Published in final edited form as:
Health Place. 2011 July ; 17(4): 911–919. doi:10.1016/j.healthplace.2011.04.008.

Active children use more locations for physical activity

Kirsten Corder[1,2], **James F Sallis**[3], **Noe C Crespo**[4], and **John P Elder**[4]

[1]Centre for Diet and Activity Research (CEDAR), Institute of Public Health, University of Cambridge, UK

[2]Medical Research Council Epidemiology Unit, Cambridge, UK

[3]Department of Psychology, San Diego State University, San Diego, CA

[4]Institute for Behavioral and Community Health, San Diego State University, San Diego, CA

Abstract

We examined frequency of use of 11 physical activity (PA) locations among 539 San Diego children (45.0% male, 41.2% Latino; Mean±SD age: 6.6±0.7 yrs) and explored associations between location use, PA and potential correlates. Parents reported child's use (visits/week) of 11 locations. Child PA was assessed by accelerometry (subsample n=178). The most frequently used locations (Mean±SD times/week) were homes (3.2±2.3) and parks/playground (1.6±1.3). Children used 4.0±2.0 locations in a typical week, and made a total of 12.5±6.8 visits/week to all locations. Latinos used fewer locations regularly (3.6±2.1 vs. 4.3±1.9 locations; $p<0.001$) and had fewer visits to all locations (11.4±7.4 vs. 13.2±6.4 visits/week; $p=0.003$) than non-Latinos. Accelerometry-assessed vigorous PA (VPA) was positively associated with the number of locations regularly used ($\beta=0.04$, $p=0.03$) and total visits to all locations among Latinos ($\beta=0.09$, $p=0.005$). Parental PA support was positively associated with locations used ($\beta=0.64$, $p<0.001$) and visits to all locations ($\beta=2.56$, $p<0.001$). Children using a greater variety of locations did more VPA. Latinos making more total visits to all locations had higher VPA.

Keywords

physical activity; children; correlates; location; parents; Latino

Introduction

Regular physical activity is important for obesity prevention in children (Steinbeck, 2008; Wareham et al., 2005), and is associated with a reduced risk of the metabolic syndrome (Brage et al., 2004; Ekelund et al., 2009; Steele et al., 2008) and beneficial effects on mental health (Smith and Biddle, 2008). Recent estimates show that only 42% of US children aged 6–11 meet physical activity guidelines (Troiano et al., 2008), and physical activity declines with age throughout childhood and adolescence (Jago et al., 2008; Nader et al., 2008; Sallis et al., 1999a). More research is needed to understand the modifiable factors associated with

Corresponding author: Kirsten Corder, PhD, Centre for Diet and Activity Research (CEDAR), Box 296, Institute of Public Health, University of Cambridge, Forvie Site, Robinson Way, Cambridge, CB2 0SR, UK, Telephone: +44 (0)1223 769150, Fax: +44 (0)1223 330316, klc29@medschl.cam.ac.uk.

children's physical activity. Research examining the association between use of locations for physical activity and overall physical activity levels may help to determine effective intervention delivery sites for physical activity promotion. For example, it is unknown whether an intervention delivered at just one site, versus one at multiple sites would be most effective to increase physical activity, and which sites may be most important for increasing physical activity.

A review showed that the availability of neighborhood facilities, the proximity of parks and playgrounds and the number of play areas within walking distance of home were associated with higher physical activity in youth (Davison and Lawson, 2006). Though it is known that children use multiple locations for physical activity (Grow et al., 2008; Krizek et al., 2004; Sallis et al., 2006), it is unknown if the frequency of use of different locations relates to overall physical activity.

Most studies investigating the location of child physical activity have focused on the school, the neighborhood, and parks, even though many more locations might be important sites for physical activity (Hoefer et al., 2001). Parentally-reported use, proximity and active transport to 12 physical activity locations were investigated in a previous study which showed that indoor recreation areas, walking/running tracks, school sites, playgrounds and open space were positively associated with active transport in children (Grow et al., 2008). However this study did not examine associations with overall physical activity. We hypothesize that use of a greater variety of locations for physical activity would be associated with higher physical activity levels. This may be especially relevant to young children whose parents are likely to be required to provide support, or permission, for visiting different physical activity locations. This is supported by evidence that a parent's decision to enroll their child in sport is influenced by availability of a greater variety of locations, especially in lower income families (Hardy et al.). As higher levels of participation in organized and non-organized sport is associated with higher overall physical activity levels (Mota et al., 2008) we also believe that a greater number of visits to physical activity locations may be associated with greater physical activity.

Physical activity levels may differ by ethnicity, although evidence is equivocal (Sallis et al., 1999b; van der Horst et al., 2007; Whitt-Glover et al., 2009). Associations between child physical activity and the proximity of parks and playgrounds may also differ by ethnicity (Adkins et al., 2004; Gomez et al., 2004). There is especially limited evidence regarding physical activity location use among Latino children with conflicting evidence on the availability of physical activity environments in that group (Powell et al., 2004; Powell et al., 2006).

Information about where youth go to be physically active is needed to inform public health professionals, planners and policy-makers (Grow et al., 2008; Krizek et al., 2004; Sallis et al., 2006). Though physical activity interventions in children have targeted specific ethnic groups, evidence regarding their effectiveness is limited (van Sluijs et al., 2007). Therefore examination of the locations used for physical activity by different ethnic groups throughout a large urban area could be useful in targeting intervention development. The present study examined the frequency of use of eleven physical activity locations by 5–8 year old children living in San Diego County (CA) and how location related to their physical activity in a sub-sample, and home and family factors.

Methods

The present study used baseline data from the MOVE/me Muevo Project, a randomized controlled childhood obesity prevention trial based in public recreation centers. Participants

included 541 children (aged 5 to 8 years-old) and their primary caregiver living in San Diego County, California. This study was approved by the San Diego State University Institutional Review Board.

Recruitment took place from November 2006 to May 2008. Families were contacted through targeted phone calls, flier dissemination, presentations, and staffed information booths in communities and elementary schools near the recreation centers. Eligibility criteria for the study included having a child aged 5–8 years on the baseline measurement date, living within 1.75 miles from one of 30 participating recreation centers, being willing to participate in the study for 3.5 years and to be randomly assigned to the control or intervention conditions, and being able to speak and read English or Spanish. The distance of 1.75 miles from a recreation center was chosen to ensure that participants could access the center without the need for motorized transport. Children with medical and psychological conditions that affected diet, physical activity, growth or weight, or who had been told by a doctor to avoid exercise for health reasons were excluded. Parents (or primary caregivers) provided written informed consent and children provided oral assent.

Parents completed a questionnaire, and child anthropometric measures were taken. Height (Shorr Measuring Height Board) and weight (SECA 880 and 876 digital scales) were assessed using standard anthropometric procedures by trained staff to the nearest 0.1 cm and 0.1 kg, respectively. Participants were asked to remove their shoes and empty pockets before measurements. Body mass index (BMI) z-scores were calculated using the CDC 2000 reference data (Center for Disease Control and Prevention, 2000).

The questionnaire was administered to primary caregivers at the measurement session. Parents reported demographic information for themselves and their child including: age, gender, Hispanic ethnicity (reporting to be Latino, Hispanic, Mexican/Mexican American, or of Spanish origin), income (reported in 12 categories and collapsed into four) and parent education (ranging from middle school or less to post-graduate work).

Physical activity location

Child use of physical activity locations was reported by parents. These questions were adapted from the ‘Active Where?’ survey with reliability ranging from ICC=0.60 to 0.89 (Kerr et al., 2008). Respondents were asked to select the frequency of their child’s participation in physical activity at 11 types of locations during a typical week. The locations investigated were the nearest public recreation center, other public recreation centers (e.g. YMCA, Boys and Girls Club), commercial facilities (private gym/studio, batting cages, etc.), school grounds (after-school only), school grounds (weekends only), parks or playgrounds, walking/hiking/biking trails, beach or lake, neighborhood (vacant lot/field), family’s yard or apartment complex common area, and friend’s or relative’s home. Response categories were ‘never’, ‘less than once a week’ (both recoded as 0 days/week), ‘1–2 times a week’, ‘3–4 times a week’ and 5–7 times a week’ (recoded as, 1.5 days/week, 3.5 days/week and 6 days/week, respectively). Frequent use of a location was classified as ‘1–2 times a week or more’. Response categories were recoded into ‘days per week’, and two composite variables were derived: total locations used frequently (sum of locations with a response of ≥ once/week) and total weekly visits to any location (times/week).

Potential correlates

Potential home and family correlates of physical activity location use were parentally reported at baseline. Cronbach’s alpha was computed to determine the internal consistency of item groups where appropriate. The presence of eight parental rules regarding physical activity were asked with the following question “Do you have the following rules for your

child?" and answered as "yes", "no" and "sometimes", the latter two categories combined as we hypothesized that if a rule is only reported as 'sometimes' by a parent, it is unlikely to be regularly enforced. The rules were: "do homework before going out", "stay close to or within sight of the house/parent", "do not go into the street", "do not go places alone", "stay within the neighbourhood", "wear a helmet (when biking, skateboarding, etc.)", "wear protective clothing (like knee pads when biking, skateboarding, etc.)" and "avoid strangers". Parental rule questions were taken from a previously used survey with reported reliability ranging from ICC=0.42 to 0.74 (Kerr et al., 2008). Due to most parents reporting having all rules, these responses were dichotomized as ≤7 rules or all 8 rules. Presence of all of these rules was hypothesized to reduce the likelihood of physical activity. Rules regarding sedentary behavior, were 'no TV/DVD/computer before homework', 'less than 2 hours per day of TV/DVD/computer use' and 'no internet without permission'. These have been used previously (Ramirez et al., In press). Frequency of parental support for physical activity was derived as a mean of three questions regarding encouragement, transport and doing physical activity with their child (α=0.75) with original response categories as "never", "less than once a week", "1–2 times a week", "3–4 times a week" and "5–7 times a week" (recoded as 0 days/week, 1.5 days/week, 3.5 days/week and 6 days/week, respectively). A mean score for parental encouragement for less sedentary behavior was derived from two questions; "to help children think of ways to be less inactive" and "encouraging less inactive time" with the same original response categories as above (α=0.79). The total number of electronic media items in the child's bedroom was also parentally-reported and adapted from a published scale (Rosenberg et al., 2010) (previously reported ICC α=0.90) and dichotomized as 0 and ≥1. The number of types of physical activity equipment available at home (range 0–8) was examined using an adapted version of a scale with acceptable reliability (ICC=0.80) (Rosenberg et al., 2010).

Physical activity and sedentary behavior

Accelerometer subsample—Physical activity was objectively assessed in a subsample of participants (n=178) using the Actigraph accelerometer (Model GT1M). The Actigraph has been shown to accurately assess energy expenditure in children during free-living conditions (Ekelund et al., 2003; Ekelund et al., 2001). During the measurement session, children were fitted with the monitor and received wearing instructions. The monitor was set to record at 30-second epochs. Children were asked to wear the monitors during waking hours for 7 days and to remove them while bathing, showering and swimming.

Accelerometry data were analyzed using a batch processing program (MAHUffe: http://www.mrc-epid.cam.ac.uk/Research/Programmes/Programme_5/InDepth/Programme%205_Downloads.html) to remove any data recorded after 11pm and before 6am; periods of ten minutes or more that had continuous zero activity counts and any days with less than 500 minutes of recording (the cut-off used to define a valid day) (Cliff et al., 2009). Participants with fewer than three valid days of recording (including at least one weekend-day and one weekday) were also excluded; three days of measurement has been shown to result in a reliable estimate of total physical activity in children (Penpraze et al., 2006). The data were examined as time spent in moderate physical activity (MPA) and vigorous physical activity (VPA) derived using age specific equations (Freedson et al., 2005) to determine activity over 4.5 METS and 6 METS respectively. Valid minutes spent below 100 counts per minute were used as an estimate of sedentary time (Treuth et al., 2004). Before being applied to the data the cut-points were divided by two in order to get a 30-second cut-point to match the 30-second data collection epoch.

Statistical Analysis

Differences in participant characteristics by gender and ethnicity (Latino and non-Latino) were tested using logistic regression, adjusting for clustering of recreation center recruitment area.

Differences in physical activity location use by gender and ethnicity were tested using multiple linear regression adjusted for caregiver education and clustering by recreation center recruitment area. Models investigating gender differences were adjusted for ethnicity and those investigating ethnic differences were adjusted for gender.

The associations between PA location use (both single and composite) and physical activity variables were investigated using multilevel multiple linear regression models adjusted for gender, ethnicity and caregiver education and clustering by recreation center recruitment area. Associations between composite physical activity location use and physical activity variables were also stratified by gender and ethnicity.

Differences in potential correlates by gender and ethnicity were investigated using logistic regression, adjusting for clustering by recreation center recruitment area. In order to investigate correlates of physical activity location use, associations between potential correlates and composite physical activity location use were examined using multilevel multiple linear regression (number of locations used and frequency of use of locations were the dependent variables). Analyses were adjusted for gender, ethnicity, parent education, and clustering by recruitment area. These latter models were also stratified by gender and ethnicity. Models investigating home PA equipment and home sedentary provision were also adjusted for income. Analyses were done using Stata 11.0 (Statacorp, College Station, TX).

Results

Out of 9,607 parents contacted for potential recruitment into Project MOVE/me Muevo, 2,618 (27.3%) were ineligible, 781 (8.1%) declined to participate, 2,406 (25.0%) did not respond, 3,189 (33.2%) were not included as recruitment was complete and 72 (<1%) families were excluded because they were already enrolled in other studies. A total of 541 children were measured at baseline; two who did not have complete questionnaire data were not included in these analyses (N=539). Of the 190 participants who were given an accelerometer, 178 had valid data to be included in the analysis.

Table 1 presents the characteristics of the 539 participants. In the accelerometry subsample, boys had higher MVPA than girls, but no other gender differences were observed. Latino children had a higher BMI z-score than non-Latino children and a greater proportion were in the lowest categories of income and parental education. Parents of Latino children reported significantly lower overall physical activity for their children than those of non-Latino children.

As shown in Table 2, the most frequently used physical activity locations were the yard or apartment complex, a park or playground, school grounds during after-school hours, and friend or relative's home. Children used an average of 4.0±2.0 different physical activity locations in a typical week, and made a total of 12.5±6.8 visits/week to all physical activity locations. Compared to non-Latino children, parents of Latino children reported less frequent use of commercial facilities, neighborhood areas, yard or apartment complex and friends' or relatives' homes, but no other gender or ethnic differences were observed. The use of a neighborhood space as a physical activity location was associated with higher

vigorous physical activity, however, no other associations between use of separate physical activity locations and physical activity were found.

Latino children used fewer locations frequently and had fewer visits to any location, than non-Latino children as shown in Table 3. Vigorous physical activity was significantly associated with use of the number of sites frequency used for all children in the subsample with accelerometry data. Vigorous physical activity was positively associated with total weekly visits to all sites for Latino children. No associations between sedentary time, MPA or overall PA (cpm) and the composite physical activity location variables were observed.

No sex differences in potential correlates of PA location use were identified. Latino children were subject to less PA-restricting rules, had lower PA equipment availability in the home but had more electronic media available in their bedrooms. Table 4 also shows results of adjusted associations between composite physical activity locations and PA rules, sedentary rules, parental PA encouragement, parental encouragement for less sedentary behavior, home PA equipment and electronic media in the bedroom. The number of places frequently used and the total number of visits to any location were positively associated with parental PA support, parental encouragement for less sedentary behavior and home PA equipment for all groups. Contrary to expectations, the presence of all 8 PA-restricting rules was positively associated with the number of locations used for boys.

Discussion

The diverse sample of 5–8 year-old children in the present study used an average of 4 different physical activity locations at least once per week, and the number of locations used was positively associated with objectively-measured vigorous physical activity in the subsample with physical activity data. The total number of visits to any physical activity location was also associated with higher vigorous physical activity levels among Latino children. The results are generally consistent with other studies showing that access to places to play is a correlate of children's physical activity (Grow et al., 2008; Sallis et al., 1993; Sallis et al., 2000; van der Horst et al., 2007).

The four most frequently used locations were the yard or apartment complex, park or playground, school grounds during after-school hours, and friend or relative's home. Identification of the yard or apartment complex as the most commonly used location appears to be consistent with previous research indicating that children are most likely to be active within approximately 800 meters of their home (Jones et al., 2009). However, we were unable to investigate this further as data were not available regarding the distance from the participants' homes to these locations. The number of places visited at least once per week was related to vigorous physical activity in the accelerometry-subsample, suggesting that regular access to play locations may be required to impact habitual vigorous physical activity.

Children using a greater variety of locations engaged in more VPA. This could indicate that variety of locations is generally more important for child VPA than the total number of visits. Increasing children's access to multiple locations where they can engage in spontaneous play may be an effective approach for promoting physical activity in this age group. More frequent use of all locations was only associated with higher vigorous physical activity among Latino children. As Latino children tend to use fewer locations than non-Latino children, they therefore may have more potential to increase their use of different locations. As non-Latino children tend to use more locations anyway there may be less scope for them to increase their location use and therefore other strategies may be more important for developing effective interventions in this group.

When investigating associations between composite location use and physical activity variables, significant associations were only found with vigorous physical activity. No associations were seen between location use and sedentary time, moderate or overall physical activity. This may indicate that these children are doing sport, or other high intensity activities at these locations. It is possible that alternative locations may be important sites for other aspects of physical activity, or this could be due to a lack of statistical power among the accelerometry subsample.

Use of neighborhood space was the only location that was significantly related to accelerometry-derived vigorous physical activity. However, when examining composite location use, there were significant associations with VPA for all children for variety of locations and for Latino children for total visits. Subsequently, there would seem to be a potential to intervene to increase children's use of a variety of locations for physical activity. Reducing psychological (e.g., concerns about safety) or environmental (e.g., lack of play equipment or other children) barriers to use of neighborhood space for physical activity could become an intervention goal. However, the certainty of our results may be limited given the reduced sample size and thus statistical power in the accelerometer sample.

Given the consistent gender differences in physical activity (Sallis et al., 2000), it was surprising that none of the location use variables differed between girls and boys. However, it is notable that boys did more moderate physical activity and vigorous physical activity than girls but also had higher BMI Z-scores. This counterintuitive finding could be due to characteristics of the population, or possibly selection bias in the accelerometry subsample.

There was a clear pattern of ethnic differences with Latino children using 3 of the 11 specific locations less often and having lower scores on both of the composite use variables than non-Latino children. It is possible that ethnic differences in physical activity location use may result from variation in the promotion, access and support of sports facilities and physical activity environments among different ethnic groups, but there is little evidence exploring this. Latino children used home and apartment complex, neighborhood areas, and friend and relative's homes less often than non-Latino children. This may suggest that these ethnic differences may be due to differences in parental factors rather than access to the locations. However, these Latino children appear to be subject to less PA-restricting rules than non-Latino children, which contrary to our findings may suggest that they have more freedom to visit different physical activity locations. However, it is possible that less physical activity equipment availability in the home and the greater amount of electronic equipment in the bedrooms of Latino children may be important regarding use of different physical activity locations in this group.

Parent support of physical activity was associated with PA location use for all groups, and was positively related to both composite variables of location use. Parent support behaviors were encouragement, transportation to locations, and doing physical activity with the child. These results perhaps suggest that parental knowledge of a variety of PA locations, along with increasing support and encouragement for their use may be important in physical activity interventions. This adds to previous evidence that a parent decision to enroll their child in sport is influenced by availability of a greater variety of locations, this has previously been shown to be especially important in lower income families (Hardy et al.), and our results indicate that this might be particularly relevant for Latino children.

Parent support for reducing sedentary behaviors was significantly related to composite location-use variables as were the number of pieces of physical activity equipment at home. A surprising finding was that for boys, having all physical activity restricting rules at home was positively associated with the number of locations used. We could hypothesize that

despite imposing rules restricting physical activity freedom around the home, these parents also could be supporting these children to do organized or non-organized sports at other locations. This pattern of results suggests that encouraging parent support for increasing physical activity and reducing sedentary behaviors could be an effective intervention target. Home activity equipment could be a marker for general support of children's physical activity as well as parent modeling of activity. Home physical activity equipment could play an important role in facilitating children being active in the convenient physical activity locations that are used most often.

The present study provided no evidence that use of physical activity locations was related to sedentary behaviors, moderate physical activity or overall physical activity. This is not surprising since the accelerometry subsample was quite small and many of the locations assessed are likely to be venues for vigorous physical activities such as sports. Further, physical activity correlates have generally not been related to sedentary behavior in the few published studies on this topic (King et al.; Nilsson et al., 2009; Williams et al., 1999) and the few studies examining moderate and vigorous physical activity separately have found that the two intensities may have different correlates (van Sluijs et al., 2010). Thus, interventions may need to specifically target different physical activity intensities separately.

An important limitation of the present study was the smaller sample with accelerometer measures that reduced statistical power. Further, the exploratory nature of this analysis resulted in many statistical tests. Following the suggestions of Rothman *et al.,* (Rothman, 1990) corrections for multiple testing have not been made as this may lead to rejecting the null hypothesis too readily. This is an exploratory analysis and the intention was to identify avenues that may warrant further investigation while being careful not to over emphasize significant results in this manuscript. The correlates of physical activity location use explored were perhaps limited. For example, it would have been preferable to investigate a wider range of physical activity restricting rules with more heterogeneity in responses than those available here. Study strengths included a large diverse sample of young children, a more comprehensive measure of physical activity locations than has been used previously, and an examination of correlates of location use.

Present results have several implications for intervention. Interventions based on present results would consider that all children have regular access to multiple places near their home for physical activity, reduce physical and social barriers to the use of those places, such as dangerous equipment and threat of crime, and encourage parents to support their children's physical activity through encouragement, transportation, and active participation. These recommendations may be especially relevant to interventions targeting Latino children.

Acknowledgments

Data used for this study were obtained from Project MOVE/me Muevo; a recreation center-based obesity prevention and control intervention for children who reside in San Diego County, and is funded by the National Institute of Diabetes and Digestive and Kidney Diseases (R01 DK072994). Kirsten Corder was funded by the Medical Research Council Epidemiology Unit, Cambridge, UK. Noe C. Crespo was supported by grants T32HL079891 and F31KD079345 and John P. Elder was supported by NIDDK grant R01 DK072994 and partially by PRC grant U48 DP000036. The authors thank Jamie Moody, Lisa M. Shadron and the whole Project MOVE team and also Esther van Sluijs for comments on the manuscript.

References

Adkins S, Sherwood NE, Story M, Davis M. Physical activity among African-American girls: the role of parents and the home environment. Obes Res. 2004; 12(Suppl):38S–45S. [PubMed: 15489466]

Brage S, Wedderkopp N, Ekelund U, Franks PW, Wareham NJ, Andersen LB, Froberg K. Features of the metabolic syndrome are associated with objectively measured physical activity and fitness in Danish children: the European Youth Heart Study (EYHS). Diabetes Care. 2004; 27:2141–2148. [PubMed: 15333475]

Center for Disease Control and Prevention. 2000. http://www.cdc.gov/growthcharts/

Cliff DP, Reilly JJ, Okely AD. Methodological considerations in using accelerometers to assess habitual physical activity in children aged 0–5 years. J Sci Med Sport. 2009; 12:557–567. [PubMed: 19147404]

Davison K, Lawson C. Do attributes in the physical environment influence children's physical activity? A review of the literature. International Journal of Behavioural Nutrition and Physical Activity. 2006:3.

Ekelund U, Åman J, Westerterp K. Is the ArteACC index a valid indicator of free-living physical activity in adolescents? Obes Res. 2003; 11:793–801. [PubMed: 12805401]

Ekelund U, Anderssen S, Andersen LB, Riddoch CJ, Sardinha LB, Luan J, Froberg K, Brage S. Prevalence and correlates of the metabolic syndrome in a population-based sample of European youth. Am J Clin Nutr. 2009; 89:90–96. [PubMed: 19056570]

Ekelund U, Sjöström M, Yngve A, Poortvliet E, Nilsson A, Froberg K, Wedderkopp N, Westerterp K. Physical activity assessed by activity monitor and doubly labelled water in children. Medicine and Science in Sports and Exercise. 2001; 33:275–281. [PubMed: 11224818]

Freedson P, Pober D, Janz K. Calibration of Accelerometer Output for Children. Med Sci Sports Exerc. 2005; 37:S523–S530. [PubMed: 16294115]

Gomez JE, Johnson BA, Selva M, Sallis JF. Violent crime and outdoor physical activity among inner-city youth. Prev Med. 2004; 39:876–881. [PubMed: 15475019]

Grow HM, Saelens BE, Kerr J, Durant NH, Norman GJ, Sallis JF. Where are youth active? Roles of proximity, active transport, and built environment. Med Sci Sports Exerc. 2008; 40:2071–2079. [PubMed: 18981942]

Hardy LL, Kelly B, Chapman K, King L, Farrell L. Parental perceptions of barriers to children's participation in organised sport in Australia. J Paediatr Child Health. 46:197–203. [PubMed: 20105247]

Hoefer WR, McKenzie TL, Sallis JF, Marshall SJ, Conway TL. Parental provision of transportation for adolescent physical activity. Am J Prev Med. 2001; 21:48–51. [PubMed: 11418257]

Jago R, Wedderkopp N, Kristensen PL, Moller NC, Andersen LB, Cooper AR, Froberg K. Six-year change in youth physical activity and effect on fasting insulin and HOMA-IR. Am J Prev Med. 2008; 35:554–560. [PubMed: 18848414]

Jones AP, Coombes EG, Griffin SJ, van Sluijs EM. Environmental supportiveness for physical activity in English schoolchildren: a study using Global Positioning Systems. Int J Behav Nutr Phys Act. 2009; 6:42. [PubMed: 19615073]

Kerr, J.; Sallis, JF.; Rosenberg, DE.; Norman, GJ.; Saelens, BE.; Durant, N. Active Where? Surveys. Active Living Research; 2008.

King AC, Parkinson KN, Adamson AJ, Murray L, Besson H, Reilly JJ, Basterfield L. Correlates of objectively measured physical activity and sedentary behaviour in English children. Eur J Public Health.

Krizek KJ, Birnbaum AS, Levinson DM. A schematic for focusing on youth in investigations of community design and physical activity. Am J Health Promot. 2004; 19:33–38. [PubMed: 15460099]

Mota J, Silva P, Aires L, Santos MP, Oliveira J, Ribeiro JC. Differences in school-day patterns of daily physical activity in girls according to level of physical activity. J Phys Act Health. 2008; 5 (Suppl 1):S90–97. [PubMed: 18364527]

Nader PR, Bradley RH, Houts RM, McRitchie SL, O'Brien M. Moderate-to-vigorous physical activity from ages 9 to 15 years. Jama. 2008; 300:295–305. [PubMed: 18632544]

Nilsson A, Andersen LB, Ommundsen Y, Froberg K, Sardinha LB, Piehl-Aulin K, Ekelund U. Correlates of objectively assessed physical activity and sedentary time in children: a cross-sectional study (The European Youth Heart Study). BMC Public Health. 2009; 9:322. [PubMed: 19735565]

Penpraze V, Reilly J, MacLean C, Montgomery C, Kelly L, Paton J, Aitchison T, Grant S. Monitoring of Physical Activity in Young Children: How Much Is Enough? Pediatric Exercise Science. 2006; 18:483–491.

Powell L, Slater S, Chaloupka FJ. The relationship between community physical activity settings and race, ethnicity and socioeconomic status. Evidence-based Preventive Medicine. 2004; 1:135–144.

Powell LM, Slater S, Chaloupka FJ, Harper D. Availability of physical activity-related facilities and neighborhood demographic and socioeconomic characteristics: a national study. Am J Public Health. 2006; 96:1676–1680. [PubMed: 16873753]

Ramirez E, Norman GJ, Rosenberg DE, Kerr J, Saelens BE, Durant N, Sallis JF. Adolescent screen time and rules to limit screen time in the home. Journal of Adolescent Health. In press.

Rosenberg DE, Sallis JF, Kerr J, Maher J, Norman GJ, Durant N, Harris SK, Saelens BE. Brief scales to assess physical activity and sedentary equipment in the home. Int J Behav Nutr Phys Act. 2010; 7:10. [PubMed: 20181057]

Rothman KJ. No adjustments are needed for multiple comparisons. Epidemiology. 1990; 1:43–46. [PubMed: 2081237]

Sallis JF, Alcaraz JE, McKenzie TL, Hovell MF. Predictors of change in children's physical activity over 20 months. Variations by gender and level of adiposity. Am J Prev Med. 1999a; 16:222–229. [PubMed: 10198662]

Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. An ecological approach to creating active living communities. Annu Rev Public Health. 2006; 27:297–322. [PubMed: 16533119]

Sallis JF, Nader PR, Broyles SL, Berry CC, Elder JP, McKenzie TL, Nelson JA. Correlates of physical activity at home in Mexican-American and Anglo-American preschool children. Health Psychology. 1993; 12:390–398. [PubMed: 8223363]

Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. Med Sci Sports Exerc. 2000; 32:963–975. [PubMed: 10795788]

Sallis JF, Prochaska JJ, Taylor WC, Hill JO, Geraci JC. Correlates of physical activity in a national sample of girls and boys in grades 4 through 12. Health Psychol. 1999b; 18:410–415. [PubMed: 10431943]

Smith, A.; Biddle, S. Youth physical activity and sedentary behavior. Human Kinetics; Champaign, IL: 2008.

Steele R, Brage S, Corder K, Wareham N, Ekelund U. Physical activity, cardiorespiratory fitness, and the metabolic syndrome in youth. Journal of Applied Physiology. 2008; 105:342–351. [PubMed: 18369096]

Steinbeck K. The importance of PA in the prevention of overweight and obesity in childhood: a review and an opinion. Obesity Reviews. 2008; 2:117–130. [PubMed: 12119663]

Thompson A, Campagna P, Rehman L, Murphy R, Rasmussen R, Ness G. Physical Activity and Body Mass Index in Grade 3, 7, and 11 Nova Scotia Students. Medicine and Science in Sports and Exercise. 2005; 37:1902–1908. [PubMed: 16286859]

Treuth M, Schmitz K, Catellier D, McMurray R, Murray D, Almeida M, Going S, Normal J, Pate R. Defining thresholds for activity intensities in adolescent girls. Medicine and Science in Sports and Exercise. 2004; 36:1259–1266. [PubMed: 15235335]

Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc. 2008; 40:181–188. [PubMed: 18091006]

van der Horst K, Chin A Paw M, Twisk J, van Mechelen W. A Brief Review on Correlates of Physical Activity and Sedentariness in Youth. Medicine and Science in Sports and Exercise. 2007; 39:1241–1250. [PubMed: 17762356]

van Sluijs E, McMinn A, Griffin S. Effectiveness of interventions to promote physical activity in children and adolescents: systematic review of controlled trials. British Medical Journal. 2007:6. [PubMed: 17615187]

van Sluijs EM, Jones NR, Jones AP, Sharp SJ, Harrison F, Griffin SJ. School-level correlates of physical activity intensity in 10-year-old children. Int J Pediatr Obes. 2010

Wareham N, van Sluijs E, Ekelund U. Physical activity and obesity prevention: a review of the current evidence. Proceedings of the Nutrition Society. 2005

Whitt-Glover MC, Taylor WC, Floyd MF, Yore MM, Yancey AK, Matthews CE. Disparities in physical activity and sedentary behaviors among US children and adolescents: prevalence, correlates, and intervention implications. J Public Health Policy. 2009; 30(Suppl 1):S309–334. [PubMed: 19190581]

Williams CD, Sallis JF, Calfas KJ, Burke R. Psychosocial and demographic correlates of television viewing. Am J Health Promot. 1999; 13:207–214. [PubMed: 10351850]

Table 1

Baseline characteristics of the MOVE/me Muevo sample (N=539) (means and SD, unless otherwise stated).

	Overall	Boys	Girls	OR (95% CI) P value *(gender difference)**	Latino	Non-Latino	OR (95% CI) P value *(ethnic difference)**
				Reference group: girls			**Reference group: non-Latino**
Gender N *(%)*		45.1	54.9		49.6 (% male)	42.0 (%male)	Reference group: girls 1.35 (0.97, 1.91) 0.08
Age *(years)*	6.6 (0.7)	6.6 (0.7)	6.6 (0.7)	0.90 (0.76, 1.07) 0.23	6.7 (0.68)	6.6 (0.7)	1.02 (0.81, 1.27) 0.88
BMI z-score	0.66 (0.96)	0.75 (1.04)	0.59 (0.88)	1.19 (1.00, 1.42) 0.049	0.90 (1.0)	0.49 (0.89)	1.58 (1.30, 1.93) <0.001
Ethnicity	41.2 *(% Latino)*	45.3 *(% Latino)*	37.8 *(% Latino)*	1.36 (0.97, 1.91) 0.08	41.2%	58.8%	
Monthly Income *(% participants)*							
$0–$2,000	22.7	24.0	21.7		45.3	7.9	
$2,001–$3,500	15.2	17.1	13.7	1.13 (0.63, 2.01) 0.69	21.6	11.0	0.34 (0.17, 0.69) 0.002
$3,501–$5,000	12.7	12.4	12.9	0.87 (0.49, 1.53) 0.63	8.4	15.5	0.10 (0.04, 0.22) <0.001
$5,001+	49.4	49.5	51.7	0.81 (0.51, 1.31) 0.39	24.7	65.5	0.67 (0.03, 0.13) <0.001
Parental education *(% participants)*							
Middle school or less	14.7	16.5	13.2	Reference group	35.1	0.32	Reference group
High school	15.2	18.1	12.8	1.13 (0.56, 2.27) 0.73	26.1	7.6	0.03 (0.005, 0.20) <0.001
Some college but not graduated	26.9	29.1	24.3	0.67 (0.33, 1.35) 0.26	24.8	28.4	0.007 (0.001, 0.056) <0.001
College Graduate	24.7	25.1	24.3	0.83 (0.47, 1.45) 0.50	11.3	34.1	0.003 (0.00, 0.02) <0.001
Post-graduate work	18.6	16.1	20.6	0.62 (0.29, 1.32) 0.22	2.7	29.7	0.01 (0.01, 0.01)
Accelerometry subsample (n=178)							
Sedentary time (mins/day)	337.4 (0.39)	343.3 (73.0)	334.2 (60.9)	1.00 (1.0, 1.01) 0.39	342.5 (66.9)	334.0)	1.0 (1.0, 1.0) 0.31
MPA (mins/day)	42.2 (13.6)	46.6 (14.3)	39.9 (12.7)	1.04 (1.02, 1.06) <0.001			
VPA (mins/day)	21.7 (10.7)	25.0 (12.6)	20.0 (9.2)	1.04 (1.02, 1.07) 0.001			
Overall physical activity (cpm)	579.1 (125.8)	597.4 (133.4)	569.8 (121.3)	1.00 (1.0, 1.0) 0.08	566.4 (112.9)	587.7 (133.6)	1.0 (1.0, 1.0) 0.31

PA physical activity; MPA moderate physical activity; VPA vigorous physical activity; cpm counts per minute;

*analysis using logistic regression adjusted for recreation center recruitment area clustering

Table 2

Associations between physical activity location use (days/week) with gender and ethnicity, and associations between physical activity location use and physical activity variables adjusted for gender, ethnicity, caregiver education and clustered for recreation center recruitment area. Values Mean (SD) (times per week), unless otherwise stated.

Location	All (n=539)	Boys (n=243)	Girls (n=296)	Gender difference β (95% CI) p value (ref: girls)	Latino (n=222)	Non-Latino (n=317)	Ethnic difference β (95% CI) p value (ref: non-Latino)	Accelerometry subsample (n=178) β (95% CI) p value			
								Sedentary (mins)	MPA (mins)	VPA (mins)	Overall PA (cpm)
Nearest Recreation Center	0.84 (1.23)	0.87 (1.27)	0.82 (1.20)	0.05 (−0.14, 0.25) 0.58	0.89 (0.18)	0.81 (0.12)	0.08 (−0.12, 0.29) 0.41	−0.01 (−0.01, 0.01) 0.42	−0.01 (−0.02, 0.01) 0.63	−0.01 (−0.02, 0.02) 0.80	−0.01 (−0.01, 0.01) 0.84
Other Recreation Facility (e.g. YMCA, Boys and Girls Club)	0.51 (1.11)	0.51 (1.14)	0.51 (1.08)	0.01 (−0.16, 0.18) 0.91	0.46 (0.12)	0.55 (0.10)	−0.01 (−0.01, 0.01) 0.53	−0.01 (−0.01, 0.01) 0.68	−0.02 (−0.01, 0.01) 0.68	−0.01 (−0.02, 0.01) 0.41	−0.01 (−0.01, 0.01) 0.74
Commercial facility (e.g. Gym, Batting cages)	0.40 (0.83)	0.37 (0.82)	0.43 (0.84)	−0.06 (−0.19, 0.08) 0.40	0.24 (0.77)	0.52 (0.86)	**−0.27 (−0.43, −0.12) 0.001**	0.01 (−0.01, 0.01) 0.47	0.01 (−0.01, 0.01) 0.97	0.01 (−0.01, 0.01) 0.19	−0.01 (−0.01, 0.01) 0.88
School grounds (after-school)	1.49 (2.06)	1.52 (2.07)	1.46 (2.05)	0.07 (−0.28, 0.42) 0.70	1.42 (2.06)	1.54 (2.07)	−0.12 (−0.46, 0.22) 0.48	−0.01 (−0.01, 0.01) 0.88	0.02 (−0.01, 0.04) 0.14	0.01 (−0.02, 0.03) 0.57	0.01 (−0.01, 0.01) 0.66
School grounds (weekends)	0.35 (0.96)	0.30 (0.67)	0.39 (1.15)	−0.10 (−0.29, 0.09) 0.31	0.41 (1.08)	0.31 (0.88)	0.10 (−0.12, 0.32) 0.36	−0.01 (−0.01, 0.01) 0.26	0.01 (−0.01, 0.03) 0.055	0.01 (−0.01, 0.03) 0.07	0.01 (−0.01, 0.01) 0.09
Parks or playgrounds	1.60 (1.32)	1.53 (1.21)	1.65 (1.40)	−0.13 (−0.35, 0.10) 0.26	1.58 (1.41)	1.61 (1.26)	−0.02 (−0.21, 0.16) 0.81	−0.01 (−0.01, 0.01) 0.99	0.01 (−0.01, 0.02) 0.47	0.01 (−0.01, 0.02) 0.81	−0.01 (−0.01, 0.01) 0.68
Walking/hiking/biking trails	1.14 (1.46)	1.11 (1.37)	1.17 (1.54)	−0.06 (−0.28, 0.16) 0.59	1.19 (1.53)	1.10 (1.41)	0.09 (−0.16, 0.34) 0.47	0.01 (−0.01, 0.01) 0.53	−0.01 (−0.02, 0.01) 0.30	0.01 (−0.01, 0.02) 0.47	−0.01 (−0.01, 0.01) 0.51
Beach or lake	0.64 (0.81)	0.66 (0.85)	0.62 (0.78)	0.04 (−0.09, 0.17) 0.55	0.56 (0.87)	0.70 (0.76)	−0.13 (−0.31, 0.04) 0.13	0.01 (−0.01, 0.01) 0.44	0.01 (−0.01, 0.01) 0.68	0.01 (−0.01, 0.01) 0.47	−0.01 (−0.01, 0.01) 0.67
Neighborhood (e.g. vacant lot/ field)	0.98 (1.70)	0.92 (1.71)	1.02 (1.70)	−0.10 (−0.38, 0.18) 0.48	0.80 (1.55)	1.10 (1.80)	−0.29 (−0.61, 0.03) 0.07	−0.01 (−0.01, 0.01) 0.43	0.01 (−0.01, 0.03) 0.21	**0.03 (0.01, 0.05) 0.04**	0.01 (−0.01, 0.01) 0.11
Yard or apartment complex	3.22 (2.34)	3.32 (2.33)	3.15 (2.36)	0.16 (−0.19, 0.52) 0.35	2.75 (2.35)	3.56 (2.28)	**−0.81 (−1.23, −0.04) <0.001**	0.01 (−0.01, 0.01) 0.66	0.01 (−0.03, 0.03)	−0.01 (−0.03, 0.03) 0.93	−0.01 (−0.01, 0.01) 0.75
Friend or relative's home	1.31 (1.41)	1.33 (1.43)	1.29 (1.40)	0.04 (−0.19, 0.27) 0.70	1.11 (1.30)	1.44 (1.48)	**−0.33 (−0.56, −0.09) 0.008**	0.01 (−0.01, 0.01) 0.22	0.01 (−0.01, 0.03) 0.31	0.01 (−0.01, 0.03) 0.22	0.01 (−0.01, 0.01) 0.62

Table 3

Differences in composite physical activity location use (days/week) by gender and ethnicity, and associations between composite physical activity location use and physical activity variables. Multilevel linear regressions are adjusted for gender, ethnicity, caregiver education and clustered for recreation center recruitment area. Values Mean (SD) (times per week), unless otherwise stated.

Location		All (n=539)	Gender difference β (95% CI) p value (ref: girls)	Ethnic difference β (95% CI) p value (ref: non-Latino)	Accelerometry subsample (n=178) β (95% CI) p value			
					Sedentary (mins)	MPA (mins)	VPA (mins)	Overall PA (cpm)
Number of sites frequently used	**Boys** (n=243)	4.00 (2.00)	0.007 (−0.28, 0.30) 0.96		0.002 (−0.01, 0.01) 0.66	0.04 (−0.01, 0.10) 0.09	0.04 (−0.02, 0.10) 0.17	0.01 (−0.01, 0.01) 0.71
	Girls (n=296)	4.00 (2.00)			−0.004 (−0.01, 0.002) 0.19	0.01 (−0.02, 0.04) 0.38	0.04 (−0.01, 0.08) 0.06	0.003 (−0.01, 0.01) 0.06
	Latino (n=222)	**3.64 (2.13)**		**−0.62 (−0.98, −0.27) 0.001**	−0.01 (−0.02, 0.01) 0.41	0.05 (−0.01, 0.1) 0.056	**0.09 (0.03, 0.14) 0.005**	0.004 (−0.003, 0.01) 0.26
	Non-Latino (n=317)	**4.26 (1.87)**			−0.01 (−0.01, 0.01) 0.96	0.01 (−0.02, 0.04) 0.71	0.01 (−0.01, 0.04) 0.34	0.001 (−0.001, 0.004) 0.30
Total weekly visits to all sites	**Boys** (n=243)	12.45 (6.94)	−0.06 (−0.96, 0.88) 0.90		0.02 (−0.01, 0.04) 0.22	0.08 (−0.04, 0.20) 0.19	0.04 (−0.09, 0.17) 0.49	−0.002 (−0.01, 0.01) 0.67
	Girls (n=296)	12.51 (6.80)			−0.01(−0.03, 0.10) 0.36	0.04 (−0.04, 0.12) 0.36	0.11 (−0.001, 0.23) 0.054	0.01 (−0.01, 0.02) 0.19
	Latino (n=222)	**11.4 (7.37)**		**−1.79 (−2.92, −0.66) 0.003**	−0.01 (−0.04, 0.03) 0.84	0.07 (−0.06, 0.21) 0.27	**0.17 (0.02, 0.33) 0.03**	0.01 (−0.02, 0.02) 0.94
	Non-Latino (n=317)	**13.22 (6.39)**			0.01 (−0.01, 0.02) 0.85	0.03 (−0.04, 0.1) 0.40	0.02 (−0.05, 0.09) 0.60	0.002 (−0.005, 0.01) 0.48

Significant differences/correlations highlighted in bold text; PA physical activity; MPA moderate physical activity; VPA vigorous physical activity; cpm counts per minute

Frequent use classified as at least once a week.

Table 4

Adjusted associations of composite physical activity location use variables with potential correlates; results from multilevel linear regression adjusted for caregiver education and gender and/or ethnicity, and clustered for recreation center recruitment area. Values are β (95% Confidence interval) p value.

	Gender difference β (95% CI) p value (ref: girls)	Ethnic difference β (95% CI) p value (ref: non-Latino)	Places frequently used (n places with frequent use) β (95% CI) p value					Total times using sites (times/week) CI) p value				β (95%
			All	Boys	Girls	Latino	Non-Latino	All	Boys	Girls	Latino	Non-Latino
PA rules (all 8 rules) (reference category: ≤8 rules)	0.98 (0.88, 1.08) 0.62	**0.74 (0.64, 0.86) <0.001**	**0.34 (0.02, 0.65) 0.04**	**0.62 (0.11, 1.13) 0.018**	0.12 (−0.42, 0.65) 0.66	0.36 (−0.2, 0.9) 0.20	0.35 (−0.08, 0.78) 0.10	0.73 (−0.45, 1.92) 0.22	1.29 (−0.35, 2.92) 0.12	0.36 (−1.50, 2.21) 0.70	1.0 (−1.2, 3.2) 0.36	0.61 (−0.83, 2.10) 0.39
Sedentary rules (all 3 rules) (reference category: <3 rules)	0.83 (0.55, 1.27) 0.40	1.44 (0.92, 2.25) 0.11	0.13 (−0.19, 0.44) 0.41	0.30 (−0.28, 0.89) 0.30	−0.03 (−0.54, 0.48) 0.90	0.26 (−0.35, 0.88) 0.39	0.06 (−0.47, 0.59) 0.81	−0.04 (−0.72, 0.64) 0.91	0.41 (−1.71, 2.54) 0.69	−0.45 (−0.203, 1.13) 0.57	0.43 (−1.59, 2.45) 0.67	−0.29 (−1.85, 1.27) 0.71
Parental PA support (mean times per week)	1.10 (0.95, 1.27) 0.18	0.87 (0.70, 1.08) 0.20	**0.76 (0.63, 0.89) <0.001**	**0.64 (0.41, 0.88) <0.001**	**0.88 (0.66, 1.10) <0.001**	**0.70 (0.41, 0.99) <0.001**	**0.85 (0.70, 1.01) <0.001**	**3.03 (2.49, 3.58) <0.001**	**2.56 (1.78, 3.33) <0.001**	**3.53 (2.34, 4.71) <0.001**	**2.89 (1.79, 3.98) <0.001**	**3.28 (2.39, 4.17) <0.001**
Parent support for less sedentary (mean times per week)	0.97 (0.84, 1.11) 0.63	1.08 (0.95, 1.23) 0.23	**0.36 (0.26, 0.47) <0.001**	**0.36 (0.19, 0.54) <0.001**	**0.37 (0.24, 0.50) <0.001**	**0.44 (0.23, 0.65) <0.001**	**0.31 (0.18, 0.45) <0.001**	**1.00 (0.76, 1.25) <0.001**	**1.08 (0.57, 1.59) <0.001**	**0.95 (0.47, 1.42) <0.001**	**1.17 (0.37, 1.98) 0.006**	**0.90 (0.37, 1.43) 0.002**
Home PA equipment (number of items available)*	0.98 (0.88, 1.08) 0.62	**0.74 (0.64, 0.86) <0.001**	**0.40 (0.28, 0.51) <0.001**	**0.47 (0.34, 0.61) <0.001**	**0.34 (0.18, 0.50) <0.001**	**0.42 (0.23, 0.61) <0.001**	**0.38 (0.25, 0.51) <0.001**	**1.35 (0.88, 1.82) <0.001**	**1.38 (0.74, 2.01) <0.001**	**1.29 (0.72, 1.87) <0.001**	**1.12 (0.29, 1.96) 0.01**	**1.43 (0.93, 1.92) <0.001**
Home sedentary provision (electronic media in bedroom)* (reference category: *0 electronic media in bedroom)*	0.78 (0.50, 1.21) 0.27	**2.2 (1.33, 3.57) 0.002**	0.40 (−0.07, 0.87) 0.10	0.34 (−0.25, 0.94) 0.24	0.44 (−0.27, 1.14) 0.21	0.69 (−0.24, 1.62) 0.14	0.33 (−0.24, 0.90) 0.24	0.57 (−0.95, 2.11) 0.45	0.19 (−1.93, 2.31) 0.86	0.94 (−1.28, 3.16) 0.39	2.26 (−0.57, 5.10) 0.11	0.03 (−1.86, 1.92) 0.98

Significant differences highlighted in bold text. PA physical activity.

*adjusted for income