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Joint Physical Activity and Sedentary Behavior in Parent-Child Pairs

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Abstract

Purpose—Research examined joint physical activity and sedentary behavior among 291 parent-child pairs who both wore an accelerometer and global positioning systems (GPS) device over the same 7-day period.

Methods—Children were 52.2% female, 8-14 years, and 43.0% Hispanic. Parents were 87.6% female. An Actigraph GT2M accelerometer and GlobalSat BT-335 GPS device collected activity and global positioning data, respectively. Linear distance between the parent and child for each 30-sec. epoch was calculated using geographic coordinates from the GPS. Joint behavior was defined as a separation distance less than 50m between parents and children.

Results—On average during non-school waking hours, parents and children spent 2.4 min. (SD = 4.1) per day performing moderate-to-vigorous physical activity (MVPA) together and 92.9 min. (SD = 40.1) per day in sedentary behavior together. Children engaged in an average of 10 min. per day of MVPA during non-school waking hours when their parent was nearby but not engaging in MVPA. During this same period, parents engaged in 4.6 min. per day of MVPA when their child was nearby but not engaging in MVPA. Household income level and the child's age were negatively associated with joint MVPA. Girls engaged in a greater percentage of their total MVPA together with their parent than boys. Girls and older children engaged in more sedentary behavior together with their parent than boys and younger children. Older parents engaged in a greater percentage of their sedentary behavior together with their children than younger parents.

Conclusion—Replacing the time that parents and children spend together in sedentary pursuits with joint physical activity could have health benefits, especially for girls, older children, older parents, and higher income families.

Keywords

moderate-to-vigorous physical activity; accelerometer; global positioning systems; age; sex

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Introduction

Evidence indicates that regular physical activity during childhood can reduce the risk of a number of serious health problems (12,28). Yet less than half of U.S. children 6-11 years of age and only 6-11% of children 12-15 years of age engage in 60 minutes per day of moderate-intensity activity on at least 5 out of the past 7 days (30). Also, children 6-15 years of age spend an average of 5-7 hours per day in sedentary activity (34). A growing body of research suggests that parents play an important role in shaping children's physical activity levels through support and behavioral modeling. A recent systematic review found that the majority of studies demonstrated positive effects of parental social support (including purchasing equipment, payment of fees, providing transportation, doing activity with, watching and supervising activities, offering encouragement, and discussing benefits) on youth physical activity (3). In a longitudinal study of girls from ages 9 to 15 years, maintaining physical activity levels over that time period was associated with higher parental modeling of physical activity and enrolling girls in activities and driving them to events (11). This work underscores the potential impact of parents' behavior on children's physical activity levels. However, information is lacking about the exact nature of these parental influences, particularly the extent to which parents and children engage in physical activity and sedentary behaviors together.

Research generally shows that physically active parents are more likely to have physically active children. In a recent study of 12-year old boys and girls, parents' physical activity levels were highly correlated with children's physical activity levels. Having two physically active parents, girls were almost four times as likely and boys were eight times as likely to participate in a sport as compared with children who had two inactive parents (15). A related study found that among 12-year olds, children with both parents engaging in sports were more likely to participate in structured physical activity outside of school than children with neither parent practicing a sport (33). However, there is some evidence to the contrary. In a study of children who were 11 to 15 years of age, Kimiecik and colleagues (22) found no association between parents' level of exercise and their children's participation in moderate-to-vigorous physical activity. Also, Jago and colleagues found that that 10-11 year old children's and parents' physical activity time was unrelated. However, this study found that overall sedentary time was positively correlated for girls and their parents (21). In a longitudinal study of adolescents who were 13 years old at baseline and 21 at the last assessment, changes in parents' physical activity levels were not associated with changes in adolescent physical activity across this time period (2). Given these inconsistencies, more information is needed about how parental physical activity levels impact children's physical activity levels.

Research in this area could be advanced by understanding how much time per day that children and their parents spend in physical activity and sedentary behavior together. Although a few studies have addressed this research question, they are either qualitative in nature or rely on self-reported physical activity levels. Through qualitative interviews, Thompson and colleagues (29) found that families performed very little or no physical activity together during the week. The joint parent-child activities reported on weekdays were primarily sedentary (e.g., TV watching). On the weekends, parents performed more physical activity together with their children, but these activities usually did not include the whole family unit. In another study that followed 4-6 year old children for anywhere from one to nine years, the amount of physical activity that parents reported performing together with their children decreased from 60 minutes at baseline to 40 minutes at follow-up (1). Veitch and colleagues (32) also found that when a family reported visiting a park or playground together, children engaged in more frequent play at that park on weekdays. Research in this area could be greatly informed by the use of objective physical activity

assessment and location monitoring instruments to examine the extent to which parents and children engage in joint-physical activity and sedentary behavior. This study examined minute-to-minute correspondence in physical activity levels in parent-child pairs who both wore an accelerometer and Global Positioning System (GPS) device over the same 7-day period. The primary research objective was to determine how much time per day that children and their parents spend in physical activity and sedentary behavior together (i.e., at the same time and same location). A second objective was to determine whether the amount of physical activity performed together by parent-child pairs differs by weekday versus weekend day; child's sex, age, family income, race/ethnicity, and body mass index (BMI); and the parent's sex and BMI.

Methods

Sample

The current study analyzed baseline data from a subgroup of children and parents participating in a larger 4-year intervention trial (Healthy PLACES), which is investigating the effects of smart growth community design principles on the prevention of family obesity risk. Participants included fourth through eighth grade children (ages 8-14 years) and their parents. Families lived in Chino, CA or surrounding communities within 30 minutes driving time from Chino (including Ontario, Pomona, Diamond Bar, Corona, and Yorba Linda/Mira Loma). Recruitment was through a variety of channels including informational flyers and letters distributed at community events, housing association meetings, residences, schools, clinics, churches, and community groups. Additionally, study advertisements were placed in local newspapers, posters were displayed at community sites, and postcards were mailed to homes in the selected areas. All recruitment materials included the study recruitment hotline phone number and email address. A telephone recruiter called all interested families and screened for eligibility. Inclusion criteria consisted of the following: a) child currently enrolled in the 4-8th grade, b) living in Chino, CA or a surrounding community, and c) annual household income less than \$165,000. Upper income households were excluded because the goal of the study was to focus on children from low- to middle-income families who have higher obesity risk. Children who met the eligibility criteria were scheduled for a data collection appointment at a local community site or their home. Written informed consent and minor assent was obtained from participants. This research was reviewed and approved by the Institutional Review Board at the University of Southern California.

Study Design

Measurement occurred through a cross-sectional design. Objective physical activity, GPS, and survey data were collected from March 2009- Dec. 2010. No data collection took place from late July-Aug and during Jan. due to typically adverse temperatures and weather conditions that limit outside activity in that part of Southern California. Within the parent-child pairs, both wore an accelerometer and GPS device over the same 7-day period.

Measures

Physical activity—The Actigraph, Inc. GT2M model activity monitor (firmware v06.02.00) provided an objective measure of physical activity. The device was worn on the right hip attached to an adjustable belt. A 30-second epoch was set for the recording of activity counts. Participants were asked to wear the accelerometers across seven continuous days. The devices were not worn when sleeping, bathing, or swimming. Cut-points for (moderate-to-vigorous physical activity) MVPA were consistent with studies of national surveillance data (30,4). For adults, the MVPA threshold was 2020 counts per minute (equivalent to 3 METs). MVPA for children was defined using age-specific thresholds generated from the Freedson prediction equation (16,17). A threshold for moderate activity

of 4 METs was used for children (as opposed to a 3 METs moderate activity cut-off for adults) to account for higher resting energy expenditure in children and youth (18,27). For both adults and children, light activity was greater than or equal to 100 counts per minute through the MVPA threshold. Sedentary activity was defined as less than 100 counts per minute (25,20).

Location Monitoring—Portable Global Positioning System (GPS) devices were used to assess locations in both children and parents. Geographic locations were logged for a 7-day period with the BT-335 Bluetooth GPS data logger device by GlobalSat Technology Corp (Taipei) attached to a belt worn around the waist along with the accelerometer. The BT-335 (16M bit, 1575.42 MHz) consists of a GPS receiver and data logger with Bluetooth PC interface. This device records time, date, speed, altitude, and GPS location at preset intervals. It is WAAS/EGNOS/MSAS enabled and uses a SiRF star III chipset for accurate position tracking (up to 5m accuracy outdoors) and improved indoor signal acquisition. The recording interval was set to a 30-second epoch to match the accelerometer specifications. After the GPS devices were returned, all recorded information was downloaded to a computer where the recorded longitudinal and latitudinal data and speed were downloaded to a CSV file format. As the device has a battery life of 25 hours, a battery charger was provided, and participants were instructed to recharge the battery each night. Linear distance between the parent and child for each 30-sec. epoch was calculated using geographic coordinates from the GPS.

Height and weight—Parents' and children's height and weight were measured in duplicate using an electronically calibrated digital scale (Tanita WB-110A) and professional stadiometer (PE-AIM-101) to the nearest 0.1 kg and 0.1 cm, respectively. Body Mass index (BMI) was calculated (kg/m^2). Children's weight status was classified according to CDC age- and sex-specific BMI percentile cut-offs.

Demographic and time variables—Age, sex, and ethnicity were assessed through child and parent self-report surveys. Parents reported annual household income, which was divided into quartiles (Less than \$30,000; \$30,000-\$59,999; \$60,000-\$99,999; and \$100,000 and above).

Data Merging and Processing

In order to conduct data manipulation tasks prior to analysis, accelerometer and GPS files were imported into the R version 2.9.2 programming language interface. Date and time stamps to the nearest 30-second epoch were used to match all accelerometer and GPS records within each parent-child pair. In the numerous cases where concurrent accelerometer and GPS were unavailable for either the parent or the child, we used a missing data code (NA) for designating the accelerometer and/or GPS values for these epochs. Overnight (11pm-5am) and school (8am-3pm on weekdays) hours were removed from the analyses. Strings of consecutive readings of 0 activity counts lasting 60 minutes or more were considered accelerometer non-wear and excluded from analyses. Activity outliers were identified as records with greater than 16,383 counts per 30-second epoch (30). Records with GPS speeds greater than 169 kph (105 mph) were also considered outliers, because normal driving speeds are well below this value. Motorized activity, which were identified by records with speeds greater than 32 kph since typical bicycling speeds range from 15 to 30 kph (9.32 to 18.64 mph), were also excluded from the analyses. Once these records were removed, parent-child pairs were determined to have sufficient data for inclusion in the analysis if they had a minimum of 2 valid days (any combination of weekdays or weekend days) of matched available data—where a valid weekday was defined as a minimum of two hours of matched available accelerometer and GPS data points for the pair, and a valid

weekend day was defined as a minimum of four hours of matched available accelerometer and GPS data points for the pair. “Joint” or “together” behaviors were defined as activities of the same intensity level (sedentary or MVPA) that occurred at the same time and in the same location (< 50m. apart). A maximum separation of less than 50m between the parent and child was selected because this distance is approximately equivalent to the length of a ball court (e.g., basketball, volleyball, racquetball) or large residential yard.

Data Analyses

Using the parent-child pair as the unit of analysis, multiple linear regression models were fit for the following outcomes: 1) average daily minutes of MVPA performed by parents and children together during non-school waking hours, 2) the percent of MVPA performed by parents and children together during non-school waking hours out of children’s total MVPA during this period, 3) the percent of MVPA performed by parents and children together during non-school waking hours out of parents’ total MVPA during this period, 4) average daily minutes of sedentary behavior performed by parents and children together during non-school waking hours, 5) the percent of sedentary behavior performed by parents and children together during non-school waking hours out of children’s total sedentary behavior during this period, and 6) the percent of sedentary behavior performed by parents and children together during non-school waking hours out of parents’ total sedentary behavior during this period. Predictors in the models include parent and child’s sex, age, BMI, ethnicity/race, and family income. To examine differences in daily MVPA and sedentary minutes performed together by parents and children between weekdays and weekend days, multilevel models were fit using day-level data and controlled for clustering of observation within each parent-child pair. All analyses were conducted using SAS (Version 9.2).

Results

Of the 363 parent-child pairs participating in the study, 291 parent-child pairs had sufficient data and thus met our criteria for inclusion in the analysis. Descriptive statistics for the demographic characteristics of this final analytic sample are shown in Table 1. Children were 52.2% female and ranged in age from 8-14 years ($M = 11.2$ years, $SD = 1.5$ years). Mean BMI percentile for children was 63.9 ($SD = 30.7$). Approximately 35.9% were overweight or obese. Forty-three percent were Hispanic, but a sizable proportion was Caucasian/White (26.1%). The majority of parents participating in this study were female (87.6%). The mean age of parents was 39.6 years ($SD = 6.0$ years, range = 26 – 62 years). Median annual household income was \$60,000, with 34.2% earning less than \$40,000 and 10.8% earning over \$120,000. Parents in the excluded sample were younger ($M = 37.0$ years, $SD = 5.4$ years) than the analytic sample ($t = 3.3$, $p = .001$), and more of them were male (25%; $\chi^2 = 7.0$, $p = .008$). Children in the excluded sample had a higher mean BMI percentile ($M = 73.0$, $SD = 29.1$) than the analytic sample ($t = -2.2$, $p = .03$), but these two samples did not differ significantly in terms of weight categories.

On average, parent-child pairs had 4.5 ($SD = 1.6$) valid days over the same 7-day period with 310.8 minutes ($SD = 75.2$ minutes) per day of matched available data for analysis after removing records representing overnight hours (11pm-5am), school time (8am-3pm on weekdays), time spent in motorized transit (> 32 kph), missing accelerometer and GPS data and outliers, and accelerometer non-wear for either the parent or the child. Table 2 shows descriptive statistics for the accelerometer and GPS sampling characteristics of the 291 parent-child pairs included in the analyses. Missing GPS data (due to power loss or signal loss) and accelerometer non-wear accounted for the majority of the unavailable data, after exclusions of overnight hours, school hours, and motorized transport.

Parent-child pairs spent an average of 233.6 minutes (SD = 80.0) per day in the same location (less than 50m apart) during non-school waking hours together, not accounting for time spent together in the car. Of this time, 2.4 minutes (SD = 4.1) per day were spent performing MVPA together and 92.9 minutes (SD = 40.1) per day were spent engaging in sedentary behavior together. Results of the day-level multilevel model indicated that parent-child pairs spent more time performing MVPA together during waking hours on weekend days (M = 3.9 minutes, SD = 8.1) than during non-school hours on weekdays (M = 2.0 minutes, SD = 4.0) ($\beta = 1.83$, SE = .48, $p = .001$). Parent-child pairs also spent more time in sedentary behavior during waking hours on weekend days (M = 143.9 minutes, SD = 79.9) than during non-school waking hours on weekdays (M = 81.5 minutes, SD = 38.5) ($\beta = 58.26$, SE = 4.22, $p < .001$). Overall, 89.4% of parent-child pairs engaged in some MVPA together during non-school waking hours whereas 100% of parent-child pairs engaged in some sedentary behavior together during this monitoring period. On average, children performed 19.5 minutes (SD = 15.5) of MVPA each day during non-school waking hours, of which 10.3% occurred together with their parent. Children engaged in a mean of 170.7 minutes (SD = 53.53) of sedentary each day during non-school waking hours, of which 46.5% took place together with their parent. During non-school waking hours, parents engaged in 11.7 minutes (SD = 11.7 minutes) of MVPA of which 16.0% occurred together with their child and 191.0 minutes (SD = 55.5 minutes) of sedentary behavior of which 41.7% took place with their child. While their child was nearby (< 50M) engaging in MVPA, parents engaged in 7.4 minutes (SD = 7.2) per day of sedentary behavior and 2.6 minutes (SD = 2.4) of light activity. On the other hand, children engaged in 1.9 minutes (SD = 2.3) per day of sedentary behavior and 2.7 minutes (SD = 4.5) per day of light activity while their parent was nearby (< 50m) engaging in MVPA.

Table 3 shows the results for the multiple regression analyses testing covariates predicting average daily minutes of MVPA performed by parents and children together during non-school waking hours (Model 1), the percent of MVPA performed by parents and children together during non-school waking hours out of children's total MVPA during this period (Model 2), and the percent of MVPA performed by parents and children together during non-school waking hours out of parents' total MVPA during this period (Model 3). Model 1 shows that child age was marginally negatively associated with average daily MVPA minutes performed together ($p = .06$). Also, children from households with an annual income of less than \$30,000 performed more MVPA together with their parents than children from household with an annual income greater than \$100,000 ($p = .02$). The average daily MVPA minutes performed together during non-school waking hours did not differ according to the child's sex, race/ethnicity, or BMI; or the parent's sex, age, or BMI (Model 1). Model 2 found that girls engaged in a marginally greater percentage of their non-school MVPA performed together with their parent than boys ($p = .06$). The percent of parents' MVPA occurring together with their child was negatively associated with the child's age ($p = .007$) (Model 3).

Results for the multiple regression testing variables predicting average daily minutes of sedentary behavior performed by parents and children together during non-school waking hours (Model 1), the percent of sedentary behavior performed by parents and children together during non-school waking hours out of children's total MVPA during this period (Model 2), and the percent of sedentary behavior performed by parents and children together during non-school waking hours out of parents' total sedentary behavior during this period (Model 3) are displayed in Table 4. Girls engaged in more minutes of sedentary behavior on average together with their parent during non-school waking hours than boys ($p = .03$) (Model 1). Older children ($p = .005$) and older parents ($p = .046$) performed more minutes of sedentary behavior together during non-school waking hours (Model 1). Similarly, Model 3 found that older children ($p = .02$) and older parents ($p = .01$) engaged in a greater

percentage of their sedentary behavior together. The percentage of children's sedentary behavior spent together with their parent during non-school waking hours did not differ according to the child's sex, age, race/ethnicity, or BMI; or the parent's sex, age, BMI, and annual household income (Model 2).

Discussion

To our knowledge, this is the first study to use objective physical activity assessment and location monitoring instruments to investigate the amount of time spent by parents and children engaging in physical activity and sedentary behavior together. This research examined minute-to-minute correspondence in activity levels among parent-child pairs who both wore an accelerometer and GPS device over the same 7-day period. Results indicated that joint parent-child physical activity only accounted for small proportion of children's and parents' overall physical activity. However, some sex, age, and income differences in joint parent-child physical activity emerged, which offer insights into tailored intervention opportunities.

Although almost 90% of the parent-child pairs in the sample performed some joint MVPA during non-school waking hours, the average duration of these activities was very short (2 minutes on weekdays and 4 minutes on weekend days). Consistent with previous research (29), results from the current study indicate that much more time was spent together per day engaging in sedentary pursuits than MVPA. While younger children (ages 4-6 years) have been found to perform 40 to 60 minutes of physical activity per day with a parent (1), the current results suggest that joint parent-child physical activity time is much shorter in somewhat older children (ages 8-14 years). The difference in joint parent-child physical activity time could be due to the older ages of the children in the current study. Older children may need less parental supervision during physical activity (24) or may prefer to be physically active with friends instead of family. Previous research has found that children engage in less physical activity with family members as they get older (14). Another explanation for the difference in time spent in joint parent-child physical activity may be the use of objective activity and proximity measures in the current study, which are less prone to reporting biases and errors.

The approximately 10 minutes each day (during non-school waking hours) that parents spend in either sedentary or light activity while their child performs MVPA nearby and the 5 minutes per day that children spend in either sedentary or light activity while their parents performs MVPA nearby present potential opportunities to increase parent and child activity levels, respectively. Although this study did not have the capacity to determine the types of activities for which this occurs, possible scenarios could include parents watching their child engaging in unstructured active play in their own yards, on playgrounds, or at sporting facilities, or parents performing housework or yardwork while the child is engaged in sedentary play nearby. In these situations, the parent's physical activity could be increased by joining the child in active play, and the child's activity could be augmented by assisting the parent with the active chore.

The amount of time spent in joint parent-child physical activity differed according to the sex and age of the child, age of the parent, and annual household income. Girls spent more time in physical activity together with their parent than boys, despite the fact that girls tend to have lower overall physical activity levels than boys (34). These findings could reflect the fact that boys have more independent mobility in their active play than girls (5). Encouraging joint physical activity among girls and their parents may be a useful way to address sex disparities in physical activity in youth of this age. Results also indicated that older children spent less time in physical activity and more time in sedentary behavior

together with their parent than the younger children in this sample. There may be higher amounts of joint television watching between parents and older children because their television viewing preferences are more likely to coincide (13). Results further indicated that parents and children from lower income households spent more time engaging in physical activity together than higher income households. These findings could reflect reduced access to and opportunities for organized sports, classes, and lessons for lower income families (10). Future research could use electronic real-time data capture strategies such as Ecological Momentary Assessment (EMA) (2) to explore whether the nature of these joint sedentary behaviors are productive (e.g., homework, discussion) or non-productive (e.g., TV, video games). Overall, these findings suggest that promoting joint parent-child physical activity in families with older children and older parents may be a useful way to combat age-related declines in youth (4) and adult (7) physical activity levels.

Despite the strengths of the study, which include objective measures of activity and location, there were some limitations. It is possible that some of the MVPA performed by children could have taken place together with the other parent not participating in the study (and thus not captured). For each child enrolled in the study, either a mother (88%) or a father (12%) volunteered to participate. Post-hoc analyses tested whether parental influence was greater in same-sex parent child pairs. The “parent-child same sex pair” variable (1= same sex pair, 0= opposite sex pair) only came up to be marginally significant ($p=.051$) in predicting the percent of children’s total MVPA. Joint MVPA performed by same sex parent-child pairs accounted for a greater percentage of children’s total MVPA than joint MVPA performed by opposite sex parent-child pairs. Due to the large number of mother-son (opposite-sex pairs), joint MVPA could be underestimated. Other limitations can be attributed to weaknesses of the accelerometer and GPS technology. Neither device is fully waterproof and thus cannot be worn while swimming. Inherent measurement error in the GPS units ($\pm 15\text{m}$.) could have contributed to erroneous over- or underestimation of joint activity when the linear distance of parent-child proximity was close to the specified 50m separation distance. Post-hoc analyses show that there is very little change in the number of minutes of joint parent-child MVPA when distance thresholds of $<100\text{m}$, $<150\text{m}$, $<250\text{m}$, and $<500\text{m}$ were applied. Also, although the SiRF star III chipset is designed to improve the performance of the GPS device in indoor environments, a greater amount of measurement error and missing data is expected with indoor compared to outdoor wear. Overall, 21% of the GPS data was lost due to poor signal quality or power drain, and 49% of the accelerometer was lost due to non-wear. These rates of data loss are similar to rates observed in other studies using accelerometer (8,31) and GPS devices (9,23,26), yet the number of missing analysis units was compounded by the deletion of matched parent-child minutes when either accelerometer or GPS observations were missing in either the parent or the child. In order to preserve the sample size for analysis, a minimum threshold of at least 2 days of matched parent-child data was selected. There is some evidence to suggest that 2 days is a reliable indicator of MVPA in older adults (19,6). Whether 2 days of matched parent-child data is a reliable indicator of joint physical activity and sedentary behavior is unknown. Joint activities performed by pairs with younger, male parents and children with a higher BMI may not be fully represented because they were more likely to be excluded due to insufficient data. Furthermore, it is possible that some of children’s or parents’ time spent sleeping during the day, before 11pm at night or after 5am could be misclassified as joint sedentary behavior if the child or parent forgot to remove the accelerometer device during this time. Lastly, the study sample had a larger proportion of Hispanic participants (43%) than the general U.S. population. However, results for average daily MVPA (including school and non-school hours) (~30 minutes) for the study sample are comparable to nationally-representative samples (4).

Overall, findings from this study suggest that replacing the time that parents and children spend together in sedentary pursuits (e.g., watching TV and movies) with joint physical activity (e.g., playing Frisbee) could have health benefits for both children and parents alike. Future studies should explore the nature of the social interactions between parents and children during joint physical activity and sedentary behavior (e.g., interacting behavior versus parallel but non-interacting behavior). Research should also seek to better understand where (e.g., home, parks, schoolyards, commercial space) joint parent-child physical activity and sedentary behavior occurs.

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Table 1

Demographic characteristics for the 291 parent-child pairs included in the analyses

Child (N = 291)	
Sex (n, %)	
Female	152, 52.2%
Male	139, 47.8%
Age (mean, range)	11.2, 8 – 14
BMI Percentile (mean, range)	64.2, < 1.0 – 99.6
Race (n, %)	
Caucasian/White	76, 26.1%
African Am./Black	11, 3.8%
Hispanic	125, 43.0%
Asian	27, 9.3%
Other	52, 17.9%
Parent (N = 291)	
Sex (n, %)	
Female	255, 87.6%
Male	36, 12.4%
Age (mean, range)	39.6, 26 – 62
BMI (mean, range)	28.2, 17 – 55
Annual Household Income (n, %)	
<\$30,000	73, 26.5%
\$30,000 – \$60,000	61, 22.1%
\$60,000 – \$100,000	82, 29.7%
>\$100,000	60, 21.7%

Note. Sample sizes vary due to missing data.

Table 2

Accelerometer and Global Positioning System (GPS) sampling characteristics of the 291 parent-child pairs included in the analyses

	Mean (range)
Missing accelerometer data %	0.003 (0 – .02)
Missing GPS data %	20.6 (.4 – 48.7)
Accelerometer outlier %	6.7 ⁻⁶ (0 – .1)
GPS outlier %	6.8 ⁻⁷ (0 – .01)
Accelerometer non-wear %	48.6 (22.9 – 83.2)

Note. Summary statistics were calculated from the merged dataset after removing school hours (8am-3pm on weekdays), overnight hours (11pm-5am), and motorized transport (> 32kph).

Table 3

Results of the multiple linear regression predicting moderate-to-vigorous physical activity (MVPA) performed by parents and children together (less than 50m apart).

Variable	Model 1 ^a			Model 2 ^b			Model 3 ^c		
	b (CI)	p		b (CI)	p		b (CI)	p	
Child									
Sex (REF: Boy)	-.12 (-1.13 – .89)	.81		.03 (-.001 – .06)	.06		.02 (-.02 – .06)	.26	
Age	-.32 (-.67 – .02)	.06		.01 (-.004 – .02)	.23		-.02 (-.03 – -.01)	.007	
BMI (REF: Obese)									
Underweight	-1.91 (-5.60 – 1.78)	.31		-.08 (-.19 – .04)	.19		.02 (-.12 – .16)	.78	
Normal weight	-.35 (-1.76 – 1.05)	.62		-.01 (-.05 – .04)	.75		-.01 (-.06 – .05)	.82	
Overweight	-.30 (-2.04 – 1.45)	.74		.02 (-.04 – .07)	.49		.002 (-.06 – .07)	.96	
Race/Ethnicity (REF: White)									
African American	-.98 (-3.81 – 1.85)	.50		-.06 (-.15 – .03)	.19		-.04 (-.15 – .07)	.48	
Asian	-1.13 (-3.02 – .77)	.24		-.05 (-.11 – .01)	.12		-.02 (-.09 – .05)	.63	
Hispanic	.35 (-.97 – 1.66)	.52		-.004 (-.05 – .04)	.84		.01 (-.04 – .06)	.63	
Other	.61 (-.97 – 2.19)	.45		.01 (-.04 – .06)	.68		.02 (-.04 – .08)	.56	
Parent									
Sex (REF: Male)	-.23 (-1.83 – 1.38)	.78		.01 (-.04 – .07)	.57		.03 (-.03 – .09)	.28	
Age	.02 (-.07 – .11)	.64		.001 (-.002 – .003)	.69		.0003 (-.003 – .004)	.87	
BMI	-.07 (-.16 – .02)	.12		-.001 (-.004 – .001)	.32		-.002 (-.006 – .001)	.22	
Annual Household Income (REF: >\$100,000)									
<\$30,000	1.89 (.29 – 3.49)	.02		.04 (-.009 – .09)	.10		.02 (-.05 – .08)	.62	
\$30,000 – \$60,000	.91 (-.68 – 2.49)	.26		.01 (-.04 – .06)	.62		.003 (-.06 – .06)	.91	
\$60,000 – \$100,000	.43 (-1.00 – 1.86)	.56		.01 (-.03 – .06)	.54		-.01 (-.06 – .04)	.72	

Note. CI: 95% confidence interval

^aModel 1 outcome is average daily minutes of MVPA performed by parents and children together during non-school waking hours.

^bModel 2 outcome is the percent of MVPA performed by parents and children together during non-school waking hours out of children's total MVPA during this period.

^cModel 3 outcome is the percent of MVPA performed by parents and children together during non-school waking hours out of parents' total MVPA during this period.

Table 4

Results of the multiple linear regression predicting sedentary behavior performed by parents and children together (less than 50m apart).

Variable	Model 1 ^a			Model 2 ^b			Model 3 ^c		
	b (CI)	p		b (CI)	p		b (CI)	p	
Child									
Sex (REF: Boy)	10.55 (1.05 – 20.05)	.03		.02 (-.02 – .05)	.31		.03 (-.001 – .07)	.06	
Age	4.62 (1.40 – 7.85)	.005		-.004 (-.02 – .01)	.50		.01 (.002 – .02)	.02	
BMI (REF: Obese)									
Underweight	-31.14 (-65.88 – 3.59)	.08		-.07 (-.20 – .06)	.29		-.08 (-.20 – .04)	.20	
Normal weight	-8.87 (-22.08 – 4.34)	.19		-.01 (-.06 – .04)	.67		-.03 (-.07 – .02)	.26	
Overweight	-7.33 (-23.73 – 9.08)	.38		-.001 (-.06 – .06)	.97		.02 (-.04 – .08)	.45	
Race/Ethnicity (REF: White)									
African American	.30 (-26.35 – 26.95)	.98		.03 (-.07 – .13)	.50		-.01 (-.11 – .08)	.77	
Asian	1.25 (-16.60 – 19.10)	.89		.03 (-.04 – .10)	.35		.03 (-.03 – .09)	.31	
Hispanic	9.90 (-2.51 – 22.30)	.12		.03 (-.02 – .08)	.21		.03 (-.02 – .07)	.22	
Other	6.58 (-8.29 – 21.44)	.38		.05 (-.01 – .10)	.09		.03 (-.02 – .08)	.24	
Parent									
Sex (REF: Male)	10.11 (-5.01 – 25.23)	.19		.03 (-.02 – .09)	.27		.03 (-.02 – .08)	.27	
Age	.85 (.02 – 1.68)	.046		.001 (-.002 – .004)	.45		.004 (.001 – .007)	.01	
BMI	-.001 (-.86 – .86)	.997		.0001 (-.003 – .003)	.94		-.001 (-.004 – .002)	.60	
Annual Household Income (REF: >\$100,000)									
<\$30,000	-1.07 (-16.14 – 14.00)	.89		.01 (-.05 – .06)	.80		.02 (-.03 – .07)	.49	
\$30,000 – \$60,000	1.40 (-13.57 – 16.36)	.85		.004 (-.05 – .06)	.89		.02 (-.03 – .07)	.49	
\$60,000 – \$100,000	3.79 (-9.68 – 17.27)	.58		-.01 (-.06 – .04)	.61		.005 (-.04 – .05)	.84	

Note. CI: 95% confidence interval

^aModel 1 outcome is average daily minutes of sedentary behavior performed by parents and children together during non-school waking hours.

^bModel 2 outcome is the percent of sedentary behavior performed by parents and children together during non-school waking hours out of children's total sedentary behavior during this period.