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Policies and Characteristics of the Preschool Environment and Physical Activity of Young Children

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What's Known on This Subject

It is known that preschools can influence how active children are while in the preschool.

What This Study Adds

We used an objective measure of physical activity and explored characteristics and policies of preschools to determine what might influence the physical activity levels of children. Such information may be helpful for planning interventions.

ABSTRACT

OBJECTIVE. The purpose of this study was to examine policies and characteristics of preschools and the extent to which they influence the physical activity of 3- to 5-year-old children during the preschool day.

METHODS. A total of 299 children from 20 preschools wore accelerometers for an average of 8.1 hours/day (SD: 1.5 hours/day), for 5.5 days (SD: 2.1 days). A researcher completed the Early Childhood Environment Rating Scale-Revised for each preschool to assess quality. Classrooms and playgrounds were measured, and the preschool director was interviewed about physical activity policies. For each policy or characteristic, preschools were divided into 2 groups on the basis of whether the characteristic/policy was presumed to promote or not promote physical activity.

RESULTS. Children spent fewer minutes per hour in sedentary activity and more minutes per hour in moderate/vigorous physical activity in preschools that had higher quality scores, less fixed playground equipment, more portable playground equipment, lower use of electronic media, and larger playgrounds. Five preschools had all 5 of these characteristics, and children in those preschools had significantly more moderate/vigorous physical activity minutes per hour and fewer sedentary minutes per hour compared with children in the other preschools.

CONCLUSION. Children in the top 5 physical activity-promoting preschools accumulated >60 minutes of moderate/vigorous physical activity per day, compared with the children in the other preschools, who accumulated <60 minutes of moderate/vigorous physical activity per day. *Pediatrics* 2009;123:e261–e266

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Key Words

children, preschool, child care, physical activity, accelerometer

Abbreviations

PPA—promoting physical activity
NPA—not promoting physical activity
MVPA—moderate/vigorous physical activity
ECERS-R—Early Childhood Environment Rating Scale-Revised

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EXPERTS HAVE CONCLUDED that children 3 to 5 years of age should participate in both free play and structured physical activity. The National Association for Sport and Physical Education¹ recommends that preschoolers accumulate ≥ 60 minutes of structured physical activity and ≥ 60 minutes of unstructured physical activity daily. More than 60% of US children ≤ 6 years of age who are not yet in kindergarten are in some form of child care or preschool.² Preschool may be one place for young children to obtain a significant proportion of their daily physical activity.

Recently, Oliver et al³ reviewed 49 studies of physical activity in young children. They concluded that preschool-aged children spend very little time in vigorous physical activity and the majority of their time is spent in inactivity. In a study in which children wore accelerometers while in preschool, 3- to 5-year-old children spent an average of 42 minutes/hour in sedentary activity and only 7.7 minutes/hour in moderate/vigorous physical activity (MVPA).⁴

There is some evidence that the preschools children attend influence their levels of physical activity.^{4,5} Two studies used observational methods to identify characteristics of preschools and the physical activity levels of children who attended the preschools.^{6,7} One study involved 9 preschools and collected physical activity and contextual data on individual children in different settings and at different times of the school day.⁶ The second study involved 20 preschools and collected data on small groups of children in different settings and at different times.⁷ To date, no

TABLE 1 Characteristics and Policies of 20 Preschools

| Variable | Source | Hypothesized NPA | Hypothesized PPA | PPA | |
|--|--|--------------------------|--------------------------|----------------------|-------------------------------------|
| | | | | Preschools, <i>n</i> | Children, <i>n</i> (%) ^a |
| Quality | ECERS-R | Score of ≤5 | Score of >5 | 12 | 197 (65.8) |
| Field trips | Director interview | 0–2 per mo | 3 or 4 per mo | 4 | 60 (20.1) |
| Community organization visits | Director interview | <4 per mo | 4 per mo | 10 | 170 (56.9) |
| Teacher-led physical activity | Director interview | <60 min/d | ≥60 min/d | 8 | 103 (34.5) |
| Time outside | Director interview | <60 min/d | ≥60 min/d | 13 | 173 (57.9) |
| Teachers' education | Director interview | <50% with college degree | ≥50% with college degree | 6 | 114 (38.1) |
| Physical activity opportunities | Director interview | <120 min/d | ≥120 min/d | 7 | 100 (33.4) |
| Teachers had recent physical activity training | Director interview | No | Yes | 16 | 260 (87.0) |
| Electronic media | Observational System for Recording Physical Activity in Children-Preschool Version | ≥7% of observations | <7% of observations | 16 | 240 (80.3) |
| Portable playground equipment | Observation | 0 pieces | ≥1 piece | 14 | 185 (61.9) |
| Fixed playground equipment | Observation | >8 pieces | ≤8 pieces | 9 | 155 (51.8) |
| Children per classroom | Director interview | >15 | ≤15 | 5 | 74 (24.7) |
| Playground size | Measured and averaged over all playgrounds | <4157 ft ² | ≥4157 ft ² | 17 | 248 (82.5) |
| Classroom size | Measured and averaged over all classrooms | <347 ft ² | ≥347 ft ² | 15 | 225 (75.3) |

^a *N* = 299.

studies have examined preschool factors in relation to children's activity levels across the entire school day and in a large number of preschools. The purpose of the present study was to examine policies and characteristics of preschools that may influence the time children spend in physical activity and sedentary behaviors. This study included 20 preschools, and children wore accelerometers to measure physical activity during the preschool day.

METHODS

Study Design and Participants

Participants in this study were enrolled in the Children's Activity and Movement in Preschool Study. All 3- to 5-year-old children from preschools (*N* = 24) enrolled in the study were asked to participate. Three types of preschools, namely, commercial preschools, faith-based preschools, and federally supported Head Start programs, were included in the study. For the analyses presented in this article, accelerometer data from 2 preschools were unusable and 2 of the preschools were excluded because of lack of information about the time of children's arrival at and departure from school. Of the 20 preschools included in the accelerometer analyses, 11 were commercial preschools, 6 were faith-based preschools, and 3 were Head Start programs. Data were collected at each preschool during 2 data collection waves of 2-week duration each, separated by 13 to 19 months. After deletions because of missing data on age (*n* = 4), accelerometer data for 299 children were available for analysis. Written informed consent was obtained from each child's parent or guardian before collection of data. The study was approved by the University of South Carolina institutional review board.

Director Interview

A structured interview was conducted by a member of the research team with an administrator in each preschool. The interview was designed to determine the physical activity and sedentary activity policies and practices of the preschools.⁶ The interview was composed of questions that allowed the interviewer to probe for additional details (such as number of times per day or week).

For each policy or characteristic from the interview, the preschools were divided into 2 groups, that is, those promoting physical activity (PPA) and those not promoting physical activity (NPA) (Table 1). The PPA and NPA groups for physical activity minutes per day were based on recommendations for preschool-aged children.¹ Groupings for other characteristics were based on results from a previous study.⁶ The categories for the PPA group included ≥3 field trips per month (versus <3), ≥4 community organization visits per month (versus <4), ≥60 minutes of teacher-led physical activity per day (versus <60 minutes), and 60 minutes of outside time per day (versus <60 minutes). The PPA group also reported that ≥50% of teachers had college degrees (versus <50%), that teachers had received physical activity training recently (in the past 2 years), and that there were 120 minutes of physical activity opportunities per day (versus <120 minutes).

Preschool Quality

One of the researchers who had been trained to use the Early Childhood Environment Rating Scale-Revised (ECERS-R)⁸ administered it in 1 classroom at each preschool. The ECERS-R evaluates levels of quality on the basis of current understanding of recommended practices in early childhood education. The ECERS-R has 7

dimensions, which evaluate space and furnishings, personal care routines, language-reasoning, activities, interaction, program structure, and provisions for parents and staff members. The scale includes 43 items, which are rated from 1 to 7 on a Likert-type scale (with a score of 1 for inadequate and 7 for excellent). In this study, scores from each subscale were added and divided by the number of items. The psychometric properties of the ECERS-R have been reported elsewhere.⁸ Higher-quality preschools had higher scores, and preschools were divided into 2 groups by using an overall average score of 5, which represents a good score (≤ 5 for NPA and > 5 for PPA).

Electronic Media

The Observational System for Recording Physical Activity in Children-Preschool Version was used to record indoor activity codes while children were inside the preschools.⁹ Children in the 24 preschools ($N = 476$) were observed for a minimum of 600 observation intervals of 30 seconds each (ie, 5 hours per child). Preschools were divided into high or low use of electronic media on the basis of the proportion of intervals in which children were observed to be using electronic media (television, movies, or computer) while inside the preschool. Of the intervals that were coded as use of electronic media, $>40\%$ were from 4 of the preschools ($>7\%$ of codes for electronic media each); these were classified as preschools with high use of electronic media (NPA) for the current study.

Preschool Sizes and Equipment Inventories

Data collectors measured classrooms and playgrounds used by 3- to 5-year-old children at each of the preschools, and the sizes were averaged across the preschool. Preschools were divided into those in the upper quartile of size (PPA) versus those in the 3 lower quartiles (NPA). The number of children in each class of 3-, 4-, and 5-year-old children also was determined, and preschools with <15 children per classroom were hypothesized to be in the PPA group. Counts were made of fixed playground equipment for physical activity (eg, jungle gyms, slides, and swings) and portable equipment (eg, balls and tricycles) brought to the playground. Preschools were divided into 2 groups on the basis of the median values for portable equipment (range: 0–8 pieces; median: 1 piece) and fixed equipment (range: 3–14 pieces; median: 8 pieces).

Accelerometry

Children wore ActiGraph accelerometers (model 7164; ActiGraph, Pensacola, FL) over a 2-week period. The ActiGraph accelerometer is a uniaxial accelerometer that measures acceleration in the vertical plane; it is small ($2.0 \times 1.6 \times 0.6$ inches), light (1.5 oz), and unobtrusive. Its acceleration signal is filtered by an analog bandpass filter (0.1–3.6 Hz) and digitized by an 8-bit analog/digital converter at a rate of 10 samples per second; data are stored in user-defined intervals. For the present study, the monitors were initialized to save data in 15-second

intervals, to detect the short bursts of activity that are characteristic of 3- to 5-year-old children.

Participants wore the accelerometers on an elastic belt on the right hip (anterior to the iliac crest). Parents were instructed to remove the accelerometer only during water activities (eg, bathing or swimming) and when the child went to bed at night. Accelerometers were replaced before the weekend and again on the following Monday. Data were later linked according to child. Sixty minutes of consecutive zero values were considered nonwear time. On weekdays, the child must have attended school for ≥ 5 hours for the data for that day to be included in the analyses.

Trained data collectors recorded preschool arrival and departure times for each child, using sign-in and sign-out sheets that had been completed by the parent or guardian. Days on which a child was absent from preschool were not included. Occasional missing entry and exit times were imputed from the child's other data (usual times entered on the consent form, entry and exit times on other days, and school average entry and exit times) by using a SAS program (SAS Institute, Cary, NC) that weighted the child-specific data more heavily than the school-level data.

Accelerometer data were reduced by using cutoff points developed specifically for 3- to 5-year-old children, to categorize each interval as sedentary (<36.5 counts per 15-second interval) or MVPA (>420 counts per 15-second interval).¹⁰ In-school minutes per hour of sedentary behavior and MVPA were then calculated by using each child's time spent in the preschool as the divisor. For the present study, only physical activity that occurred during the preschool day was of interest and was analyzed. On average, children wore the accelerometer for 8.1 hours (SD: 1.5 hours) for 5.5 days (SD: 2.1 days) while in preschool.

Body Mass Index

Children's height was measured to the nearest 0.1 cm by using a portable stadiometer (Shorr Productions, Olney, MD). Weight was measured to the nearest 0.1 kg by using an electronic scale (model 770; Seca, Hamburg, Germany). The average of 2 measurements was used for both height and weight. BMI was calculated by dividing weight (in kilograms) by height (in meters) squared.

Parent Survey

A parent or guardian completed a survey that included questions about the child's date of birth, gender, and race and the level of education of adults in the household.

Statistical Analyses

Descriptive statistics were calculated for the 299 children. For each preschool policy or characteristic, the preschools were divided into 2 groups, according to whether the characteristic was hypothesized to be PPA or NPA. Mixed-model analyses of variance were used to determine whether there were differences in sedentary and MVPA time (minutes per hour) between the 2

TABLE 2 Results of Mixed-Model Analyses of Variance for MVPA and Sedentary Activity Time

| Characteristic | Sedentary Activity, Mean ± SE, min/h | | | MVPA, Mean ± SE, min/h | | |
|--|--------------------------------------|------------|-------|------------------------|-----------|------|
| | PPA | NPA | P | PPA | NPA | P |
| Quality | 32.8 ± 0.8 | 36.1 ± 1.1 | .01 | 7.5 ± 0.3 | 6.2 ± 0.4 | .01 |
| Field trips | 34.9 ± 1.7 | 33.8 ± 0.8 | .58 | 7.2 ± 0.6 | 7.0 ± 0.3 | .81 |
| Community organization visits | 34.0 ± 1.1 | 34.1 ± 1.1 | .98 | 6.9 ± 0.4 | 7.2 ± 0.4 | .60 |
| Teacher-led physical activity | 33.6 ± 1.2 | 34.3 ± 1.0 | .64 | 7.0 ± 0.5 | 7.0 ± 0.4 | .95 |
| Time outside | 34.4 ± 0.9 | 33.4 ± 1.3 | .55 | 7.2 ± 0.4 | 6.8 ± 0.5 | .50 |
| Teachers' education | 33.8 ± 1.3 | 34.1 ± 0.9 | .85 | 6.8 ± 0.5 | 7.1 ± 0.3 | .57 |
| Physical activity opportunities | 33.9 ± 1.3 | 34.0 ± 1.0 | .92 | 7.3 ± 0.5 | 6.9 ± 0.4 | .52 |
| Teachers had recent physical activity training | 33.6 ± 0.8 | 36.3 ± 1.8 | .17 | 7.2 ± 0.3 | 6.2 ± 0.7 | .18 |
| Electronic media | 33.4 ± 0.8 | 36.7 ± 1.5 | .05 | 7.3 ± 0.3 | 5.9 ± 0.6 | .03 |
| Portable playground equipment | 33.4 ± 0.8 | 36.7 ± 1.5 | .05 | 7.4 ± 0.3 | 6.2 ± 0.4 | .03 |
| Fixed playground equipment | 32.3 ± 0.8 | 35.8 ± 0.9 | <.01 | 7.6 ± 0.3 | 6.4 ± 0.4 | .02 |
| Children per classroom | 33.0 ± 1.5 | 34.4 ± 0.9 | .39 | 7.5 ± 0.5 | 6.8 ± 0.3 | .26 |
| Classroom size | 33.6 ± 0.8 | 36.5 ± 1.8 | .13 | 7.1 ± 0.3 | 6.7 ± 0.7 | .58 |
| Playground size | 33.1 ± 0.8 | 36.7 ± 1.3 | .02 | 7.3 ± 0.3 | 6.0 ± 0.5 | .02 |
| PPA characteristics ^a | 29.9 ± 1.0 | 35.2 ± 0.6 | <.001 | 8.3 ± 0.5 | 6.6 ± 0.3 | .001 |

Analyses controlled for BMI, race, gender, age, and parental education of the child, with preschool as a random variable.

^a Characteristics included quality, use of electronic media, portable playground equipment, fixed playground equipment, and playground size (5 preschools and 64 children).

groups. Mixed models handle multilevel data when the unit of analysis is not the individual but a naturally occurring group, such as a school. To control for the correlation among children within a preschool (with a common social and physical environment), preschool was entered as random variable. A mixed-model analysis of variance was then performed for each characteristic, controlling for the child-level variables of BMI, race, gender, age, and parental education, all of which have been associated with physical activity,^{3,4} and using preschool as a random variable. A final model was analyzed in which the preschools were categorized into 2 groups according to whether they had all of the characteristics that were significant in the separate analysis of variance results.

RESULTS

Of the 299 children, 50% were male, 49% black, 42% white, and 10% other race/ethnicity; 38.5% were 3 years of age, 47.8% were 4 years of age, and 13.7% were 5 years of age. The average BMI was 16.6 kg/m² (SD: 3.8 kg/m²), and 54% of the children had a parent with more than a high school education.

Table 2 shows results of separate mixed-model analyses of variance for the PPA characteristics, controlling for BMI, race, gender, age, and parental education and using preschool as a random variable. Children had fewer sedentary minutes per hour in PPA preschools that had higher quality (ECERS-R scores of >5), lower use of electronic media, ≥1 piece of portable equipment on the playground, less fixed playground equipment, and larger playgrounds. Children had more MVPA in PPA preschools that had higher quality (ECERS-R scores of >5), lower use of electronic media, ≥1 piece of portable equipment on the playground, less fixed playground equipment, and larger playgrounds.

Also included in Table 2 is the model comparing the preschools with all 5 characteristics that were associated significantly with physical activity. Higher PPA pre-

schools had higher quality, lower use of electronic media, more pieces of portable equipment on the playground, less fixed equipment on the playground, and larger playgrounds. These 5 higher PPA preschools had significantly less sedentary activity time and more MVPA time than did the lower PPA preschools. All 5 of the higher PPA preschools also had provided recent physical activity training for their teachers.

DISCUSSION

A preliminary step in planning interventions for preschool-aged children is to determine the factors of the preschool environment that influence the physical activity of the children. In this study, accelerometers were used to measure the physical activity of children from 20 preschools during the preschool day. Children spent less time in sedentary activity and more time in MVPA in preschools that had higher quality scores, less fixed playground equipment, more portable playground equipment, lower use of electronic media, and larger playgrounds. These findings suggest that educators and health professionals can modify the preschool environment in ways that help children spend more time in physical activity and less time in sedentary pursuits.

Children in higher-quality preschools participated in less sedentary activity and more MVPA than did children in lower-quality preschools. In a previous study, the ECERS-R was used to measure quality in 9 preschools; children in preschools in the upper quartile of scores (higher quality) were observed to spend less time in sedentary activities, compared with children in preschools with lower ECERS-R scores.⁶ Bower et al⁷ used the Environmental and Policy Assessment and Observation instrument to quantify both the social and physical environment of 22 preschools. Children in preschools with higher Environmental and Policy Assessment and Observation scores were observed to spend significantly greater proportions of time in MVPA and smaller proportions of time in sedentary activity. In the present

study, all 3 types of preschools were included in the higher-quality preschool group. This suggests that different types of preschools (ie, Head Start programs, commercial preschools, and faith-based preschools), with probably different levels of financial resources, can promote physical activity.

Children in preschools with more fixed playground equipment (eg, slides and jungle gyms) were less active than children in preschools with less fixed equipment. Also, children in preschools with more portable equipment (eg, balls and tricycles) were more active than children in preschools with less portable equipment. Other researchers found similar results.^{7,11,12} One reason for increased sedentary behavior with fixed playground equipment may be that children tend to congregate on and under the equipment. Brown et al,¹³ using an observational system (Observational System for Recording Physical Activity in Children-Preschool Version), reported that, when children were observed on fixed playground equipment, only 13% of the intervals were spent in MVPA. Twice as many intervals were spent in MVPA when the children had balls and other portable physical activity equipment.¹³ Preschools can increase children's activity levels by providing balls and equipment for active games, which typically are inexpensive and can be rotated in and out for variety.

Consistent with the results of other studies,^{11,14,15} playground size was an important characteristic of the PPA preschools. Experts recommend that playgrounds have a minimum of 75 ft² of outdoor play area for each child.¹ Preschools with smaller playgrounds may need to schedule playtimes so that fewer children are on the playground at one time.

Children in preschools with lower use of electronic media participated in significantly fewer minutes of sedentary activity and more minutes of MVPA per hour. Studies of physical activity and television viewing in preschool-aged children have yielded inconsistent results.¹⁶ Bower et al⁷ reported that, when more televisions and computers were present in the preschool, children participated in higher levels of physical activity. However, electronic media were measured differently in the present study, compared with the study by Bower et al.⁷ Rather than division of the preschools into groups on the basis of the numbers of televisions and computers that were present, preschools were divided into high and low use on the basis of observations of the children actually using electronic media in the preschools. The measure of numbers of computers and televisions used in the study by Bower et al⁷ might have been a measure of the financial resources of the preschools. The findings in the present study suggest that preschools that limit the use of electronic media can decrease the time children spend in sedentary activities and can increase their physical activity.

Strengths of the present study include the use of accelerometers to measure physical activity and the use of objective measures to classify preschools into PPA and NPA categories. Also, the sample included large proportions of both white and black children and children of various ages and body sizes. The study was cross-sectional,

however, and these findings need to be studied longitudinally. Also, all of the preschools were located around 1 city in South Carolina, which may limit generalizability.

CONCLUSIONS

The highest levels of MVPA (66 minutes in the PPA preschools, compared with 53 minutes in the NPA preschools, over an 8-hour day) and lowest levels of sedentary activity were in the 5 preschools with the PPA characteristics of higher quality, lower use of electronic media, more portable equipment on the playground, less fixed equipment on the playground, and larger playground size. Teachers at these preschools also had recent physical activity training. Of those 5 preschools, 1 was a commercial preschool, 2 were Head Start programs, and 2 were faith-based preschools. Preschool personnel can encourage physical activity by providing inexpensive portable playground equipment, limiting access to fixed equipment, limiting the number of children on the playground at any one time, and limiting use of electronic media. Preschools can provide opportunities for children to accumulate ≥ 60 minutes of MVPA each day.¹⁷

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