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After-school setting, physical activity, and sedentary behavior in 5th grade boys and girls

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ABSTRACT

After-school hours are considered critical for children's physical activity (PA) and sedentary behaviors (SB); however, whether the after-school setting influences children's activity patterns is unknown. This study examined the influence of after-school setting (i.e., parent report of the child's usual after-school setting) on 5th grade children's PA and SB, and differences by race/ethnicity. Boys whose parents reported they usually attended an after-school program had higher PA than boys who usually went home after school. A significant interaction between race/ethnicity and after-school setting showed that minority girls whose parents reported they usually attended an after-school program had higher PA and engaged in less SB compared with those who usually went home, whereas the activity patterns of white girls did not differ by after-school setting. Children's usual after-school setting affects their activity patterns; after-school programs may potentially increase PA in boys and minority girls.

1. Introduction

Despite increased public health efforts, few children meet the national guidelines which recommend engaging in at least 60 min of moderate-to-vigorous physical activity (MVPA) per day (Centers for Disease Control and Prevention, 2003, 2010). A combination of limited resources and increased pressure on academic achievement reduces the opportunity for children to be physically active during the school day (Pate and O'Neill, 2009). The after-school context has been identified as one setting that can be targeted to increase physical activity in children as a significant portion of children's physical activity occurs during the hours after school (Atkin et al., 2008).

Several studies have examined children's physical activity levels outside of the school day (Cox et al., 2006; Tudor-Locke et al., 2006, 2009; Dale et al., 2000; Flohr et al., 2006; Steele et al., 2010; Nyberg et al., 2009), although most of the studies have not examined the specific settings in which the activities occurred. Trost et al. (2008) looked specifically at the physical activity of children attending after-school programs; however, this study did not explore racial/ethnic differences in activity levels, nor did it compare children's activity levels in the after-school program with their activity levels in other settings.

Children engage in a variety of activities during after-school hours, including physical activity, lessons and classes, homework, and electronic media and other sedentary pursuits (Atkin et al., 2008; Stanley et al., 2011). However, no research has examined how patterns of activity vary across after-school settings. It is likely that the setting within which children spend the majority of their after-school time will facilitate different levels of activity; though, it is unclear whether children who are at home after school are more or less physically active than those who attend after-school programs.

Studies have shown that after-school programs can contribute up to one-third of a child's recommended daily physical activity (Trost et al., 2008), and positively affect physical fitness, body composition, and blood lipid profiles (Beets et al., 2009). After-school programs may be particularly important for racial/ethnic minority children, who tend to participate in physical activity at lower levels than white children (Centers for Disease Control and Prevention, 2010). Up to 40% of children participating in after-school programs are racial/ethnic minorities (Afterschool Alliance, 2009). However, no studies have examined differences in levels of physical activity and sedentary behavior across racial/ethnic groups in selected after-school settings. Determining whether physical activity levels differ by race/ethnicity during the after-school hours could help to tailor interventions to increase children's physical activity after school.

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In sum, although it is understood that the hours after school are important contributors to children's physical activity, it is unclear how specific after-school settings contribute to the activity patterns of boys and girls of different racial/ethnic backgrounds. The aims of the current study are: (1) to determine the physical activity and sedentary behaviors of children during the hours after school until 6 p.m. by usual after-school setting (i.e., parent report of whether the child usually attended an after-school program or went home after school), and (2) to examine racial/ethnic differences in the physical activity and sedentary behaviors of children by usual after-school setting. Analyses were performed separately for boys and girls because gender differences exist in the physical activity patterns of children after school (Mota et al., 2003).

2. Methods

2.1. Participants and setting

Data were drawn from the Transitions and Activity Changes in Kids (TRACK) study, a multi-level, longitudinal study of influences on the changes in children's physical activity as they transition from elementary to middle school. The original sample of 1098 5th graders was limited to children with complete baseline data on race/ethnicity, parental education, after-school physical activity, and body mass index (BMI), resulting in a final sample of 662 5th grade students, including 297 boys and 365 girls.

Children were recruited from 21 public elementary schools in 2 school districts in South Carolina. District approval was obtained through meetings with district superintendents and administrators prior to soliciting school participation. Fourteen of the 17 elementary schools in one district and all 7 of the elementary schools in the other district agreed to participate. Recruitment assemblies were held in all schools, during which 5th graders were invited to participate in the study and received information regarding the data collection procedures. Informed consent packets were sent home with the children for their parents to read, complete and return. Children also gave their assent before beginning any study procedures. The Institutional Review Board at the University of South Carolina approved all protocols.

2.2. Measures

2.2.1. Physical activity

Physical activity was measured by accelerometry (ActiGraph GT1M and GT3X models, Fort Walton Beach, FL). The ActiGraph has been validated for use with children and has high inter-rater reliability and strong correlations with energy expenditure. Children wore the monitors on their right hip for 7 consecutive days during most waking hours, except when sleeping or doing water-related activities (e.g., bathing or swimming). Monitors were initialized prior to data collection and were set to begin collecting data at 5:00 a.m. on the day after they were distributed to participants at school. Data were collected and stored in 1-min intervals. Non-wear time, i.e., any period of 60 or more minutes of consecutive 0's, was recoded to missing. For the present analyses, only activity counts from the 5 weekdays that occurred during after-school hours were used. Children wore the accelerometers for an average of 3.5 h per day (min 2.3 h, max 3.6 h) during the hours after school until 6 p.m.

The threshold for moderate physical activity was 2200 counts/min corresponding to 4.0 metabolic equivalents (METs; 1 MET$=$3.5 mL O_2 kg^{-1} min^{-1}), and the threshold for vigorous physical activity was 5100 counts/min corresponding to 7 METs (Freedson et al., 2005). The threshold to distinguish sedentary from light activity was set at 100 counts/min. Using these cut-points, accumulated minutes per hour of total physical activity (total PA), moderate-to-vigorous physical activity (MVPA), and sedentary behavior were determined for each participant. In addition, the proportion of children who met current physical activity guidelines to engage in at least 60 min of MVPA per day was calculated.

Ninety-two percent of children had complete accelerometer data for 3 or more days during the hours after school. Missing after-school accelerometer data was imputed separately by gender for children with 2 or more days with at least 60% ($\geq$2.2 h) of after-school wear using PROC MI in SAS (Yuan, 2000). Imputed days and/or hours of wear were based on the child's data record from the remaining days.

2.2.2. After-school setting

Parent report of the child's usual after-school setting was assessed with the question, "Where does your child go most often after school?" Possible response options included: after-school program at school, after-school program at another location, home (with supervision), home (without supervision), home of a relative/friend, and other. For the present analyses, responses were collapsed into two groups: (a) after-school program [at school or other location] and (b) home [with supervision or home of a relative/friend]. The 'home (without supervision)' and 'other' categories were considered to be conceptually distinct from the other groups and were dropped (n=17 and n=21, respectively).

2.2.3. Sociodemographics

Participants completed a survey that asked about their age, gender, and race/ethnicity. For race, they were asked to check as many categories as applied (white, African American/black, Asian, American Indian/Alaskan Native, and other). They were also asked to identify whether they consider themselves Hispanic or Latino (Y/N). The racial/ethnic background of the current sample was approximately 39% white, 33% black, 11% Hispanic, and 17% mixed or other race; however, due to the diversity of the mixed/other race category (n=137), this category was dropped and responses were re-coded as 'white' and 'minority' (i.e., black and Hispanic) for the present analysis. Participant height and weight was measured by trained staff at baseline using Shorr measuring boards and Seca model 770 scales. With this information, body mass index (BMI) was calculated using the standard equation (body weight [kg]/height [m]^2).

Socio-economic status (SES) was estimated based on parental report of the highest level of parental education; the item was re-coded as 'high school or less' and 'more than high school.' In addition, parents reported whether they were currently employed (Y/N). The parent survey also included questions about whether their child participated in any organized sports and/or physically active classes/lessons within the past year (Y/N), and whether the parent believed it was safe for their child to play outdoors in their neighborhood (agree/disagree).

2.3. Statistical analysis

Descriptive statistics were calculated for the total group and for children according to after-school setting. T-tests and Chi-square analyses were used to determine if there were differences in any of the characteristics by setting (home versus after-school program). Mixed model ANOVAs with school and location (school district) as random variables were utilized to determine if there were differences in sedentary behavior, MVPA and total PA

Table 1
Descriptive characteristics of children according to usual after-school setting.

Characteristic	% (*n*) or Mean (SD)			
	Total (*n*=662)	**Home (*n*=534)**	**Program (*n*=128)**	***p*-value**
Gender, (%) male	44.8	46.6 (249)	37.5 (48)	0.062
Age, mean (SD), (y)	10.6 (0.5)	10.6 (0.6)	10.5 (0.5)	0.387
Race, (%)				**0.019**
White	46.8	49.1 (262)	37.5 (48)	
Minority	53.2	50.9 (272)	62.5 (80)	
Parents with > high school education, (%)	67.4	67.4 (360)	67.2 (86)	0.961
Parent employed, (%)	66.0	61.7 (317)	83.6 (107)	**<0.001**
Neighborhood safe, (%)	74.6	75.3 (391)	71.5 (88)	0.385
Sport participation/other PA lessons, (%)	65.1	62.4 (314)	76.0 (95)	**0.004**
Meeting daily PA guidelines, (%)	10.6	10.7 (57)	10.2 (13)	0.864
BMI, mean (SD)	21.2 (5.0)	21.1 (4.9)	21.4 (5.2)	0.584
Sedentary behavior, mean (SD), (min/h)	27.9 (6.9)	28.3 (7.0)	26.2 (6.3)	**0.002**
MVPA, mean (SD), (min/h)	3.4 (2.9)	3.2 (2.8)	3.9 (3.2)	**0.019**
Total PA, mean (SD), (min/h)	32.1 (6.9)	31.7 (7.0)	33.8 (6.3)	**0.002**

Note: SD, standard deviation; y, year; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); PA, physical activity; MVPA, moderate-to-vigorous physical activity; Minority group includes African American/black and Hispanic/Latino participants; bold-face type indicates significant difference ($p<0.05$) between after-school settings.

Table 2
Minutes per hour of physical activity and sedentary behavior during the hours after school until 6 p.m. according to usual after-school setting.

Dependent variable	Boys (*n*=297)			Girls (*n*=365)		
	Program (*n*=48)	**Home (*n*=249)**	***p*-value**	**Program (*n*=80)**	**Home (*n*=285)**	***p*-value**
Unadjusted						
Sed behavior	25.31 (1.07)	27.45 (0.59)	0.050	26.48 (0.78)	29.02 (0.45)	**0.003**
MVPA[a]	5.19 (0.49)	4.14 (0.22)	**0.027**	3.10 (0.25)	2.43 (0.16)	**0.010**
Total PA	34.69 (1.07)	32.55 (0.59)	0.050	33.52 (0.78)	30.97 (0.45)	**0.003**
Adjusted						
Sed behavior	25.12 (1.08)	27.25 (0.59)	0.050			[b]
MVPA[a]	5.27 (0.49)	4.24 (0.24)	**0.023**			[c]
Total PA	34.90 (1.08)	32.75 (0.59)	0.050			[d]

Note: Data are given as least square means (SE); adjusted models included covariates age, race/ethnicity, BMI and SES; Sed, sedentary; MVPA, moderate-to-vigorous physical activity; PA, physical activity.

[a] *P*-value is based on square-root transformation.
[b] Data not shown due to significant interaction between race/ethnicity and after-school setting ($p=0.002$). See Fig. 1 for further detail.
[c] Data not shown due to significant interaction between race/ethnicity and after-school setting ($p=0.04$). See Fig. 2 for further detail.
[d] Data not shown due to significant interaction between race/ethnicity and after-school setting ($p=0.002$). See Fig. 3 for further detail.

(light+MVPA) between after-school settings. Models were performed separately by gender and were calculated with and without adjusting for age, race/ethnicity, BMI and SES. An interaction term between race/ethnicity and after-school setting was also tested. If the interaction was not significant, the term was removed from the model.

3. Results

Descriptive characteristics (percents or means and standard deviations) of the children according to after-school setting are presented in Table 1. On average, children were 10.6 ± 0.5 years old, 53% were minorities (black and Hispanic), 67% of children's parents had more than a high school education, and only 10.6% of children were meeting daily physical activity guidelines. Parents reported that the majority of children usually went home after school (80.6%) rather than to an after-school program (19.3%).

Children who usually attended an after school program were more likely to be minorities ($p<0.05$), have a parent who was employed ($p<0.001$), and participate in organized sports and lessons over the past year ($p<0.01$) compared with children who usually went home after school (Table 1). Overall, those children who usually attended an after-school program accumulated fewer minutes per hour of sedentary behavior ($p<0.01$) and more minutes per hour of MVPA ($p<0.05$) and total PA ($p<0.01$) compared with those who usually went home. However, the proportion of children who met current physical activity guidelines did not differ by after-school setting.

Table 2 presents the results of the unadjusted and adjusted mixed model ANOVAs comparing the activity patterns of boys and girls by after-school setting. In the unadjusted model, boys whose parents reported they usually attended an after-school program engaged in significantly more MVPA than those who usually went home after school. When the model was adjusted for covariates (i.e., age, BMI, race/ethnicity, and SES), these boys had significantly higher levels of MVPA (program: 5.3 min/h, home: 4.2 min/h; $p<0.05$) compared with boys who usually went home after school. Boys also spent less time in sedentary behavior (program: 25.1 min/h, home: 27.3 min/h) and had higher levels of total PA (program: 34.9 min/h, home: 32.8 min/h) compared with boys who usually went home after school (p's=0.05).

In the unadjusted model, girls whose parents reported they usually attended an after-school program spent significantly less time in sedentary behavior and had higher levels of MVPA and total PA than girls who usually went home after school (all p's <0.05). In the adjusted model, a significant interaction effect was present between race/ethnicity and after-school setting for

sedentary behavior ($p=0.002$), MVPA ($p=0.04$), and total PA ($p=0.002$). That is, minority girls who usually attended an after-school program (27.7%) spent significantly less time in sedentary behavior and had higher levels of MVPA and total PA than those who usually went home (all p's <0.01).

Specifically, minority girls who usually attended an after-school program participated in 5 fewer minutes of sedentary behavior per hour (i.e., a potential total of approximately 15 fewer minutes per day during after-school hours) compared with those who usually went home after school (Fig. 1, $p<0.0001$). Minority girls who usually went to an after-school program engaged in approximately 3 more minutes per hour of MVPA per day during after-school hours compared to those who usually went home after school (Fig. 2, $p<0.0001$). Further, minority girls who attended an after-school program accrued an additional 5 min/h of total PA compared to those who went home after school (Fig. 3, $p=0.001$). For white girls, the amount of time spent in sedentary behavior, MVPA, and total PA did not differ by after-school setting (Figs. 1–3).

Though the interaction effect between race/ethnicity and after-school setting was not significant for boys, minority boys who usually attended an after-school program (17.3%) spent less time in sedentary behavior ($p<0.05$), and had higher levels of MVPA ($p<0.01$) and total PA ($p<0.05$) compared with minority boys who usually went home after school.

4. Discussion

This study examined the influence of parent-reported usual after-school setting on the activity patterns of 5th grade children during the hours after school, and determined whether this

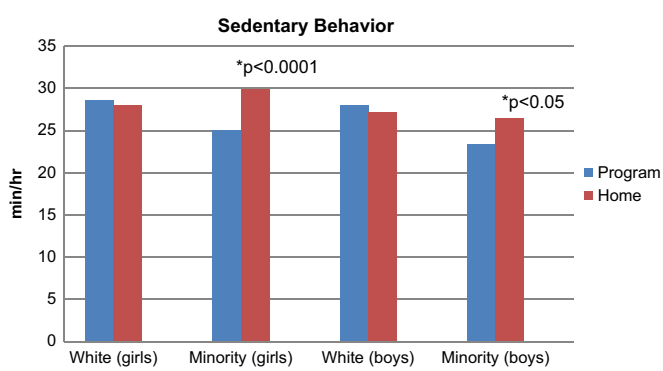

Fig. 1. Interaction between race/ethnicity and after-school setting for sedentary behavior (min/h), boys ($p=0.32$) and girls ($p=0.002$).
*p-value testing differences in sedentary behavior between home and after-school program

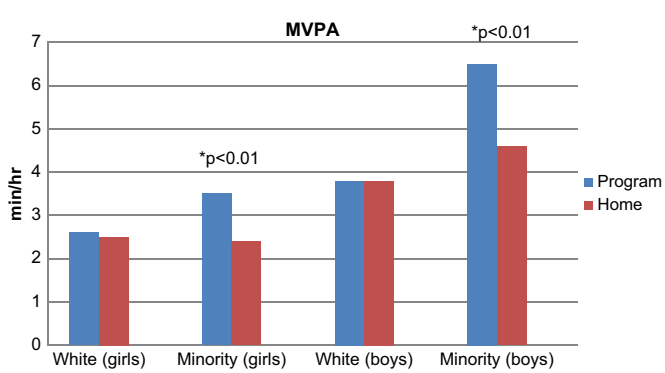

Fig. 2. Interaction between race/ethnicity and after-school setting for moderate-to-vigorous physical activity (MVPA) (min/hr), boys ($p=0.15$) and girls ($p=0.04$).
*p-value testing differences in MVPA between home and after-school program

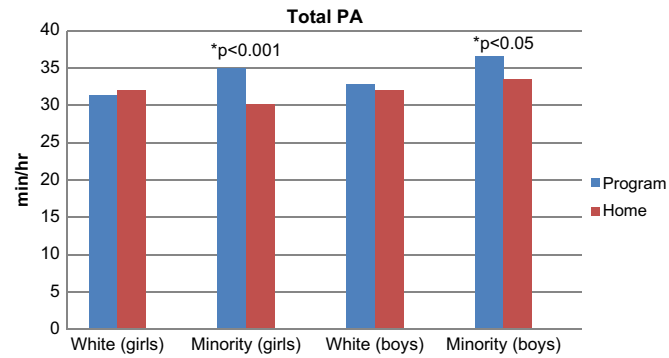

Fig. 3. Interaction between race/ethnicity and after-school setting for total physical activity (total PA) (min/h), boys ($p=0.32$) and girls ($p=0.002$).
*p-value testing differences in total PA between home and after-school program

relationship differs by race/ethnicity. The major finding from this study was that boys and minority girls whose parents reported they usually went to an after-school program had higher levels of physical activity compared with those who usually went home after school. This study provides evidence that the setting where children spend their after-school hours may affect activity patterns, particularly for boys and minority girls.

This study is the first to identify higher levels of physical activity and lower levels of sedentary behavior in minority girls who usually attend after-school programs compared with those usually at home. One previous study examining whether children in after-school programs were meeting state and national physical activity guidelines found that African American children were more active than their white, non-Hispanic counterparts (Beets et al., 2010). Activity preferences differ between girls of different races/ethnicities (Olvera et al., 2009; Grieser et al., 2006; Dowda et al., 2004), and the after-school programs in this study may have focused on activities that appealed more to minority girls than white girls. In addition, social norms for minority girls may differ between the after-school program and the home environment. For example, program staff may expect and encourage minority girls to be active, but parents or other home caregivers may expect them to participate in activities (e.g., childcare, chores) that may limit their leisure-time physical activity. In addition, safety issues may prevent them from playing outside when at home after school (Gomez et al., 2004). Studies examining the correlates of physical activity for minority children during after-school hours are needed; such information could help to tailor interventions to increase physical activity in minority children in different after-school settings.

The majority of children in this study usually went home after school, and children at home engaged in more sedentary behavior than those who usually participated in an after-school program. However, it is important to note that children, regardless of setting, spent nearly half of their after-school hours in sedentary activities. Previous studies have similarly reported that children spend a large portion of their after-school time in sedentary behaviors, including playing video games and watching television (Trost et al., 2008; Atkin et al., 2008). As such, efforts need to be made to reduce children's sedentary behaviors during after-school hours, regardless of after-school setting.

Another significant finding is that minority girls who went to an after-school program participated in 5 fewer minutes per hour of sedentary behavior during the hours after school, compared with minority girls who usually went home; if a girl attended the program every day, this could result in a potential decrease of 75 min of sedentary behavior over the entire week. Because minority females, particularly black girls, experience higher rates of overweight and obesity compared to girls of other race/ethnicities (Ogden et al., 2010), the current findings suggest that after-school programs may be

an effective way to decrease minority girls' time in sedentary behavior and increase physical activity to improve their health and weight status. Further, after-school programs may be able to address common barriers to physical activity for low-income, minority children, including barriers related to transportation, cost, and neighborhood safety (Kien and Chiodo 2003; Ziviani et al., 2008; Brockman et al., 2009). More research is needed on the characteristics, structure, and activities of after-school programs that may promote physical activity in children of diverse race/ethnicities.

Strengths of this study included the objective measure of physical activity, a racially/ethnically diverse sample of children, and the information on after-school setting. To our knowledge, this is the first study to examine children's after-school activity patterns according to after-school setting. The study was limited by the small sample size of those in the after-school program group, which may have decreased the ability to detect meaningful differences between groups and a significant interaction effect between race/ethnicity and after-school setting for the boys. Further, after-school setting was based on parental report of where the child usually goes after school. Therefore, it is possible that children were in other settings on some days or that the setting varied between the hours after school until 6 p.m.

There were statistically significant differences between the activity patterns of boys and minority girls based on place, i.e., the after-school program versus home, but these differences were relatively small. It is possible that small changes in individuals lead to more meaningful differences in activity levels at the population-level. Integration of more precise measures of place for a specific time frame (i.e., hours after-school) will improve our ability to examine the relationship between place and child activity patterns.

We took additional steps to examine possible confounders (e.g., living in a single-parent household, sport participation, parent employment) that may have explained the racial/ethnic differences in activity patterns by after-school setting; however, under these alternative specifications, the interaction effect for girls remained significant. It is likely that each after-school setting has unique facilitators and barriers to children's physical activity, and that these characteristics of place influence children of diverse race/ethnicities differently. Further study into the physical, social and cultural aspects of place that influence children's after-school physical activity is warranted.

In sum, this study provides further evidence that the hours after school are critical for children's physical activity (Atkin et al., 2008; Mota et al., 2003; Tudor-Locke et al., 2006), and that after-school programs may make an important contribution to boys' and girls' physical activity. Because the majority of children went home after-school, encouraging and instructing parents in how to promote physical activity after school at home in- or outdoors is warranted. Continued efforts should focus on reducing children's sedentary behaviors during after-school hours, recruiting children into after-school programs, and examining the characteristics of after-school programs that promote physical activity in children of diverse race/ethnicities.

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