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In-School and Out-of-School Physical Activity in Preschool Children

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Abstract

Background—Little is known about the relationship between children's physical activity (PA) in preschool (In-School) and outside of preschool (Out-of-School). This study described this relationship.

Methods—Participants were 341 children (4.6 ± 0.3 years) in 16 preschools. Accelerometers measured moderate-to-vigorous and total PA (MVPA, TPA) In-School and Out-of-School. In the full sample, Pearson correlation was used to describe associations between In-School and Out-of-School PA. Also, children were categorized as meeting or not meeting a PA guideline during school. MVPA and TPA were compared between the two groups and In-School and Out-of-School using 2-way repeated measures ANOVA.

Results—In the full sample, In-School and Out-of-School PA were positively correlated for MVPA (r = .13, P = .02) and TPA (r = .15, P = .01). Children who met the guideline In-School remained comparably active Out-of-School. However, those who did not meet the guideline were more active Out-of-School than In-School. The groups were active at comparable levels while out-of-school. Identical patterns were seen for MVPA and TPA.

Conclusions—Children's In-School PA was positively associated with Out-of-School PA. Children who did not meet the guideline In-School were more active Out-of-School than In-School, suggesting preschool and classroom factors may reduce some children's PA In-School.

Keywords

accelerometry; guidelines and recommendations; childcare center

Introduction

Over 20% of American children between the ages of two and five years are overweight or obese,[1] and expert panels have suggested that low levels of physical activity may be contributing to the high prevalence of overweight.[2, 3] Recently, the potential importance of promoting physical activity as an obesity prevention strategy has gained increasing attention from researchers, practitioners and policy makers.[3-6] One key step has been to establish physical activity guidelines for 2-5 year-old children, and authoritative groups in the U.S. and elsewhere have concluded that young children should be physically active for at least three hours per day.[3-6]

Approximately 55% of American children who are not yet in kindergarten are enrolled in preschools and other forms of center-based care.[7] Because so many children spend 4 to 10 hours per day in these settings, the preschool/child care center environment is likely to exert an important influence on children's physical activity levels. Studies have shown that children's physical activity during the preschool day varies considerably across centers[8-14] and that preschool interventions can increase children's physical activity during the school day.[3, 15] However, little is known about the relationship between young children's physical activity in the preschool setting and their activity levels outside of school. Knowledge of this relationship is needed to inform center-based interventions that are aimed at preventing excessive weight gain by increasing children's overall physical activity levels.

The present study was designed to describe the relationship between young children's physical activity levels while they are in the preschool or child care center setting and their activity levels outside this setting. We examined this relationship in two ways. First, in a diverse sample of young children, we determined the association between physical activity in the preschool setting (In-School) and outside of preschool (Out-of-School). Second, we compared In-School and Out-of-School physical activity in two sub-groups of children, those meeting and those not meeting a physical activity guideline during the school day.

Methods

Study Design and Participants

This study used a cross-sectional design and two distinct analytic strategies to examine the association between In-School and Out-of-School physical activity. Participants (n=341) were children ages 3 to 5 years from 16 public and private preschools. Data collection was conducted between September 2008 and August 2011. Written informed consent was obtained from each child's parent or guardian prior to data collection. The study was approved by the University of South Carolina Institutional Review Board.

Measurement of Physical Activity

Physical activity was measured with ActiGraph accelerometers (models GT1M and GT3X; Pensacola, FL). Accelerometers were initialized to save data in 15-second intervals in order to detect the spontaneous physical activity of preschool children.[16]

Participants were instructed to wear the accelerometers on an elastic belt on the right hip for a total of 5 consecutive weekdays. Parents were instructed to remove the accelerometer during water activities (bathing, swimming) and at bedtime. Trained data collectors checked each child's accelerometer at the beginning of each school day during the week. If a child was not wearing the accelerometer upon arrival at preschool, a temporary accelerometer was provided while the child attended preschool. Accelerometer data were later linked for each child. Accelerometers were removed prior to the weekend. A valid day was one in which the accelerometer was worn between 6 and 18 hours. To be included in the present analysis, children were required to provide at least 2 valid days of data.

Accelerometer cut-points specifically developed for preschool children were used to determine the time per hour spent in MVPA (≥ 420 counts/15 sec)[17] and total physical

activity (light + MVPA, > 200 counts/15 sec).[18] The school day was defined by each preschool as the period of instruction. Time not within the school day was considered Out-of-School. In-School and Out-of-School minutes per hour of MVPA and total physical activity (Total PA) were calculated as an average across the valid days for each participant.

Additional Variables

Each child's parent or guardian completed a survey to assess demographic characteristics. Parents reported their child's date of birth and race/ethnicity (categorized as African American, White, and Other) and their own educational level (categorized as below or above 2 years of college education).

Statistical Analyses

We used two distinct analytic strategies to examine In-School and Out-of-School physical activity. First, In-School and Out-of-School physical activity levels were compared with repeated measures ANOVA. Then, Pearson correlations were used to describe the association between In-School and Out-of-School MVPA and Total PA. We calculated the correlations for the total sample, and then separately for boys and girls.

The second analytic strategy compared In-School and Out-of-School physical activity in two sub-groups. Children were categorized on the basis of their compliance with a physical activity guideline for preschool children.[3] Children who obtained ≥ 15 min/hr of Total PA during the school day (averaged across all of the valid days) were categorized as *Meet Guideline*, and children who obtained < 15 min/hr of Total PA were categorized as *Do Not Meet Guideline*.[3] We conducted analyses for the entire sample, then separately for boys and girls. We used a 2-way repeated measures ANOVA to examine the effects of setting (In-School, Out-of-School) and group (*Meet Guideline, Do Not Meet Guideline*) on children's physical activity. Models were adjusted for race/ethnicity, parental education, and time spent in preschool (full vs. half day). Models for the total sample were adjusted for gender. Preschool (exact preschool attended) was a random variable in all models. All analyses were conducted using SAS 9.3.

Results

The characteristics of the study participants are presented in Table 1. Approximately 46% of the participating children were African American, 37% were White, and 17% were in other race groups. A majority of children (57.8%) had parents with at least a 2-year college degree. Children wore accelerometers for an average of 3.3 days and for 5.5 and 6.5 hr per day in the In-School and Out-of-School settings, respectively. Approximately one-third of children met the physical activity guideline, and significantly more boys (44.3%) than girls (24.6%) ($P < .001$) met the guideline.

The results of the correlational analyses performed in the full sample and in gender-specific groups are presented in Table 2. Children were significantly more physically active in the Out-of-School period than the In-School period ($P = .01$). This was the case for both MVPA and Total PA in the full sample and in both gender groups. In the full sample, In-School physical activity was positively associated with Out-of-School physical activity for both

MVPA ($P = .02$) and Total PA ($P = .01$). Among boys, In-School and Out-of-School physical activity were not associated for MVPA or Total PA. Among girls, In-School and Out-of-School physical activity were positively associated for Total PA ($P = .02$) but not MVPA.

Comparisons of In-School and Out-of-School physical activity in the two guideline compliance groups are presented in Table 3. Children who met the guideline during school hours remained active at essentially the same levels outside of school. However, children who did not meet the guideline during the school day had higher levels of MVPA outside of school than during the school day ($P < .001$), and those MVPA levels were comparable to the Out-of-School MVPA levels of children who met the guideline. Identical patterns were found for Total PA.

Discussion

Researchers have theorized that children's physical activity levels are determined largely by inherent, genetically-based factors.[19] If that theory is correct, children who are highly active in one setting would tend to be highly active in other settings. A major finding of the present study was that in-school physical activity was positively correlated with out-of-school physical activity, but the level of association was very modest. This observation indicates that young children's physical activity levels in the school setting are not predictive of their activity levels outside of school. This suggests that factors operating in specific settings, such as preschools, exert important influences on children's physical activity levels. Further, our findings suggest that, if an inherent genetic influence on children's physical activity exists, its effect is minimal in comparison to the effects of social and physical environmental factors that operate in settings like the school and home.

Although several studies have examined young children's physical activity patterns across the day,[20-22] this is the first study to directly compare in-school physical activity to out-of-school physical activity in young children. We found that young children were more physically active outside of school than in-school. This finding is consistent with that of O'Dwyer et al. who found that children who attended half-day preschool obtained significantly more MVPA than children who attended full-day preschool during the hours of 9:00 am to 3:00 pm.[23] Our findings and those of O'Dwyer et al.[23] suggest that children are less active in the preschool environment than when they are outside that setting.

Our findings extend those of previous studies by demonstrating different response patterns in children who met a physical activity guideline during the school day versus those who did not meet the guideline. We found that children who did not meet the physical activity guideline during the school day were substantially more active outside of school than in school. Outside of school, these children were as active as children who met the physical activity guideline during the school day. This suggests that, for some children, the preschool environment constrained their physical activity levels. Based on previous work by our research group and others, it is also likely that this effect was greater in some preschools than others.[8-14] For instance, previous studies have found that physical activity levels vary widely across preschools.[8-14] In the current study, physical activity levels varied considerably across preschools; MVPA ranged from 4.5 to 11.3 minutes per hour, and Total

PA ranged from 8.4 to 20.0 minutes per hour. The preschools also differed on the percentage of children who met the physical activity guideline during the school day: from 0% to 83%. The public and private preschools were evenly distributed across this range of meeting the physical activity guideline. There was also wide variability between classes, even those within the same preschool. This information suggests that there may be specific characteristics of the classroom (e.g., teachers, classroom management) that influence children's activity levels during preschool attendance. We have previously reported that overall preschool quality, playground size and characteristics, use of electronic media, and teacher physical activity training influence the physical activity levels of children in preschools.[24] Other studies have shown that portable play equipment,[25-27] large playgrounds with open outdoor space [14, 25-27] and less fixed equipment,[25, 26, 28] indoor opportunities to be active,[28] and teacher physical activity training [26, 28] are positively associated with children's activity in preschools. It is also possible that individual children respond to components of the preschool environment in ways that increase or decrease their physical activity levels. Additional research is needed to clarify the ways that preschool, classroom, teacher, and child characteristics influence children's physical activity levels in preschools.

The results of the present study underscore the importance of creating preschool environments that promote physical activity in all children. In this study, children who did not meet the physical activity guideline in school did not "catch up" with children who met the guideline. The physical activity levels of the two groups were very similar during the out-of-school period, for both MVPA and Total PA, indicating that children who did not meet the guideline did not compensate by becoming more active during out-of-school time than children who met the guideline.

This study has both strengths and limitations that need to be acknowledged. Strengths include the objective measurement of physical activity with accelerometry and a large, diverse sample of children from multiple preschools. This study is limited by its cross-sectional design, which does not allow for inference of causality, and the sampling of one metropolitan area, which may limit generalizability.

Conclusions

Young children's In-School physical activity was associated with their Out-of-School physical activity, but the level of association was very low. Further, children who did not meet the physical activity guideline during school were more active outside of school, suggesting that factors associated with the preschool and classroom may markedly reduce some children's activity levels during the school day.

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Table 1

Participant Characteristics ($N = 341$)

	Total Sample N = 341		Boys n = 174		Girls n = 167		*P*
	n	**%**	***n***	**%**	***n***	**%**	
Race/ethnicity							
African American	157	46.0%	78	44.8%	79	47.3%	.77
White	126	37.0%	64	36.8%	62	37.1%	
Other	58	17.0%	32	18.4%	26	15.6%	
Parental Education[a]							
College graduate	197	57.8%	104	59.8%	93	55.7%	.45
< College graduate	144	42.2%	70	40.2%	74	44.3%	
Age, years, M *(SD)*	4.6 ± 0.3		4.6 ± 0.3		4.6 ± 0.3		.50
Total days monitor worn, M *(SD)*	3.3 ± 0.8		3.3 ± 0.8		3.3 ± 0.7		.64
School hours monitor worn, M *(SD)*	5.5 ± 1.5		5.5 ± 1.5		5.5 ± 1.5		.66
Outside of school hours, M *(SD)*	6.5 ± 1.4		6.7 ± 1.5		6.4 ± 1.3		.06
Total hours monitor worn, M *(SD)*	12.1 ± 1.7		12.2 ± 1.7		12.0 ± 1.7		.20
Met the physical activity guideline [b]	118	34.6%	77	44.3%	41	24.6%	< .001

[a] College graduate ≥ 2 years of college education.

[b] Obtained ≥ 15 min per waking hour of total physical activity.

Table 2

Mean (SD) In-School and Out-of-School MVPA and Total PA (min per hr) and Pearson correlations between In-School and Out-of-School MVPA and Total PA (min per hr)

	In-School	Out-of-School	Setting		r	*P*
	MVPA min/hr[a]		**F**	***P***		
Total Sample	7.1 (2.7)	8.6 (3.1)	7.8	.01	.13	.02
Boys	7.6 (2.8)	8.9 (3.2)	5.9	.03	.13	.08
Girls	6.5 (2.5)	8.2 (3.0)	8.7	.01	.09	.26
	Total PA min/hr [a]					
Total Sample	14.1 (4.5)	16.9 (4.4)	9.5	.01	.15	.01
Boys	14.9 (4.5)	17.2 (4.4)	7.0	.02	.09	.24
Girls	13.3 (4.4)	16.6 (4.4)	16.3	.001	.18	.02

MVPA, moderate-to-vigorous physical activity; PA, physical activity

[a]Per waking hour

Table 3

Comparison between In-School and Out-of-School MVPA and Total PA min per hr, (N = 341), M (SE) [a]

	MVPA		
	In-School MVPA min per hr[c]	**Out-of-School MVPA min per hr[c]**	***P***
Total Sample			
Meet Guideline	9.5 (0.3)	8.7 (0.3) [b]	.09
Do Not Meet Guideline	5.6 (0.3)	8.5 (0.3) [b]	<.001
Boys			
Meet Guideline	9.5 (0.4)	8.9 (0.4) [b]	.25
Do Not Meet Guideline	5.5 (0.4)	8.3 (0.4) [b]	<.001
Girls			
Meet Guideline	9.6 (0.5)	8.1 (0.5) [b]	.01
Do Not Meet Guideline	5.6 (0.4)	8.4 (0.4) [b]	<.001
	Total PA		
	In-School Total PA min per hr [c]	**Out-of-School Total PA min per hr [c]**	***P***
Total Sample			
Meet Guideline	18.0 (0.5)	17.2 (0.5) [b]	.25
Do Not Meet Guideline	11.6 (0.5)	16.6 (0.5) [b]	<.001
Boys			
Meet Guideline	17.8 (0.6)	17.5 (0.6) [b]	.70
Do Not Meet Guideline	11.5 (0.6)	16.4 (0.6) [b]	<.001
Girls			
Meet Guideline	18.6 (0.7)	16.5 (0.7) [b]	.006
Do Not Meet Guideline	11.4 (0.5)	16.5 (0.5) [b]	<.001

MVPA, moderate-to-vigorous physical activity; PA, physical activity.

Note: *Meet Guideline* defined as ≥ 15 min/hour of total physical activity. *Do Not Meet Guideline* defined as <15 min/hour of total physical activity.

[a] Models adjusted for race/ethnicity, parental education, and half-day/full-day program, with school as a random variable. Model with total sample also adjusted for sex.

[b] All comparisons between *Meet Guideline* and *Do Not Meet Guideline* were $P > .05$.

[c] Per waking hour