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Environmental Correlates of Physical Activity in Mexican-American Children at Home

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Abstract

Background—Understanding home environments may shed light on factors contributing to reduced physical activity (PA) in children, particularly minorities. Few studies have used micro-level observations to simultaneously assess children's PA and associated conditions in homes.

Methods—Trained observers assessed PA and associated physical and social environmental variables in the homes of 139 Mexican-American children (69 boys, 70 girls; mean age=6 years) after school.

Results—Children spent most time indoors (77%) and being sedentary (74%). Reduced PA was associated with viewing media, being indoors, and parents being present. Increased PA was associated with prompts for PA and other children being present. PA prompts differed by child gender and location and prompter age status.

Conclusions—Children are frequently sedentary at home. Micro-level observations showed PA is associated with potentially modifiable social and physical factors, including spending time outdoors. Studies to determine whether interventions on these correlates can improve children's PA are needed.

Keywords

observation; exercise; minorities; behavior analysis; prompts

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Physical activity is a modifiable risk factor for numerous diseases including obesity, diabetes, hypertension, and cardiovascular disorders (1). Physical activity during childhood and adolescence has immediate health benefits and may contribute to the development of healthy adult lifestyles which help reduce chronic diseases and their effects (2–4). Numerous studies suggest that children and adolescents accrue insufficient amounts of physical activity for health purposes (2,5), and there is a particular concern with the relationship between childhood inactivity and the growing levels of obesity and Type 2 diabetes (6,7). Because of the importance of physical activity to public health, understanding factors that relate to the accrual of activity in children is imperative.

Numerous studies have assessed variables associated with child and adolescent physical activity, and reviews of these studies have been published recently (8–11). Most of the studies are correlational and the data assessed in them were obtained primarily from surveys and questionnaires; only recently have objective measures of physical activity (e.g., accelerometers) become available (13). The use of questionnaires as the main data source limited the number of studies that could be done on prepubescent children, and the data on them were most often reported by parents.

A number of biological (e. g., gender, age, ethnicity) and social demographic (e.g., family socioeconomic status) variables that are either fixed or not easily modified have consistently been found to be associated with children's physical activity. In addition, several studies have identified factors in the physical environment that are correlated with children's activity levels (8,9). Of particular relevance to prepubescent children is the identification of modifiable factors that occur in the home setting, the location where young children spend much of their time. It has been argued that pathways for later physical activity and other behaviors are formed at home when children are young (12), and this notion is supported by both social–cognitive (14) and ecological models (15). Children's early experience within their family and aspects of family structure (16) and a stimulating home environment (17) have consistently been demonstrated to be strong predictors of academic achievement and cognitive functioning, and family-based interventions have been identified as an essential component in the prevention and treatment of childhood obesity (6,18,19).

The current study focuses on Mexican-American families, one of the fastest growing but most under studied populations in the US. Mexican-American children are disproportionately affected by the obesity epidemic (20) and Latinos of all ages are at relatively high risk for obesity, diabetes, and other health problems (21). Families in this study were selected from a cohort participating in the baseline phase of an obesity intervention program for children (22). Parenting styles in the larger cohort were previously studied using questionnaires, and parents' reported use of positive reinforcement and monitoring were found to be associated with their reports of children's healthy eating and exercise (22). The present study goes beyond the global measures of self reports to use direct observation techniques to simultaneously assess children's physical activity and associated environmental conditions at home.

Although used in a limited number of studies of physical activity, direct observation is particularly important for generating objective data on young children and in environments in which targeted behaviors and their contexts change rapidly (23). For example, Klesges and colleagues (24) used direct observation to examine the relationship between child mealtime behavior, physical activity, selected parent behaviors, and child relative weight in preschool children. They found parental encouragements to be active correlated with high levels of child physical activity and that parental encouragements to eat correlated both with the length of time the child ate and with the child's child relative weight.

The current investigators used direct observation in a number of studies in a longitudinal investigation of a cohort of 351 young Euro- and Mexican-American children (25–27). These studies, conducted at both home and school, demonstrated the viability of using direct observation to conduct micro-level examinations of physical activity and related variables. The current study continues the tradition of conducting detailed observations in the home environment, and is done specifically to assess potentially modifiable factors that may contribute to reduced physical activity and to the rise of obesity rates evident in children, particularly Mexican-Americans. Because child gender and overweight status provide for the potential differential activity levels and treatment at home, particular attention is given to these variables.

Methods

Participants and background

Participants were 139 children (M=6.5 years; SD=0.98) of Mexican-American descent and their families. Nearly all (86%) of the 69 boys and 70 girls were born in the US. They were among a 20% sample selected for home observations at random from families participating in baseline measures of *"Aventuras para Niños"* (Adventures for Children), a community intervention trial to prevent and control obesity. The children were enrolled in kindergarten and first and second grades in 13 public schools located in low income neighborhoods in south San Diego County, California. The study was approved by the IRB board at San Diego State University, and written consent for children to participate was provided by their parents.

Body Mass Index

Weight was measured to the nearest pound using a Health-o-Meter standard scale with the child standing without shoes and with objects removed from pockets. Height, without shoes, was measured to the nearest 1/4 inch, using a standard portable stadiometer. These measures were converted into metric equivalents to calculate BMI using the Quetelet index (kg/m^2). BMI percentiles and z-scores for age and sex were calculated using the 2000 reference data from the Centers for Disease Control and Prevention.

Parent self-reports—Trained bilingual measurement technicians conducted structured interviews with parents/main caregivers. Respondents reported family demographic information such as age, education, marital status, number living in the household, income, place of birth, and dominant language (see Table 1).

Systematic observation

BEACHES observation instrument—A modified version of BEACHES (Behaviors of Eating and Activity for Child Health: Evaluation System), a direct observation system to simultaneously record children's physical activity and sedentary behaviors as well as related environmental characteristics and events in homes and schools was used (28). The original system was developed within the framework of behavioral analysis and included coding for 10 separate dimensions, and has been used previously to evaluate environment-behavior relationships regarding activity and nutritional behavior in Mexican- and Euro-American children at home and at school (25–29). BEACHES uses five activity codes (lying down, sitting, standing, walking, and vigorous), and these have been validated with children using heart rate monitoring (28,30). In the modified system for the current study, observe intervals were made more frequently (i.e., 2 vs. 1 per minute), child responses to physical activity and food prompts were not recorded, and some variables within larger categories were collapsed (e.g., for people present, "grandmother" and "grandfather" became "other adult").

Observation Procedures—Trained assessors (n=3 bilingual females) used the modified version to simultaneously assess the children's physical activity levels and location, the presence of other people, prompts for physical activity and sedentary behavior, and whether or not the child viewed media and ingested food. Assessors observed the children in their homes during two 30-min observation periods after the school day, but before dinner. Observations were made both inside and outside the child's dwelling, but not when the child was away from home (e.g., at a friend's house or public park). Assessors focused on the target child for a 15-second observation interval and then had 15 seconds to enter data codes onto prepared forms. Assessors wore a single ear piece to hear voice prompts on an audio tape that paced the alternating observation and recording periods. Each observe-record cycle required 30 seconds; thus, the 60 minutes of observation yielded 120 observation intervals per child. Three dimensions (Child Activity, Location, and People Present) were scored using momentary time-sampling methods (i.e., codes were entered to describe events related to these three categories as they occurred at the end of the "observe" interval). The other four dimensions (Behavior Motivated, Motivator, Views Media, and Eats) were scored using partial-interval time sampling (i.e., events were coded if they occurred at any time during the 15-second "observe" interval).

Observer training and calibration—Assessors memorized operational definitions of the behavior dimensions and their subcategories first, and then learned the general procedures for recording data. Video examples and role-playing were used to demonstrate each category during training, and this was followed by practice observations in homes. Observer training included how to reduce reactivity from children and adults. The average training program took about 16 hours, with training for an observer continuing until she exceeded an inter-observer agreement score of 80% on two different criterion videotapes and 80% on two consecutive live observations (using interval-by-interval correspondence, with agreements divided by agreements plus agreements multiplied by 100). Additional review and training sessions of approximately one hour in length were conducted periodically.

Measures

Dependent variables—Two child physical activity variables were assessed: (a) the proportion of observed time the child engaged in MVPA (moderate to vigorous physical activity), and (b) mean EER (estimated energy rate, in kcal/kg/min). MVPA, a factor addressed in *Healthy People 2010* (31) and in *Physical Activity and Health: A Report of the Surgeon General* (32), was derived by calculating the proportion of observed time the children spent walking and in vigorous activity. The second variable, EER, accounts for time spent in all five observed categories (lying down, sitting, standing, walking, and vigorous) and serves as an overall index of physical activity. Similar to previous studies (26,28), EER was estimated using the following equation: (proportion of observations spent lying down × 0.029 kcal/kg/min) + (proportion of observations sitting × 0.047 kcal/kg/min) + (proportion of observations standing × 0.051 kcal/kg/min) + (proportion of observations walking × 0.096 kcal/kg/min) + (proportion of observations spent being vigorous × 0.144kcal/kg/min). The energy expenditure constants for activity level were derived from heart rate monitoring (28). The home observation session was regarded as the primary unit of analysis, and it included 120 separate intervals during which physical activity and each environmental variable could change.

Data analysis

Dependent variables were plotted using histograms and scatter plots and tested for normality via analyses of residuals for parametric analyses. Subsequently proportion of time in MVPA was square root transformed to provide a close to normal distribution due to curvilinear

residual plots. Pearson's moment product correlations were used to assess the relationships between activity variables and demographic, anthropometric, and environmental variables. Chi-Square tests were used to test associations between activity related prompt categories and the child's location (indoors vs. outdoors), and who prompted the target child (child vs. adult). Linear regressions were used to determine the predictors of MVPA and EER. Regression models included independent variables obtained from correlation analyses to yield final models. Collinearity assessments of independent variables were conducted via pairwise correlations. Significance levels were pre-determined at $p<0.05$. All analyses were conducted using SPSS version 13.0 for Windows.

Results

General

Respondents reporting family information during structured interviews had a mean age of 35.6 years (SD=8.9), were primarily female (97%), and lived in a household with an average of 2.7 children (SD=1.2). Data presented in Table 1 also indicates that the typical respondent was married (75%), born outside of the US (82%), mostly spoke Spanish (90%), ended her formal education before college (73%), and lived in a household with an income of less than $2501 per month (74%).

Table 2 presents descriptive data for boys and girls on selected biological, behavioral, and environmental factors. There were no statistically significant differences by gender for any listed variable. Children spent most of their time indoors (76%) and were engaged in MVPA only 25.5% of the time (12.9% walking, plus 12.5% vigorous). They were observed being sedentary 74.5% of the time (i.e., lying down, 7%; sitting, 48%; standing, 19.5%) (see Figure 1). The children focused directly on media and ingested food during 20% and 9% of the observation intervals, respectively; and 80% of the time someone else was present in the specific room/space with them.

Correlates of physical activity

Table 3 presents data on the association between selected behavioral, environmental, social, and biological factors and the children's energy expenditure (EER) and proportion of time they engaged in moderate-to-vigorous physical activity (MVPA%). Reduced time in MVPA and overall estimated energy expenditure (EER) were associated with children spending time viewing media, being indoors, and with parents being present. Additionally, time spent ingesting food and triceps circumference were significantly negatively associated with EER. Increased physical activity was associated with siblings and other children being present, active behavior being prompted, and the number of children living in the household. Child BMI was not associated with their physical activity, nor was the type of housing in which the family lived (i.e., house or apartment; owned or rented) or parental characteristics (i.e., age, education, marital status, income, place of birth, and dominant language) (data not shown).

Predictors of physical activity

Results of regression analyses show that nearly 60% of the variance in moderate to vigorous physical activity can be explained by the child's location, whether or not they were viewing media, and the proportion of observed time that physical activity behavior was being promoted. Being indoors and viewing media each independently predicted reduced MVPA, while more intervals with physical activity prompts independently predicted increased MVPA (see Table 4). Similar results were found for EER (data not shown).

Prompts for physical activity

Activity-related prompts (i.e., prompts or reinforcers to be physically active or to be sedentary) occurred during 15.3% of observed intervals, and they differed by child gender, location, and prompter status. Girls were prompted to be physically active nearly twice as often as they were prompted to be sedentary (9.0 vs. 4.7% of intervals). In comparison, boys were prompted be physically active and sedentary at similar rates (8.3 vs. 8.7% of intervals).

There was a significant relationship ($\chi^2 = 216$, df = 2, $p < 0.01$) between activity-related prompts and the children's location, with the frequency of prompts being much greater when children were outdoors than indoors (28% vs. 11% of intervals). When outdoors, children were much more frequently prompted to be physically active than to be sedentary (26% vs. 2% of intervals). In contrast, when indoors they were more likely to be prompted to be sedentary than to be physically active (8% vs. 3% of intervals).

Significant associations were observed between activity related prompts and types of people who provided them (i.e., child vs. adult); $\chi^2 = 19007$, df = 4, $p < 0.01$. Considering all locations, the activity-related prompts from children were nearly three times more likely related to promoting physical activity than to be sedentary (74% vs. 26% of children's prompts). In contrast, activity-related prompts from parents were mostly for children to be sedentary (overall, 65% to be sedentary; 35 % to be physically active). This was especially evident indoors where most activity-related prompts from parents were for children to be sedentary, including 85% of those directed to boys and 65% of those directed to girls.

Child overweight status

Based on BMI percentile cutoffs, 46% of the children were classified as at risk for overweight or overweight (i.e., 85–94th percentile and over 94th percentile, respectively). No gender differences were observed in these distributions. Differences in physical activity levels and most associated environmental variables for those in normal and overweight categories were not statistically significant. Nonetheless, there was a trend toward parents of normal weight children (n= 74) to be directly present in the child's environment more often than parents of children classified as at risk of overweight (n = 20) or overweight (n= 43) (50% vs. 34% vs. 37% of intervals, respectively; $p = 0.056$).

Discussion

This study extends our previous work (25–29,33) and highlights the significant role that family context and the home environment play relative to children's accrual of physical activity. Children in the present study were from low-income Mexican-American families; and by age six many were already overweight or at risk for overweight. They were observed spending a substantial amount of time indoors, and not surprisingly, the amounts of time they spent indoors and viewing media were correlated with their sedentary behavior.

The finding that boys and girls had similar activity levels runs counter to existing literature which typically reports boys to be more active than girls, even in and was children as young as 4 years of age at home (26). Young children's compliance rates to direct prompts to be physically active and sedentary are high (25), so in the current study, the additional prompts for boys to be sedentary may have suppressed their physical activity, bringing it down to the same level as girls.' In a 1992 study, children 1.8 years younger than those in the current investigation were also observed using BEACHES. Compared to children in the current study, the younger childered spent more time indoors (84% vs. 74% of observed intervals), less time being physically active (19% vs. 26% in MVPA), and less time viewing media (12% vs. 22% of intervals). Media viewing by children at home 16 years ago was essentially limited to television, but now is much more varied and pervasive.

Studies often report that boys receive more social support to exercise from parents than do girls (10). Most of these studies, however, have relied on global reports from parents, rather than on micro-level, direct observations of interactions. In the current study, girls and boys received similar amounts of prompts to be physically active, but boys received substantially more prompts to be sedentary, especially from parents while indoors. Children received more prompts to be active than to be sedentary from other children, thus giving support to the findings that increased physical activity was associated with both the number of children living in the household and a child being present in the observed room/space.

Questionnaires are useful for assessing demographic variables such as education, marital status, and family income, but are subject to recall and other biases (especially when pre-adolescent children are involved). Questionnaires are also unable to provide micro-level detailed information, such as that needed to assess the impact of family dynamics involving the actions of other members. The current study showed that direct observation, despite being labor intensive, is a valuable tool for simultaneously assessing PA and contextual factors in homes.

This investigation has limitations that should be considered when interpreting the findings. First, the sample was relatively small and included only young children from Mexican immigrant/Mexican-American families living in 13 neighborhoods in Southern California. It was not a representative sample, and Mexican–American children are frequently reported to be less active than Anglo-American children, a fact confirmed by direct observations in homes when children were as four years of age (26). In that study, Mexican-American children had less access to activity facilitating toys than the Anglo-American children, and they spent more time in the presence of adults. In a related study that focused specifically on physical activity prompts, Elder et al. (25) found that the frequency of both child and adult prompts for children be physically active reduced over time. Mexican-American and Anglo-American parents also have different concerns about the locations in which their children play, and these concerns change as their children age (33).

Second, the use of direct observation, despite its richness, was limited in breadth and length. Children were observed in their home for only one hour on a single afternoon when a parent was present; longer observations at different times of the day would likely have produced greater variability. Third, even though observers were thoroughly trained to reduce reactivity, it is possible that both children and adults modified their behavior during the observations. In spite of these limitations, however, the families observed were a scientifically selected sample within a broader study, and the observations were conducted at a time when children could reliably be expected to be home and have numerous behavioral options, including resting, playing, studying, and eating.

In conclusion, home dwellings are often considered a place for quiet and relaxation and there are often many ‘inside’ rules that demand children be sedentary. Nonetheless, the overall home environment could be arranged to become a propitious location for the promotion of physical activity. This study provides additional information on the impact of the home social and physical environment on young children’s physical activity at home. It specifically demonstrates how being indoors and watching TV and other media both have a negative impact on physical activity. The information yielded in the study demonstrates the advantages of direct observation for developing valid indices of health-related behavior. The results support the need for developing parent education programs aimed toward the promotion of children’s physical activity. Such programs might be directed toward designing the home physical environment, establishing rules for physical activity and media, and developing social interactive skills for prompting and reinforcing children’s engagement in physical activity.

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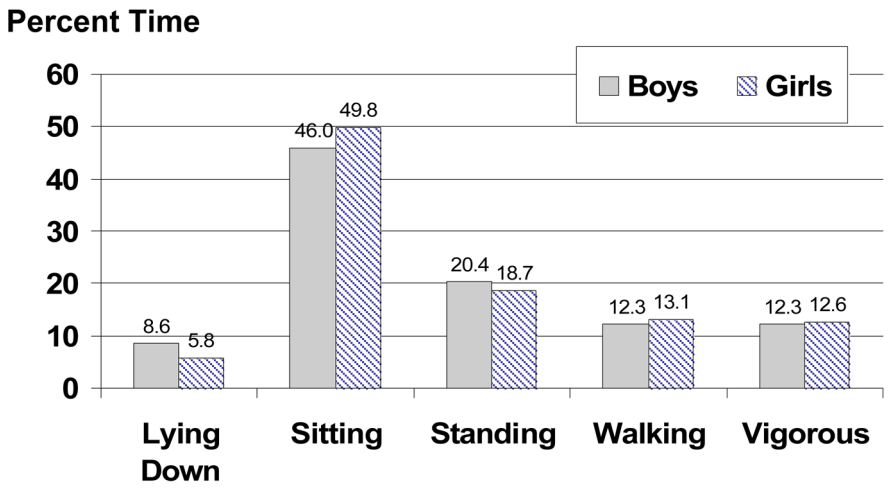

Figure 1.
Observed activity levels of boys (n=69) and girls (n=70) at home.

Table 1

Demographic information for the responding parent and families (N=139)

Variable	Frequency	%
Education		
Never attended school	1	0.7
Elementary through 6th grade	24	17.3
Middle school	34	24.5
High school	43	30.9
1–2 years of college	23	16.5
3–4 years of college	3	2.2
College graduate	11	7.9
Marital Status		
Married	104	74.8
Divorced	8	5.8
Widowed	5	3.6
Separated	11	7.9
Never been married	7	5.0
Living as married	4	2.9
Speak Spanish		
Not at all	5	3.8
Moderately	8	6.1
Often, almost always	12	9.1
Often, almost always/extremely	15	11.4
Extremely	92	69.7
Parent Place of Birth		
United States	25	18.0
Mexico or other country	114	82.0
Household Monthly Income		
< $500	5	3.8
$501–1000	26	19.7
$1001–1500	22	16.7
$1501–2000	26	19.7
$2001–2500	19	14.4
$2501–3000	16	12.1
$3001–3500	10	7.6
> $3501	8	6.1

Table 2

Comparisons of boys and girls on biological, behavioral, and environmental variables (mean ± SD)

Variable*	Boys (n=69)	Girls (n=70)	Overall
Biological factors			
Age (years)	6.2 ± 1.0	5.9 ± 1.0	6.5 ± 1.0
Height (cm)	120.3 ± 7.9	118.6 ± 7.6	119.5 ± 7.8
Weight (kg)	26.9 ± 8.1	26.4 ± 7.7	26.6 ± 7.9
BMI (kg/m^2)	18.2 ± 3.7	18.5 ± 3.8	18.3 ± 3.7
BMI percentile	73.3 ± 27.7	75.8 ± 25.9	74.6 ± 26.7
Triceps skin fold (mm)	11.2 ± 5.1	12.8 ± 4.6	12.0 ± 4.9
Triceps circumference (cm)	20.6 ± 5.9	21.0 ± 7.8	20.8 ± 6.9
Waist circumference (cm)	61.0 ± 13.3	59.0 ± 11.7	60.0 ± 12.5
Behavioral factors			
MVPA (% intervals)	26 ± 20	25 ± 18	26 ± 19
EER (kcal/kg/min)	0.065 ± 0.02	0.065 ± 0.02	0.065 ± 0.02
Viewing media (% intervals)	22 ± 31	18 ± 29	20 ± 30
Ingesting food (% intervals)	11 ± 13	8 ± 10	9 ± 11
Environmental factors			
Being indoors (% intervals)	74 ± 33	76 ± 33	76 ± 33
Being alone (% intervals)	22 ± 26	18 ± 25	20 ± 25
Parent present (% intervals)	42 ± 34	45 ± 36	44 ± 35
Sibling present (% intervals)	42 ± 36	32 ± 38	37 ± 37
Other child present (% intervals)	19 ± 33	28 ± 39	23 ± 36
Other adult present (% intervals)	13 ± 27	18 ± 30	16 ± 28

*Gender differences not statistically significant for any variable.

Table 3

Association between selected variables and time children spent in MVPA and estimated energy expenditure rate (EER)

	MVPA % r	EER (kcal/kg/min) r
Environmental and social factors		
Being indoors	−0.73**	−0.74**
Prompts for physical activity	0.52**	0.59**
Parent present	−0.24**	−0.24**
Sibling present	0.18*	0.10
Other child present	0.21*	0.24**
Other adult present	−0.06	−0.01
Being alone	−0.03	−0.06
No. children living in household	0.20*	0.21*
Behavioral factors		
Viewing media	−0.42**	−0.40**
Ingesting food	−0.16	−0.19*
Biological factors		
BMI	−0.06	−0.08
BMI percentile	−0.09	−0.11
Triceps circumference	−0.19	−0.22*

* correlation significant at 0.05 level;

** correlation significant at 0.01 level

Table 4

Predictors of moderate to vigorous physical activity (MVPA)

Percent Time in MVPA (square root) Overall adjusted R^2 = 0.599				
Independent Variables	**β**	**SE**	**t**	**p-value**
Child location (indoors = 1, outdoors = 0)	−0.341	0.040	−8.47	<0.01
Child viewed media *	−0.115	0.038	−3.034	<0.01
Physical activity motivated (% of intervals)	0.262	0.079	3.34	<0.01
Other adult present *	−0.036	0.041	−0.873	0.385
Sibling present *	0.039	0.034	1.171	0.244
Other child present *	0.012	0.037	0.333	0.740
No. of children living in household	0.003	0.010	0.271	0.787

* coded as: yes = 1, no = 0