for Disease Control, 2018b).

The intervention was introduced by the research team at each Head Start center at the end of the baseline data collection period on Day 4. Written materials explaining the benefits of PA for children and ways to incorporate it at home were sent home to parents in both intervention groups after the study was completed as the intervention was designed to increase PA during school.

4.3 | Measures

To determine feasibility of enrollment, retention, and accelerometer compliance prior to planning a future larger study, each component was assessed. Enrollment feasibility was determined by comparing the number invited to participate in the study to the actual number enrolled. Attrition were determined by the proportion of preschoolers who did not complete the study. Accelerometer wear-time compliance was determined by the accelerometer-derived data.

A demographic form for enrolled preschool children was used to determine the date of birth, sex, race, and educational level of the child's mother or legal guardian and was completed by the consenting adult. Baseline pre-intervention assessment data were collected by the researcher and included height and weight of the children without shoes or jackets. The same scale and height measurement instruments were utilized for each of the children.

PA was measured during school hours via GT3S Actigraph accelerometers (Actigraph, 2013) and via observation using the System for Observing Play and Leisure Activity in Youth (SOPLAY). Accelerometer PA measurement was done for 3 days at three times: baseline before the intervention and at 3 and 6 weeks after the intervention. The primary PA outcomes of interest: time in minutes, intensity of activity, and total PA; were obtained from accelerometers. For preschool and young children, accelerometers produce reliable estimates (Cliff, Reilly, & Okely, 2009). The staff was trained by one of the researchers and on each measurement day, the school staff placed the accelerometers on the child at the waist as recommended (Cliff et al., 2009) and removed them at the end of the school day. The same accelerometer was used for each child during the 3 days to capture individual total PA during that assessment period. After the 3 days, accelerometer data were downloaded and reset by one of the researchers. At each of the subsequent data collection periods, the accelerometers were redistributed to the staff and reinforcement of the procedure for measurement was done to assure study data collection fidelity.

Accelerometers were set using 15-s epochs to capture short bursts of activity (Cain, Sallis, Conway, Van Dyck, & Calhoun, 2013). A day was considered valid if more than 3 hours of data were obtained. Two valid days of accelerometer data from the 3 day measurement period consisting of at least 3 hr per day were considered complete and included in the analysis. The PA measurement goal at each time period was 3 days of at least 4 or more hours each day via accelerometers. The data from children with less than the minimum were considered missing for that time period. Per protocol, data collection could be rescheduled for the rain to measure indoor and outdoor PA, but rescheduling was not necessary. The ambient temperature was recorded each day of accelerometer wear, ranged from 53° to 76°, and there was little variation between the two groups. Accelerometer wear-time compliance was also measured. ActiLife 6 software was used for accelerometer-derived data (Actigraph, 2013).

Observational data on children's activity during school and contextual description of the outdoor play setting were assessed at each school on 1 day each time period using the SOPLAY. The SOPLAY is "an objective tool for quantifying PA in "open environments", such as schools, and for describing "area accessibility, area usability, presence of

supervision, presence, and classification of organized activity, and equipment availability” (McKenzie, 2006, p. 2). It has been validated and has good reliability ($r = 0.75$; McKenzie, 2006). SOPLAY uses a systematic momentary time sampling technique with periodic scans to observe individuals and contextual factors in the pre-determined areas of activity called target areas. To facilitate observation, target areas are broken into smaller scan spaces areas, which are summed for a target area score. Participants from each Head Start center (Arm I and Arm II) were observed by the same trained researcher during recess. Observed individual’s activity was coded as sedentary, walking, or very active as specified in the SOPLAY scoring manual. Weather conditions, whether there was a supervised area for play, presence of any organized play led by a staff member, and availability of portable equipment, such as balls or jump ropes were assessed. The most frequent activities and intensity within the designated area were recorded.

In addition, a four-question Likert type evaluation questionnaire of the educational intervention was administered to the childcare providers in the Head Start center receiving the Environmental Plus intervention (Arm II). The ability to recruit and retain children was also measured.

4.4 | Analytic strategy

The data were analyzed using repeated measures ANOVA (RANO-VA) in SPSS X2. Descriptive statistics and statistical assumptions testing were conducted before the analysis. Demographic and BMI for-age percentile differences between the experimental groups at baseline were assessed using independent t test and Chi-square. Because accelerometers record the activity as counts per minute of intensity, the total counts per minute (cpm) during the school day and the amount of time spent in sedentary, light, moderate, and vigorous intensity PA per school day were calculated. Counts higher than 15,000 cpm were considered implausible and were removed from the analysis (Cliff et al., 2009). Established cut-points for children were used to classify sedentary, low, moderate, and vigorous activity (Pate, Almeida, McIver, Pfeiffer, & Dowda, 2006). Using SOPLAY, activity levels were recorded as sedentary, walking, or very active and compared among different target areas.

5 | RESULTS

5.1 | Participants

Of the 97 total enrolled, over half were 4-years-old ($n = 59$) and female ($n = 52$). The educational level of the mother ranged from less than high school to a 4-year college degree or higher, with high school or a General Equivalency Diploma (GED) being the most frequently reported ($n = 36$). Only three children in the study were Caucasian, and the remainder were African American. No statistical differences in groups were identified at baseline in regard to sex $\chi^2(1, N = 97) = 0.107, p = 0.74$, mother’s education level $\chi^2(4, N = 96) = 6.046, p = .20$, or body mass index (BMI) $t(94) = 1.137, p = 0.89$.

Using CDC age- and gender-specific percentiles for BMI, mean BMI was 16.4 (S.D 1.8) for Group I (Arm I intervention) and 16.5 (S.D. 2.0) for Group II (Arm II; Centers for Disease Control, 2018a). A little more than half of the children were classified as healthy weight ($n =$

53). Thirty-eight were classified as overweight or obese with the remainder classified as underweight ($n = 5$). More females ($n = 24$) than males ($n = 14$) were classified as overweight or obese.

5.2 | Feasibility

5.2.1 | Enrollment—A total of 80 invitational packets were sent home with students at the first Head Start center and 200 packets at the second. Consents were obtained for 50 children in Arm I (62.5%) and 47 children in Arm II (23.5%).

5.2.2 | Attrition—There was a loss of one child from the study in Arm II because of relocation out of the area. There were no other study withdrawals.

5.2.3 | Accelerometer wear-time compliance—Complete PA data for the final analysis were obtained on 32 (64%) in Arm I and 24 of the children (51%) in Arm II. In arm I, of the 32 children with complete PA data, all had at least 2 days of data. In Arm II, of the 24 children with complete PA data, 17 had 2 days whereas 7 had 3 days.

5.3 | Intervention effectiveness

5.3.1 | Physical activity—Total PA by intensity did not differ by the group at baseline (light PA $t = 1.404$, $p = .164$; moderate PA $t = 1.183$, $p = .240$; vigorous PA $t = -1.330$, $p = .187$). The PA levels for both intervention groups decreased significantly from baseline at week one (T1) to follow up at weeks three (T2) and six (T3), with the exception of a nonsignificant decline in vigorous PA in Arm I. Light activity decreased significantly in Arm I (T1 to T2 = -8 min; T1 to T3 = -14 min; $p = .002$; Table 1). Moderate activity among the children in Arm I also dropped significantly from T1 to T2 by 10 min and then an additional 4 min from T2 to T3 ($F[2, 32] = 7.244$, $p = .001$). Time spent in vigorous PA did not significantly differ from T1 to T3 ($F[2, 32] = 2.816$, $p = .07$) in Arm I, decreasing only 6 min.

In the Environment Plus Arm II group, light activity decreased significantly by 16 min from T1 to T2, and increased slightly by 2 min at T3 for an overall decline of 14 light intensity minutes during the intervention ($F[2, 23] = 12.666$, $p < .001$). Moderate activity decreased significantly by over 13 min from T1 to T2 and 8 min from T2 to T3, a loss of 21 total moderate activity minutes ($F[2, 22] = 20.874$, $p < .001$). Time children spent in vigorous PA also significantly decreased in Arm II by 5 min from T1 to T2 and 14 additional minutes from T2 to T3, for a net decline of 19 min ($F[2, 23] = 25.479$, $p < .001$).

For total PA, children in Arm II had a decline of 20 more minutes than those in Arm I. The decline for both groups is seen in Figure 1. The greatest drop in physical activity occurred from T1 to T2 in both groups. Those in Arm I had a mean decrease in minutes of total physical activity at each time period for a loss of 34 min from baseline to T3. Children in Arm II had a mean decrease in 54 min of total physical activity by the end of the intervention. When minutes of MVPA were combined, children in Arm II had a loss of almost 20 min more than those in Arm I, decreasing 40 min from T1 to T3 compared with 21 min in Arm I participants.

5.3.2 | SOPLAY-observations of context—At baseline, observational findings were that the Head Start center assigned to Arm I intervention did not have *any* portable play equipment at school. The Head Start center assigned to Arm II had limited portable equipment. Recess at both involved 5 to 10 min of structured play led by the staff and then approximately 15 to 20 min of free play with about 40 or fewer children at recess at one time with staff supervising children's play.

Before the introduction of the intervention, in Arm I, the children were observed playing on fixed equipment such as slides, running in the green space, and sitting at the edge of the play area. No riding or non-fixed toys such as balls were seen. Many children chased each other in the grassy area, more boys than girls played in the grassy area, and more girls played with the fixed equipment. In the 3rd week, after the introduction of the intervention, the new portable play equipment including hula-hoops was heavily used by girls. Many students continued sitting whereas a few played on the slide. At week six post-intervention, children did not utilize the portable play equipment.

In Arm II before the intervention, children were observed playing with portable play equipment provided by the center that included several hula-hoops, large riding bouncy balls, balls, and a few tricycles. Playground fixed equipment included a slide, tunnel, bike track, balance beams, and a goal; there was also a grassy area for play. The portable equipment was in constant use. Children were also observed playing on the fixed equipment, especially the slide. Some children sat around the perimeter of the play area with females spending more time sitting than males. On the second and third observations during the third and sixth week, the additional portable play equipment provided with the intervention was available for the children. Children were observed playing with hula-hoops, throwing footballs, kicking soccer balls, and playing with bouncy play balls and basketballs. The tricycles continued to be heavily used and children were observed playing on the slide and with the goal. Boys were more active than girls.

All four teachers and all four teacher assistants completed the short evaluation. Seven of the eight strongly agreed that the interventions were useful (Table 2).

6 | DISCUSSION

This study focused on the feasibility and preliminary effectiveness of two built environmental interventions on PA in preschool children enrolled in Head Start centers. In this study, there was no positive response to either intervention, with PA declining at each time period in both groups. Other school-based PA interventions have been reported with varying success. e.g., after playground markings were introduced, time spent in MVPA increased ($p < .01$; Broekhuizen, Scholten, & de Vries, 2014). Conversely, there was no change in light, moderate, or vigorous PA in preschool children following the addition of play equipment (Davis et al., 2016; Escalante, Garcia-Hermoso, Backx, & Saavedra, 2014) similar to this intervention, or a randomized control trial to increase PA among children from eight Head Start centers (Bellows, Davies, Anderson, & Kennedy, 2013). This is also consistent with a systematic review that included seven intervention studies focused on socioeconomically disadvantaged preschool children (Laws et al., 2014). Three of the

studies had a positive effect on PA, three had a negative effect, and one had no PA outcome reported, highlighting the need for more research in this area and among this population.

Recruitment and accelerometer wear-time compliance were issues that may have affected our results. We were not able to enroll and collect data on as many participants as we had hoped on the basis of our power analysis, limiting our sample size and data for the analysis. We were dependent on the adult caregivers at the Head Start centers to assist children in putting on the accelerometers each day, which decreased accelerometer wear-time compliance and data for analysis. There were some days that no children in the classes wore the accelerometers. Teachers and aides were responsible for putting on and removing accelerometers. Although they were enthusiastic about the study, with other duties it may have been too burdensome to maintain. This is an important issue for the feasibility and provides insight into the challenges in planning and conducting other larger school-based intervention trials. Ideally, we would hire research assistants to help with enrollment or assist children and staff with the accelerometers each day but were unable to because of limited funding.

Several other measurement issues may have biased the results. The total PA at baseline was significantly higher in both groups when compared to the last measurement period at 6 weeks indicating potential novelty of the accelerometers or an increase in activity because either the students or teachers were more aware and changed their activity or for teachers, that they encouraged children to be more active because they knew what was being measured. No blinding was instituted in the study. Staff, parents, and children were all aware that the accelerometers were measuring PA. We also did not measure PA after school or on weekends. Measuring activity only during school time may be insufficient and only provide a snapshot of a child's typical day. However, our focus was on PA during the time at school. An additional limitation is that the educational intervention was evaluated only for ease of use and perception of usefulness. Finally, generalizability is limited to similar populations in the south.

There are a number of possible reasons for the PA results in this sample. Head Start centers in this state may already be doing a good job of helping children meet PA guidelines or system-wide, national policy changes to support PA may have been recently adopted and might not yet be reflected in the current literature. However, using the data from six Head Start program sites, Shen et al. (2012) found that children spent far less time at the amounts or intensity recommended, indicating that there is variation among programs. In this study, children in both groups met CDC and NASPE PA guidelines each of the three measurement periods. The Head Start centers in our study participated in a program titled *I'm Moving, I'm Learning* designed to increase MVPA to meet national guidelines. The mean total PA level in each group was greater than 60 min of MVPA and more than twice that in total PA at each time period and at the conclusion of the study even with the declines.

It is also possible that the time and intensity of the interventions may have been inadequate. New infusions of different portable play equipment may need to be introduced to motivate play. In week 6, Arm I intervention group was not observed playing with the additional portable equipment, unlike at week 3. However, in Arm II intervention group, the additional

equipment was utilized throughout the intervention. Children lacked the ability to choose portable play equipment and depended on play equipment chosen by staff. In Group I, the Arm I school did not have any portable play equipment, including tricycles for the bike path. Staff reported that equipment was frequently stolen. With Group I, the portable equipment had to be carried in and out on a daily basis by the teaching staff, which made it cumbersome. On observation, very little portable play equipment was available on the playground in week 3 and none was available at baseline or week 6.

Surprisingly, there was no additional benefit to adding education. The educational program, *Let's Move*, was designed by a multi-agency U.S. taskforce with early childhood expert members. Other studies have had inconsistent findings with educational or behavioral interventions. For example, the substitution of 30-min structured PA with goal setting, monitoring of progress, and acknowledgment of achievement in place of the regular 30-min structured PA time was used in preschool children in Atlanta. Time spent in MVPA and VPA increased in the intervention group ($p < .001$, respectively; Annesi, Smith, & Tennant, 2013). In contrast, in another study with teacher-led activities combined with an educational program, there was no difference in step counts of preschool children (Bellows et al., 2013).

Previously used combination interventions, which include both environmental and educational interventions, have also had mixed results. No response was noted in PA or step count in preschoolers in two studies (Finch et al., 2014; Tucker et al., 2017). However, Engelen et al. (2013) reported an increase in MVPA and total PA ($p = .006$ & $p = .002$, respectively) among preschoolers with a combination intervention that added loose materials, such as crash mats, weighed boxes, and milk crates to the playground and an educational intervention for parents, teachers, and staff.

Strengths of this study were the use of accelerometers to objectively measure PA and the use of a repeated measures design. Studies that measured PA in preschool children using accelerometers and heart rate monitors are recommended and are able to detect differences related to the intervention, indicating that measurement issues may be very important in studies involving young children (Annesi et al., 2013; Engelen et al., 2013; Hnatiuk et al., 2014). The addition of adding the observational component of the SOPLAY to describe the context is another strength.

Future research should be conducted using a larger, randomized trial with a control group, as well as conducting the study in multiple childcare settings, such as religious-based, in-home, and private facilities to allow for the comparison among different types. Measuring for a longer period of time and allowing children to wear accelerometers home versus just during school hours would allow for analysis of total daily PA. Measurement of total PA over longer periods of time would also contribute to testing the ActivityStat hypothesis that children compensate for an increase in activity during one part of the day with being less active at other times (Gomersall, Rowlands, English, Maher, & Olds, 2013; Ridgers, Timperio, Cerin, & Salmon, 2014). Conducting a study over a longer period of time would allow for a washout period to help control for the novelty effect of the accelerometers. Modification to the interventions should be tested. Adding more educational activities over a longer period might be more effective. A variety of portable play equipment could be

introduced at intervals to motivate more children to participate in active play. And finally, ensuring adequate study personnel to maintain study fidelity and consistent adherence to the measurement protocol is needed.

7 | CONCLUSION

The environment is increasingly being recognized as influential on health behaviors, such as PA. Although PA among children in this study conducted in Head Start centers was at or above national guidelines, other settings where preschool-aged children attend, or Head Start programs in other geographical locations may not be as supportive. Nurses have long been cognizant of the impact of the environment as a determinant of health. Public health nursing practice routinely involves prevention strategies to promote health, detect disease early, and reduce disease sequelae. The priority focus of effective public health nursing practice is through primary prevention (World Health Organization [WHO], 2018; USDHHS, 2018). Labeled a global health problem, physical inactivity is linked to major non-communicable diseases and is estimated to be the fourth leading risk factor for mortality worldwide (WHO, 2018). Thus, promoting PA in early childhood not only serves to establish a healthy behavior but is key to preventing many chronic diseases that often begin in childhood.

This study examined the feasibility and preliminary effectiveness of two built environmental interventions with Head Start preschool children to increase minutes and intensity of PA, total PA during the school day, and provide a contextual description of PA during open play. The feasibility of this study provides insight into the challenges in planning and conducting other larger interventional school-based clinical trials, including enrollment, attrition, and accelerometer wear-time compliance. In this study, neither intervention arm was effective in increasing PA, and PA declined among preschoolers at the dose offered. On a positive note, measurements indicated the preschoolers are meeting national guidelines for recommended daily physical activity. Head Start centers in Mississippi participate in an active learning campaign to promote moderate and vigorous PA, one that appears to be working well.

8 | HOW MIGHT THIS INFORMATION AFFECT NURSING PRACTICE?

Nurses work to maintain and improve health at multiple levels of influence, such as directly in the communities or at broader policy levels and are in strategic positions to educate and support PA to maintain and improve the health of all ages. National public health goals include PA objectives specifically focused on younger children and increasing the number of states with licensing regulations for physical activity, opportunities for children to participate in MVPA, and the number of minutes the children spend being physically active while in the childcare setting. In this study, strong school PA policies appear to be effective. Nurses can advocate for similar policies in all schools and other childcare settings, beginning in early childhood.

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ETHICAL CONSIDERATIONS

Approval by the University of Mississippi Institutional Review Board was obtained before beginning the study. Signed informed consent was obtained from the parents or legal guardians of the children. Formal written assent was not obtained from the children because of age. However, the children were asked if they wanted to participate in the study and wear the accelerometer with the option to refuse without consequences. Whether enrolled or not, all children had the opportunity to play with the portable play equipment included in both intervention arms and receive the group educational instruction in the play equipment plus arm.

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FIGURE 1.
Total PA minutes for Group I, Arm I and Group II, Arm II at baseline, Week 3, and Week 6.
PA, physical activity

TABLE 1
Minutes of physical activity per group by intensity level at baseline, Week 3, and Week 6

	Group I (Arm I) (<i>n</i> = 32)			Group II (Arm II) (<i>n</i> = 24)		
	Baseline	Week 3	Week 6	Baseline	Week 3	Week 6
Light	105(20)	97 (25)	91(19)	99(24)	83(26)	85(21)
Mod	78(21)	68(20)	64(13)	72(23.74)	59(24)	51(15)
Vig	29(18)	25 (15)	23(13)	34(15.96)	29(14)	15(7)
MVPA	107(37)	93(33)	86(25)	106(36)	89(36)	66(21)
Total PA	212(51)	190(50)	178(19)	205(56)	172(60)	151(39)

Abbreviations: mod, moderate; MVPA, moderate-to-vigorous physical activity; vig, vigorous; PA, physical Mean physical activity in minutes (SD).

TABLE 2Staff educational intervention component evaluation ($n = 8$)

	Strongly disagree <i>n</i> (%)	Somewhat disagree <i>n</i> (%)	Somewhat agree <i>n</i> (%)	Strongly agree <i>n</i> (%)
The PA intervention was helpful in my role as a childcare provider	0	0	1(12.5)	7(87.5)
I will use the PA information when planning daily activities of the preschool children in my care	0	1(12.5)	0	7(87.5)
The PA interventions can be easily incorporated into the daily activities of the preschool children under my care	0	1(12.5)	0	7(87.5)
The children used the new play equipment	0	0	1(12.5)	7(87.5)

Abbreviation: PA, physical activity.