Pediatric Exercise Science, 2015, 27, 226-233
http://dx.doi.org/10.1123/pes.2014-0061

Human Kinetics
ORIGINAL RESEARCH

Associations Between Home Environment and After-School Physical Activity and Sedentary Time Among 6th Grade Children

Erica Y. Lau, Daheia J. Barr-Anderson, Marsha Dowda, Melinda Forthofer, Ruth P. Saunders, and Russell R. Pate
University of South Carolina

This study examined associations of various elements of the home environment with after-school physical activity and sedentary time in 671 6th-grade children (M_{age} = 11.49 ± 0.5 years). Children's after-school total physical activity, moderate-to-vigorous physical activity, and sedentary time were measured by accelerometry. Parents completed surveys assessing elements of the home social and physical environment. Mixed-model regression analyses were used to examine the associations between each element of the home environment and children's after-school physical activity and sedentary time. Availability of home physical activity resources was associated positively with after-school total physical activity and negatively with after-school sedentary time in boys. Parental support was associated positively with after-school total physical activity and MVPA and negatively with after-school sedentary time in girls. The home physical environment was associated with boys' after-school physical activity and sedentary time, whereas the home social environment was associated with girls' after-school physical activity and sedentary time.

Keywords: activity-related parenting, availability of physical activity resources, parental support

Despite the well-established health benefits of regular physical activity (41), less than 50% of US children meet physical activity recommendations (36), and many become increasingly physically inactive as they move through adolescence (40). During early adolescence (ages 11–14), girls and boys experience declines in moderate-to-vigorous physical activity by 46% and 23%, respectively (4). Factors that may influence this decline include replacing physical activity with sedentary pursuits (e.g., surfing the internet, hanging out with friends) as early adolescents gain more control over their discretionary time (8,43) and decreased motivation for and enjoyment of physical activity due to puberty-related changes in self-concept (9,21). Because most health behaviors begin to be established during late childhood and early adolescence, developing effective strategies to facilitate positive physical activity habits among children in this developmental period is critical.

Schools are an ideal setting for promoting physical activity in children and adolescents for a number of reasons, including the number of hours spent in school each day, the availability of human and infrastructure resources in educational settings and the supportive teacher-student relationships (25). However, it is particularly challenging to incorporate physical activity opportunities into the school day in middle schools because of the crowded academic schedules and increased pressure to improve standardized test scores (6). Thus, evidence from previous studies (6,23) suggests that only 6.4% of middle schools offer physical education on a daily basis (6), and only 10% of school districts require that middle schools provide regular physical activity breaks.

Given these limitations on physical activity during the school day, the after-school period (i.e., 3:30–6:00 p.m.) (1) has been identified as a critical window for promoting physical activity in children (2). A majority of children report participating in physical activity during the after-school period (2). After-school physical activity accounts for a substantial amount of children's total daily physical activity, contributing almost 50% of total daily steps among 6th-grade children (39). More importantly, after-school time is considered a discretionary time period in which children in early adolescence are given some autonomy to decide how to spend their time, choosing from a number of physical activities and sedentary pursuits (22). Therefore, gaining an understanding of the factors that affect activity choice during the after-school

Lau, Barr-Anderson, Dowda, and Pate are with the Dept. of Exercise Science, Forthofer the Dept. of Epidemiology and Biostatistics, and Saunders the Dept. of Health Promotion, Education, and Behavior, University of South Carolina, Columbia, SC. Address author correspondence to Erica Y. Lau at lauy@email.sc.edu.

hours may be essential in designing interventions that help early adolescents initiate and maintain lifelong physical activity behaviors.

In addition to school and after-school settings, studies have shown that the home environment, where children spend much of the after-school period, is important for promoting leisure-time physical activity in children (37). The home environment is comprised of characteristics of both the social and physical environment (32,34). The home social environment includes factors such as parent modeling of physical activity behavior, social support for physical activity (e.g., funding, transportation, encouragement), and parental monitoring of sedentary behaviors (e.g., restricting television viewing time at home) (10,15,30). The home physical environment includes the availability of physical activity resources (e.g., bikes, yard) and opportunities for sedentary pursuits (e.g., television and computer video games) (33).

Previous studies have examined the effects of the home environment on children's physical activity and sedentary behaviors (24,26,42); however, very few of them have focused on the after-school period and/or children in early adolescence. In addition, most previous studies have examined the home social environment (10,15) or home physical environment (13,18) separately but not simultaneously. Therefore, the purpose of the current study was to examine the associations of the home environment with 6th grade children's physical activity and sedentary time during the after-school period.

Methods

Participants

Participants were enrolled in the Transitions and Activity Changes in Kids study (TRACK), a multilevel, longitudinal study aimed at investigating the factors that influence changes in children's physical activity during the transition from elementary school to middle school. The detailed TRACK protocol has been reported elsewhere (35). In brief, TRACK recruited children from 21 public elementary schools in 2 school districts in South Carolina. Children in 5th grade were invited to participate in the study, which included annual follow-up through 7th grade. Written informed consent and assent were obtained from the primary guardian and each child before beginning any study procedures. The study was approved by the Institutional Review Board at the University of South Carolina.

The data collection for 6th grade children was conducted in Spring (February to May) and Fall (September to November) 2011. One thousand and seven children participated in the measurement protocol in 6th grade. Eight hundred and sixty children had valid after-school accelerometer data and 671 children had returned the parent survey with complete data on the child's sociodemographics and home environmental characteristics. This resulted in a final analysis sample of 671 children including of 314 boys and 357 girls. Missing data were assumed to be missing at random as there were no statistically significant differences between children in the analysis sample and those who were excluded in terms of age, gender, BMI, parent education, after-school total physical activity, after-school sedentary time, and after-school moderate-to-vigorous physical activity. The only characteristic that associated with missingness was race. Compared with children who were excluded, children in the analysis sample had slightly higher percentage of white than black.

Measures

Physical Activity and Sedentary Time. Children's physical activity and sedentary time were measured by ActiGraph GT1M and GT3× accelerometers (Fort Walton Beach, FL). The ActiGraph is a valid assessment tool for measuring children's level of physical activity and sedentary time. During the onsite measurement, trained and certified data collectors attached accelerometers to adjustable elastic belts and worn them on the participants. Participants were instructed to wear the monitor on their right hip for 7 consecutive days while they were awake except for bathing and swimming.

Accelerometers were initialized to begin collecting data at 5:00 AM on the day after distribution of the monitor to participants at school. Data were collected and stored in 60-s epochs. This epoch length was selected based on protocol used to reduce National Health and Nutrition Examination Survey accelerometer data for a nationally representative sample of children ages 6–17 years (36). Any period of 60 min or more of consecutive zero counts was defined as nonwear time and set to missing. For the present analyses, only activity counts from the 5 weekdays that occurred during the after-school time (3:30–6:00 p.m.) were used. A valid day was defined as at least 1.5 hr of wearing time per day during the after-school period. Participants with at least 2 valid days were retained for the analysis sample.

Age-specific movement count thresholds were determined based on the Freedson's energy expenditure prediction equation as suggested by Trost and colleagues (37). The Freedson/Trost equation was selected because it has shown good classification accuracy for different levels of physical activity intensity among children over 10 years (37). The activity intensity was defined in counts per minute (cpm). The intensity-thresholds criteria was 2200 cpm or more corresponding to 4.0 metabolic equivalents (1 METs= 3.5 ml O_2 log^{-1} min^{-1}) for moderate intensity and 5100 cpm or morecorresponding to 7.0 METs for vigorous intensity. An intensity-thresholds of less than 100 cpm was used to distinguish sedentary from light intensity activity. Using these cut-points, average minutes per hour spent in total physical activity (total physical activity: light-intensity + moderate-to-vigorous intensity), moderate-to-vigorous physical activity, and sedentary behavior during the specified after-school time were calculated for each participant.

Time spent in physical activity and sedentary activities during the after-school period was calculated based on 5 days of weekday data. Any days with less than 1.5 hr of after-school wearing time were regarded as invalid and set to missing. In this study, 79% of the total monitoring days were valid. Missing days (21% of the total monitoring days) were imputed separately by gender using the SAS PROC MI procedure (44). The PROC MI procedure used a regression method (data augmented with Marko Chain Monte Carlo generation of imputed values) to predict the missing values from the observed days using the following predictor variables: wearing time, sedentary time, light-intensity PA, moderate-to-vigorous physical activity, and log-transformed MET-weighted MPA and moderate-to-vigorous physical activity. Five imputations are created for the missing data and the average of the 5 complete data sets was taken to replace the missing values.

Home Environment. The elements of the home social environment were assessed by 3 subscales. Parents' leisure time physical activity and sports participation were measured by a questionnaire designed by Baecke et al. (3). Parents responded to 8 items on 5-point Likert scales (never, seldom, sometimes, often, very often, or always). The scores of 4 items related to the 2 most frequently played sports were used to calculate a sports index. The total score of another 4 items related to leisure time television viewing, walking, and cycling were used to calculate a leisure time index. Detailed descriptions of the questionnaire and the reliability and validity were documented elsewhere (3,28). Parental support for physical activity was measured by 4 items adopted from previous study (31). Parents reported how many days in a typical week they provided their child with tangible (i.e., transportation, participation in physical activity with child and supervision) and intangible (i.e., encouragement) support for physical activity. Response options ranged from 0 to 7 days. The items showed good reliability (Cronbach's α =0.78) in the current study. Family rules on monitoring the child's time spent viewing television and playing video/computer games were measured by 2 items (19). Responses were recorded on a 5-point Likert scale ranging from *strongly disagree* to *strongly agree*. A mean score for each subscale was calculated. The items were found to have good reliability (Cronbach's $\alpha = 0.86$).

The elements of the home physical environment were assessed by a 14-item home physical activity resource checklist adopted from previous study (31). Parents reported the availability of physical activity resources at home or in the yard (e.g., indoor play space, cardio equipment, balls, jump ropes). Another 3 items measured the number of televisions, computers, and video game consoles present in the home. The scale was found to have good test-retest reliability (31).

Anthropometry. Height and weight were measured by trained staff members using a standard protocol in a private setting, with participants dressed in light clothing and with shoes removed. Height was measured to the nearest 1 mm using a Shorr measuring board. Body weight was measured to the nearest 0.1 kg with a calibrated Seca Model 770 scale. BMI was calculated by dividing weight in kilograms by height in meters squared.

Sociodemographics. Children's age (years), gender, and race/ethnicity (i.e., African American or black, Asian, American Indian or Alaskan Native, Hispanic, white, and other or mixed race) were recorded. Due to the small numbers of Asian, American Indian or Alaskan Native and other or mixed race children in this population, these 3 categories were collapsed to one category referred to as *other* or mixed race. Parents also completed a survey regarding their highest level of education (i.e., attended high school/completed high school/attended college or technical school/completed college or technical school/attended graduate school/completed graduate school). The item was recoded as *high school or less* and *more than high school*, and it was used as an indicator of child's socioeconomic status. Parents also reported the number of adults (anyone aged 18 or older) who normally live in the child's home. In addition, one item was used to ask parents to report where their child goes most often after school (i.e., after-school program at school, after-school program at another location, home with supervision, home without supervision, home of a relative or friends and others). As the majority of the parents reported their child was at home, the response to this item was dichotomized into home and not at home.

Statistical Analysis

Descriptive statistics (percentages or means and standard deviations) were calculated to describe the sample characteristics and the distribution of values for dependent and independent variables. T-tests and chi-square tests were conducted to determine gender differences in continuous and categorical variables, respectively.

Mixed-model regression analyses were performed to examine the independent association of each home environment element with after-school physical activity and sedentary time. Before conducting the regression models, assumptions of multivariate statistics were evaluated. The assumption evaluation indicated that the distribution of after-school moderate-to-vigorous physical activity was skewed, so the after-school moderate-to-vigorous physical activity data were square root transformed. In the initial models, after-school total physical activity, moderate-to-vigorous physical activity and sedentary time were used separately as dependent variables; elements of the home environment were entered as independent variables in each model. To control for clustering of children within schools and districts, school and district were entered as random effect variables in all mixed-model regression analyses. The full adjusted models controlled for the child-level variables BMI, race/ethnicity, age, parental education, numbers of adults who normally live in the child's home and after-school location, because these 5 variables are correlated with children's physical activity and sedentary time. Data were stratified by gender

for all analyses. Statistical significance was set at $p < .05$. Analyses were performed using SAS 9.2 statistical software (SAS Institute, Cary, NC).

Results

Of the 671 children, 47% were male, 40% White, 33% Black, and 18% Hispanic, and 70% had a parent with more than a high school education. On average, children were 11.49 ± 0.5 years old and the mean BMI was 21.75 ± 5.21 kg/m^2. Most of the parent surveys were completed by mothers (87%). Parents/primary care providers reported that approximately 80% of the children normally live with 2 or more adults; and over 80% of the children were at home during after-school time. The mean minutes per hour of after-school total physical activity, moderate-to-vigorous physical activity and sedentary time were 30.74 ± 6.47 (min/hr), 3.89 ± 3.24 (min/hr), and 29.45 ± 6.29 (min/hr), respectively. Compared with boys, girls had significantly higher levels of BMI and after-school sedentary time and lower levels of after-school total physical activity and moderate-to-vigorous physical activity. Girls received less parental support for physical activity, compared with boys (see Table 1).

Associations Between the Home Environment and Boys' After-School Physical Activity and Sedentary Time

The unadjusted model showed that home physical activity resources were positively associated with after-school total physical activity ($p = .04$) and negatively associated with after-school sedentary time ($p < .05$) in boys. No significant association was found between the elements of the home environment and boys' after-school moderate-to-vigorous physical activity. In the adjusted model (i.e., controlling for child's age, BMI, and race and parental education), the significant associations found in the unadjusted models remained unchanged. Boys' with more physical activity resources at home had higher levels of after-school total physical activity ($p = .003$) and lower levels of after-school sedentary time ($p = .005$) (Table 2).

Associations Between the Home Environment and Girls' After-School Physical Activity and Sedentary Time

The unadjusted model indicated that parental support was positively associated with after-school total physical activity ($p = .04$) and moderate-to-vigorous physical activity ($p = .01$) and negatively associated with sedentary time ($p = .04$) during the after-school period in girls. In addition, home physical activity resources had a marginal, negative association with girls' after-school total physical activity ($p = .06$). In the adjusted models, the significant associations found in the unadjusted models remained unchanged. Girls who received more parental support demonstrated higher levels of total physical activity ($p = .04$) and moderate-to-vigorous physical activity ($p = .008$) and lower levels of sedentary time ($p < .05$) during the after-school period. Parent's sports participation was marginally associated with girls' after-school total physical activity ($p = .06$) and sedentary time ($p = .09$) (Table 3).

Discussion

Our findings suggest that the effects of the home environment on after-school physical activity and sedentary time differ between boys and girls. For boys, availability of home physical activity resources was positively associated with after-school total physical activity and negatively associated with after-school sedentary time. However, it was not associated with boys' after-school moderate-to-vigorous physical activity, suggesting that the home physical environment was less strongly associated with boys' physical activity at a higher level of intensity. It is probable that children perform moderate-to-vigorous physical activity primarily outside the home setting (12) or the resources available at home are not conducive to moderate-to-vigorous physical activity.

The present study found no significant association between the home social environment and after-school physical activity and sedentary time among boys. Although we examined parental physical activity, parental support for physical activity and rules on sedentary behavior at home, other characteristics of the family social environment may also affect boys' activity. For example, studies (5,29) have reported a strong correlation between father's and son's physical activity. In the current study, over 80% of the respondents were mothers, which may partly explain the lack of significant associations between parental physical activity and boys' moderate-to-vigorous physical activity. Another study (27) found that family cohesion and parent-child communication also were independently associated with moderate-to-vigorous physical activity in boys. Further investigations are needed to identify the most salient home social environmental factors related to boys' after-school physical activity and sedentary time.

For girls, more parental support for physical activity was associated with higher levels of after-school total physical activity and moderate-to-vigorous physical activity and lower levels of after-school sedentary time. Similar findings have been reported in previous studies. Motl and colleagues (24) examined the effects of parental support, home physical activity resources, and neighborhood safety on adolescent girls' overall physical activity. Wilson et al. (42) investigated the associations of parental support, home physical environment, and girl's overall moderate-to-vigorous physical activity. Both studies showed that girls' overall physical activity or moderate-to-vigorous physical activity were associated with parental support for physical activity but not with the home physical environment. Norman et al. (26) studied the independent associations of the home social environment, home physical environment, and overall

Table 1 Participant Characteristics (6th Grade Children)

Variables	Total (*N* = 671)	Boys (*n* = 314)	Girls (*n* = 357)	*p*-value
Age	11.49 ± 0.53	11.51 ± 0.53	11.47 ± 0.54	.42
Body mass index	21.75 ± 5.21	21.17 ± 4.88	22.26 ± 5.44	.01
Race/ethnicity				.83
Black	224 (33.3)	108 (34.4)	116 (32.5)	
Hispanic	56 (8.4)	27 (8.6)	29 (8.1)	
Other	122 (18.2)	59 (18.8)	63 (17.7)	
White	269 (40.1)	120 (38.2)	149 (41.7)	
Parent education[a]				.11
High school or less	204 (30.4)	86 (27.4)	118 (33.0)	
More than high school	467 (69.6)	228 (72.6)	239 (67.0)	
Numbers of adults live in the child's home[a]				.66
Only one	134 (20.0)	65 (20.7)	69 (19.3)	
Two or more	537 (80.0)	249 (79.3)	288 (80.7)	
Child after-school location				.62
At home	546 (81.4)	258 (82.2)	288 (80.7)	
Not at home	125 (18.6)	56 (17.8)	69 (19.3)	
Home social environment				
Parent LTPA[a]	2.44 ± 0.70	2.40 ± 0.66	2.48 ± 0.73	.12
Parent sports participation[a]	2.07± 0.74	2.08 ± 0.77	2.06 ± 0.72	.71
Parental support[a]	2.75 ± 0.80	2.83 ± 0.80	2.68 ± 0.80	.01
Rules on sedentary behavior[a]	1.94 ± 0.71	1.92 ± 0.71	1.95 ± 0.71	.63
Home physical environment				
Home PA resources[a]	6.32 ± 2.52	6.26 ± 2.36	6.39 ± 2.65	.53
Home sedentary item[a]	7.36 ± 2.85	7.52 ± 2.95	7.21 ± 2.76	.18
Physical activity variables				
After-school TPA (min/hr)	30.74 ± 6.47	32.27 ± 6.43	29.38 ± 6.20	<.0001
After-school MVPA (min/hr)	3.89 ± 3.24	5.21 ± 3.85	2.73 ± 1.96	<.0001
After-school Sed time (min/hr)	29.45 ± 6.29	28.06 ± 6.17	30.68 ± 6.15	<.0001

Note. Data is Mean ± SD or *n*(%). MVPA = moderate-vigorous physical activity; PA = physical activity; Sed = sedentary TPA = total physical activity.
[a]87% of the respondents were mothers, 8% fathers, and 5% others.

Table 2 Multiple Regressions for the Associations Between the Elements of Home Environment and After-School Activity Variables Among Boys

	After-School TPA				After-School MVPA[c]				After-School Sedentary Time			
	Unadjusted [a]		Adjusted [b]		Unadjusted [b]		Adjusted [b]		Unadjusted [a]		Adjusted [b]	
Variables	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Parental LTPA	–0.06	0.68	–0.55	0.68	–0.05	0.08	–0.05	0.07	0.76	0.62	0.67	0.62
Parental sports	0.73	0.60	-0.40	0.60	0.01	0.07	–0.02	0.07	–0.61	0.55	–0.26	0.55
Parental support	0.11	0.57	0.27	0.56	0.07	0.06	0.09	0.06	–0.47	0.52	–0.62	0.52
Home PA resources	0.39*	0.18	0.58*	0.19	–0.001	0.02	0.02	0.02	–0.33*	0.17	–0.50*	0.17
Rules on SB	0.08	0.58	0.20	0.58	-0.01	0.06	–0.004	0.06	–0.14	0.53	–0.25	0.53
Home sed items	–0.15	0.15	–0.19	0.15	–0.001	0.02	–0.003	0.02	0.16	0.13	0.19	0.13

Note. b = beta coefficient; MVPA = moderate-to-vigorous physical activity; PA = physical activity; SB = sedentary behavior; SE = standard error; sed = sedentary; TPA = total physical activity
[a]Adjusted for random effects of school and district effects, child after-school location.
[b]Adjusted for school, district, child after-school location, parent education, numbers of adults live in the child's home, child's age, race and BMI.
*$p<.05$, *p*-value estimated based on square root transformed after-school MVPA.

Table 3 Multiple Regressions for the Associations Between the Elements of Home Environment and After-School Activity Variables Among Girls

Variables	After-School TPA				After-School MVPA[c]				After-School Sedentary Time			
	Unadjusted[a]		Adjusted[b]		Unadjusted[a]		Adjusted[b]		Unadjusted[a]		Adjusted[b]	
	b	SE	b	SE	b	SE	b	SE	b	SE	b	SE
Parental LTPA	–0.30	0.53	–0.27	0.53	–0.02	0.05	–0.02	0.05	0.19	0.51	0.19	0.51
Parental sports	–0.96	0.52	–0.90	0.52	0.01	0.05	0.005	0.04	0.83	0.50	0.87	0.50
Parental support	0.96*	0.47	0.97*	0.47	0.10*	0.04	0.11*	0.04	–0.89*	0.44	–0.91*	0.45
Home PA resources	0.21	0.13	0.20	0.14	0.02	0.01	0.01	0.01	–0.21	0.13	–0.19	0.14
Rules on SB	–0.46	0.49	–0.38	0.49	–0.05	0.04	–0.04	0.04	0.36	0.47	0.28	0.47
Home sed items	–0.12	0.13	–0.14	0.13	0.05	0.01	–0.0001	0.01	0.11	0.12	0.13	0.84

Note. b = beta coefficient; MVPA = moderate-to-vigorous physical activity; PA = physical activity; SB = sedentary behavior; SE = standard error; sed = sedentary; TPA = total physical activity

[a]Adjusted for random effects of school and district effects, child after-school location.

[b]Adjusted for school, district, child after-school location, parent education, numbers of adults live in the child's home, child's age, race and BMI.

*p<.05, p-value estimated based on square root transformed after-school MVPA.

sedentary behavior in adolescent girls. After controlling for psychosocial and neighborhood built environmental factors, girls who received more parental support for physical activity spent less time in sedentary behavior. Although these studies were not focused on the after-school period and examined a slightly different set of home environment elements, their findings align with the present results, indicating that parental support for physical activity is an important determinant of girls' physical activity and sedentary behavior.

In addition, in the current study, parents' sports participation was marginally associated with girls' after-school total physical activity and sedentary time. Other studies have reported mixed results on the parent-child physical activity relationship (17,37). The majority of previous studies found either positive (7,16) or null associations (20,38) between parental physical activity and child physical activity. One study (11) reported an inverse relationship between parent physical activity and child physical activity, but its underlying mechanism was not well understood. The conflicting findings on the parent-child physical activity relationship may be due to inconsistency of measurements, such as different instruments and different sources of the information (e.g., proxy-reported or child-reported) (17,37).

Differences in findings also may be due to other confounding factors (14,38). Trost et al. (38) found that parental physical activity had no direct association with child physical activity but that the relationship was mediated by parental support. Dzewaltowski et al. (14) suggested that parent-child bonding moderated the relationships between parental physical activity and child PA. Children who reported higher parent-child bonding were more likely to adopt their parents' physical activity behavior, compared with children who reported lower parent-child bonding. Future studies are needed to examine the parent-child physical activity relationship.

Examining the associations of the home social and physical environment with children's after-school physical activity and sedentary behavior is challenging, not only because of the broad range of potential home environmental factors, but also because of the significant variations in the operational definitions and measurements across studies. These variations prevent direct comparisons among studies. Moreover, retrospective self-report measurements do not assess the home environmental variables and activity variables simultaneously, which increases the chance of recall bias (12). To better understand factors that are associated with children's physical activity and sedentary behavior during the after-school period, future studies need to collect data on more environmental variables informed by a comprehensive conceptual model and employ more dynamic mapping approaches (e.g., electronic ecological momentary assessment).

Strengths and Limitations

Inclusion of a large racially diverse sample and use of an objective measure of physical activity and sedentary time are strengths of the current study. The current study also adjusted for children's after-school location. This provides stronger support regarding the effects of the home physical environment on boys' activity level during after-school time. However, several limitations needed to be considered. The use of a cross-sectional study design prevents the determination of causal relationships. The modifying effects of other home environmental factors (e.g., sibling's activity level, family structure, and parental supervision during after-school time), personal psychosocial factors (e.g., self-efficacy) and neighborhood environmental factors (e.g., proximity to parks and availability of recreation facilities) that have been demonstrated to be significant correlates of physical

activity and sedentary behavior need to be examined in further investigations.

Conclusions

Our findings add to the body of knowledge by demonstrating that some factors of the home environment were more important than others in shaping children's after-school activities, and that these association patterns differed by gender. Of the elements of the home environment measured, availability of home physical activity resources was associated with after-school total physical activity and sedentary time in boys; parental support for physical activity was associated with after-school total physical activity, moderate-to-vigorous physical activity and sedentary time among girls.

References

1. Arundell L, Salmon J, Veitch J, O'Connell E, Hinkley T, Hume C. Standardising the 'after-school' period for children's physical activity and sedentary behaviour. *Health Promot J Austr.* 2013; 24(1):65–67. PubMed
2. Atkin AJ, Gorely T, Biddle SJ, Marshall SJ, Cameron N. Critical hours: physical activity and sedentary behavior of adolescents after school. *Pediatr Exerc Sci.* 2008; 20(4):446–456. PubMed
3. Baecke JA, Burema J, Frijters JE. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *Am J Clin Nutr.* 1982; 36(5):936–942. PubMed
4. Brodersen NH, Steptoe A, Boniface DR, Wardle J. Trends in physical activity and sedentary behaviour in adolescence: ethnic and socioeconomic differences. *Br J Sports Med.* 2007; 41(3):140–144. PubMed doi:10.1136/bjsm.2006.031138
5. Campbell PT, Katzmarzyk PT, Malina RM, Rao DC, Pérusse L, Bouchard C. Prediction of physical activity and physical work capacity (PWC150) in young adulthood from childhood and adolescence with consideration of parental measures. *Am J Hum Biol.* 2001; 13(2):190–196. PubMed doi:10.1002/1520-6300(200102/03)13:2<190::AID-AJHB1028>3.0.CO;2-N
6. Centers for Disease Control and Prevention. Physical activity levels among children aged 9-13 years. United States, 2002-2003; 52(33):785-8.
7. Cleland V, Venn A, Fryer J, Dwyer T, Blizzard L. Parental exercise is associated with Australian children's extracurricular sports participation and cardiorespiratory fitness: A cross-sectional study. *Int J Behav Nutr Phys Act.* 2005; 2(1):3. PubMed doi:10.1186/1479-5868-2-3
8. Corder K, Sharp SJ, Atkin AJ, et al. Change in objectively measured physical activity during the transition to adolescence. *Br J Sports Med.* 2014 Apr 9; Epub 2013 Nov 22. PubMed
9. Cumming SP, Standage M, Loney T, et al. The mediating role of physical self-concept on relations between biological maturity status and physical activity in adolescent females. *J Adolesc.* 2011; 34(3):465–473. PubMed doi:10.1016/j.adolescence.2010.06.006
10. Davison KK, Cutting TM, Birch LL. Parents' activity-related parenting practices predict girls' physical activity. *Med Sci Sports Exerc.* 2003; 35(9):1589–1595. PubMed doi:10.1249/01.MSS.0000084524.19408.0C
11. DiLorenzo TM, Stucky-Ropp RC, Vander Wal JS, Gotham HJ. Determinants of Exercise among Children. II. A Longitudinal Analysis. *Prev Med.* 1998; 27(3):470–477. PubMed doi:10.1006/pmed.1998.0307
12. Dunton G, Whalen C, Jamner L, Floro J. Mapping the social and physical contexts of physical activity across adolescence using ecological momentary assessment. *Ann Behav Med.* 2007; 34(2):144–153. PubMed doi:10.1007/BF02872669
13. Dunton GF, Jamner MS, Cooper DM. Assessing the perceived environment among minimally active adolescent girls: Validity and relations to physical activity outcomes. *Am J Health Promot.* 2003; 18(1):70–73. PubMed doi:10.4278/0890-1171-18.1.70
14. Dzewaltowski DA, Ryan GJ, Rosenkranz RR. Parental bonding may moderate the relationship between parent physical activity and youth physical activity after school. *Psychol Sport Exerc.* 2008; 9(6):848–854. doi:10.1016/j.psychsport.2007.10.004
15. Edwardson CL, Gorely T. Activity-related parenting practices and children's objectively measured physical activity. *Pediatr Exerc Sci.* 2010; 22(1):105–113. PubMed
16. Fuemmeler B, Anderson C, Masse L. Parent-child relationship of directly measured physical activity. *Int J Behav Nutr Phys Act.* 2011; 8(1):17. PubMed doi:10.1186/1479-5868-8-17
17. Gustafson S, Rhodes R. Parental correlates of physical activity in children and early adolescents. *Sports Med.* 2006; 36(1):79–97. PubMed doi:10.2165/00007256-200636010-00006
18. Hume C, Salmon J, Ball K. Children's perceptions of their home and neighborhood environments, and their association with objectively measured physical activity: a qualitative and quantitative study. *Health Educ Res.* 2005; 20(1):1–13. PubMed doi:10.1093/her/cyg095
19. Jago R, Davison KK, Thompson JL, Page AS, Brockman R, Fox KR. Parental sedentary restriction, maternal parenting style, and television viewing among 10- to 11-year-olds. *Pediatrics.* 2011; 128(3):e572–e8. PubMed doi:10.1542/peds.2011-1818
20. Jago R, Fox K, Page A, Brockman R, Thompson J. Parent and child physical activity and sedentary time: Do active parents foster active children? *BMC Public Health.* 2010; 10(1):194. PubMed doi:10.1186/1471-2458-10-194
21. Labbrozzi D, Robazza C, Bertollo M, Bucci I, Bortoli L. Pubertal development, physical self-perception, and motivation toward physical activity in girls. *J Adolesc.* 2013; 36(4):759–765. PubMed doi:10.1016/j.adolescence.2013.06.002
22. Larson RW. How U.S. Children and adolescents spend time: What it does (and doesnt't) tell us about their development. *Curr Dir Psychol Sci.* 2001; 10(5):160–164. doi:10.1111/1467-8721.00139

23. Lee SM, Burgeson CR, Fulton JE, Spain CG. Physical education and physical activity: results from the School Health Policies and Programs Study 2006. *J Sch Health.* 2007; 77(8):435–463. PubMed doi:10.1111/j.1746-1561.2007.00229.x
24. Motl RW, Dishman RK, Saunders RP, Dowda M, Pate RR. Perceptions of physical and social environment variables and self-efficacy as correlates of self-reported physical activity among adolescent girls. *J Pediatr Psychol.* 2007; 32(1):6–12. PubMed doi:10.1093/jpepsy/jsl001
25. Naylor PJ, McKay HA. Prevention in the first place: schools a setting for action on physical inactivity. *Br J Sports Med.* 2009; 43(1):10–13. PubMed doi:10.1136/bjsm.2008.053447
26. Norman GJ, Schmid BA, Sallis JF, Calfas KJ, Patrick K. Psychosocial and environmental correlates of adolescent sedentary behaviors. *Pediatrics.* 2005; 116(4):908–916. PubMed doi:10.1542/peds.2004-1814
27. Ornelas I, Perreira K, Ayala G. Parental influences on adolescent physical activity: a longitudinal study. *Int J Behav Nutr Phys Act.* 2007; 4(1):3. PubMed doi:10.1186/1479-5868-4-3
28. Philippaerts RM, Westerterp KR, Lefevre J. Doubly labeled water validation of three physical activity questionnaires. *Int J Sports Med.* 1999; 20(05):284–289. PubMed doi:10.1055/s-2007-971132
29. Raudsepp L, Viira R. Influence of parents' and siblings' physical activity on activity levels of adolescents. *Eur J Phys Educ.* 2000; 5(2):169–178. doi:10.1080/1740898000050205
30. Rosenkranz R, Dzewaltowski D. Maternal physcal-activity-related parenting behaviors may influence children's physical activity levels and relative weight. *WSPAJ.* 2011; 20(1):3–12.
31. Sallis JF, Johnson MF, Calfas KJ, Caparosa S, Nichols JF. Assessing perceived physical environmental variables that may influence physical activity. *Res Q Exerc Sport.* 1997; 68:345–351. PubMed doi:10.1080/02701367.1997.10608015
32. Sallis JF, Owen N, Fisher EB. Ecological models of healh behavior. In: K Glazn, BK Rimer, and K Viswanath, editors. *Health behavior and health education Theory, research, and practice,* 4th ed. USA: Jossey-Bass A Wiley Imprint; 2008. p. 465–482.
33. Sirard J, Laska M, Patnode C, Farbakhsh K, Lytle L. Adolescent physical activity and screen time: associations with the physical home environment. *Int J Behav Nutr Phys Act.* 2010; 7(1):82. PubMed doi:10.1186/1479-5868-7-82
34. Stokols D. Establishing and maintaining healthy environments. Toward a social ecology of health promotion. *Am Psychol.* 1992; 47(1):6–22. PubMed doi:10.1037/0003-066X.47.1.6
35. Taverno Ross SE, Dowda M, Colabianchi N, Saunders R, Pate RR. After-school setting, physical activity, and sedentary behavior in 5th grade boys and girls. *Health Place.* 2012; 18(5):951–955. PubMed doi:10.1016/j.healthplace.2012.06.013
36. Troiano R, Berrigan D, Dodd K, Masse L, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. *Med Sci Sports Exerc.* 2008; 40:181–188. PubMed doi:10.1249/mss.0b013e31815a51b3
37. Trost SG, Loprinzi PD, Moore R, Pfeiffer KA. Comparison of accelerometer cut points for predicting activity intensity in youth. *Med Sci Sports Exerc.* 2011; 43(7):1360–1368. PubMed doi:10.1249/MSS.0b013e318206476e
38. Trost SG, Sallis JF, Pate RR, Freedson PS, Taylor WC, Dowda M. Evaluating a model of parental influence on youth physical activity. *Am J Prev Med.* 2003; 25(4):277–282. PubMed doi:10.1016/S0749-3797(03)00217-4
39. Tudor-Locke C, Lee S, Morgan C, Beighle A, Pangrazi R. Children's pedometer-determined physical activity during the segmented school day. *Med Sci Sports Exerc.* 2006; 38(10):1732–1738. PubMed doi:10.1249/01.mss.0000230212.55119.98
40. Wall MI, Carlson SA, Stein AD, Lee SM, Fulton JE. Trends by age in youth physical activity: Youth Media Campaign Longitudinal Survey. *Med Sci Sports Exerc.* 2011; 43(11):2140–2147. PubMed doi:10.1249/MSS.0b013e31821f561a
41. Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: the evidence. *Can Med Assoc J.* 2006; 174(6):801–809. PubMed doi:10.1503/cmaj.051351
42. Wilson DK, Lawman HG, Segal M, Chappell S. Neighborhood and parental supports for physical activity in minority adolescents. *Am J Prev Med.* 2011; 41(4):399–406. PubMed doi:10.1016/j.amepre.2011.06.037
43. Wray-Lake L, Crouter AC, McHale SM. Developmental patterns in decision-making autonomy across middle childhood and adolescence: European American parents' perspectives. *Child Dev.* 2010; 81(2):636–651. PubMed doi:10.1111/j.1467-8624.2009.01420.x
44. Yuan Y. *Multiple imputation for missing data:Concepts and new development (Version 9.0)*. Rockville, MD: SAS Institution Inc; 2000.