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Commercial venues as supports for physical activity in adolescent girls

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Abstract

Objective—The purposes of this study were to describe the types and availability of commercial facilities for physical activity (PA) in six diverse geographic areas (Washington DC and Maryland; South Carolina; Minnesota; Louisiana; Arizona; and California) and to assess the relationship between those facilities and the non-school PA of adolescent girls.

Methods—A total of 1556 6th grade girls participating in the Trial of Activity for Adolescent Girls (TAAG) wore accelerometers for 7 days providing 6 days of complete data, completed questionnaires in 2003 and had their residential addresses geocoded. Nearby commercial facilities available to provide PA (i.e. dance studios, youth organizations) within a 1-mile radius of participants' residences were identified and geocoded. The association between the presence of any commercial PA facility and girls' PA was determined using a multi-level design and controlling for demographic characteristics and other potential confounders. Analyses were conducted in 2005–2006.

Results—Sixty-eight percent of the girls had at least one commercial PA facility near their homes. Availability and types of commercial PA facilities differed by where participants lived. Girls who lived near one or more commercial PA facilities had higher non-school MET-weighted moderate-to-vigorous PA than girls who had none near their homes.

Conclusions—The findings suggest that commercial PA facilities are important contributors to the accumulation of PA among adolescent girls.

Keywords

Geographic Information Systems (GIS); Built environment; Physical activity; Adolescent females

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Introduction

The term “built environment” refers to the structures that people have assembled in which to live, work, travel, and play (Powell, 2005; Booth et al., 2005). There is increasing evidence that the built environment affects the health of individuals and populations (Booth et al., 2005; Ewing et al., 2003; Perdue et al., 2003). In particular, the relationship between the built environment and the physical activity (PA) behavior of individuals and groups needs to be better understood (Committee on physical activity, 2005), although it is clear that aspects of the environment both promote and constrain PA (Booth et al., 2005).

After-school hours provide an important opportunity for youth to accumulate leisure time physical activity (Ross et al., 1985). Access to facilities where programs occur may influence their PA, but few studies have investigated this relationship. Investigations of how children perceive their environment have included questions about access to facilities (Sallis et al., 2002; Garcia et al., 1995; Mota et al., 2005) and the perception of access to facilities has been associated with PA in middle school students.(Garcia et al., 1995; Evenson et al., 2006) Two recent studies objectively measured the availability of recreation facilities to youths (Gordon-Larsen et al., 2006; Norman et al., 2006). In both studies, PA was significantly correlated with availability of recreational facilities (Gordon-Larsen et al., 2006; Norman et al., 2006), and recreation facilities (both free and commercial) were less available in lower-socioeconomic status (SES) and high-minority areas (Gordon-Larsen et al., 2006).

Participation in PAvaries by gender (Gottlieb and Chen, 1985; Bradley et al., 2000; Aaron et al., 2002) and by race/ethnicity (Gottlieb and Chen, 1985; Dowda et al., 2004). Because girls are generally less physically active than boys, it is particularly important to understand the role the environment plays in promoting or discouraging their PA. Girls may not be aware of community facilities, or may not find activities that are affordable or of interest to them (Dunton et al., 2003; Centers for Disease Control and Prevention, 2003) Activities commonly engaged in by girls, such as dance, aerobics, bowling, roller skating, and swimming (Gottlieb and Chen, 1985; Bradley et al., 2000; Aaron et al., 2002; Dowda et al., 2004) typically take place in commercial facilities, and using these venues have been shown to be correlated with middle school girls’ PA in several studies (Norman et al., 2006; Hoefer et al., 2001). In one study, 48% of parents of 9- to 13-year-old girls reported that cost was a barrier to PA (Centers for Disease Control and Prevention, 2003).

Recent developments in Geographic Information Systems (GIS) now make it possible to more fully explore associations between environmental factors and PA. Information on community design, such as the availability of facilities and their distances to residences, user demand and preferences, and convenient transportation may lead to designing interventions to increase girls’ PA. Therefore, the purposes of this study were to describe the types and availability of commercial facilities for PA and to assess the relationship between these facilities and non-school PA of adolescent girls after controlling for selected personal and social variables (Davison and Lawson, 2006).

Methods

Participants and study design

Participants were sixth grade girls enrolled in the baseline study of the Trial of Activity for Adolescent Girls (TAAG) in 2003. TAAG is a multi-center group-randomized trial designed to test an intervention to reduce the typical decline in moderate to vigorous physical activity (MVPA) among middle-school females. It is a collaborative study involving 36 schools at six university field sites in and around the cities of Washington, DC and Baltimore, Maryland; Columbia, South Carolina; Minneapolis, Minnesota; New Orleans, Louisiana; Tucson, Arizona; and San Diego, California. Six schools from each site were randomly assigned to intervention or control conditions following baseline data collection. The study was approved by Institutional Review Boards at each participating university. Girls gave assent to participate and their parents or guardians completed consent forms. Of 1603 girls initially measured, 1556 (97%) had their residential addresses successfully geocoded.

The Coordinating Center at the University of North Carolina, Chapel Hill, and the Project Office at the National Heart, Lung, and Blood Institute, coordinated the study. The Coordinating Center provided girl-level data to RAND Corporation where the management of the GIS data and all analyses were performed in 2005–2006.

Commercial facilities

Investigators searched both the Smart Pages (http://:www.SMARTpages.com) and Info USA (http://www.infousa.com) using keywords (dancing/gymnastics; martial arts; exercise clubs; swimming/diving; golf; youth organizations; bowling; stables; racquet/tennis; yoga) to identify commercial recreational facilities in each community. The lists were compared from each search and assumed that those listed in both searches were valid. When a business was listed in one list and not the other, they were called to verify the address, offerings, and current operation. In cases where the phone number was incorrect, staff visited the location to verify its existence. Through this procedure, a total of 510 unique commercial facilities were identified in the 1-mile radius surrounding girls' homes. Using ArcGIS (ESRI) and residence as the center of a 1-mile circular radius, the total number of commercial PA facilities was calculated for each girl. The number of commercial PA facilities was positively skewed, with a median of one, and was dichotomized into none versus one or more facilities for multivariate analyses.

Measurement of physical activity

The girls wore an ActiGraph accelerometer (Manufacturing Technologies Inc. Health Systems, Model 7164, Shalimar, FL) for 7 consecutive days. TAAG staff distributed the accelerometers and provided detailed verbal and written instructions on how and when to wear them. The accelerometer was initialized prior to data collection and set to begin collecting data at 5:00 A.M. on the day after the girl received it. Data were collected and stored in 30-s increments. Girls wore accelerometers on their right hip, attached to a belt, and were asked to take it off only when sleeping, bathing, or swimming. After 6 total days of recording, data collectors retrieved the monitors, downloaded the data, and sent it to the Coordinating Center.

Accelerometer readings were processed using methods similar to those of Puyau et al. (2002). Readings at or above 1500 counts/30 s were treated as MVPA (Treuth et al., 2004). Occasional missing data within a girl's 6-day record were replaced via imputation based on the Expectation Maximization (EM) algorithm (Catellier et al., 2005). Counts above 1500/30 s were converted into METs (metabolic equivalents) using a regression equation (corresponding to 4.6 METS) (Schmitz et al., 2005). A one MET-minute represents the metabolic equivalent of energy expended while sitting at rest for 1 min, and MET-weighted minutes of MVPA (MW-MVPA) were computed. METs were summed from 6 AM to midnight to provide MET-minutes per day of MVPA. For the current analysis, only out-of-school hours data (two weekend days and after 3 P.M. on four weekdays) were used and termed "non-school".

Social support for physical activity

Support from peers was measured using three questions. Girls reported how often during a typical week their friends: (1) encouraged them to do PA or play sports; (2) did PA or played sports with them, and (3) told them that they were doing well at PA or sports. Responses

(1=none to 5=every day) to each item were coded, and an overall peer support score was obtained by averaging across the three items. Family support was measured using five items about PA or playing sports. Girls reported how often during a typical week a family member: (1) encouraged them to do PA or play sports, (2) did PA or played sports with them, (3) provided transportation to a place where they could do PA or play sports, (4) watched them participate in PA or sports, and (5) told them that they were doing well in PA or sports. Responses (1=none to 5=every day) were averaged to provide a family support score ranging from 1 to 5.

Transportation to after-school facilities

The girls answered two transportation questions. The first was ‘if you wanted to do an after-school activity someplace else besides school every day, how difficult would it be to get there?’ The second inquired about getting home afterward. Test–retest reliability was 0.45 for the first question and 0.39 for the second in a sample of 252 6th grade girls (Evenson et al., 2006). Both questions were rated 1 to 4, with 1=not at all difficult and 4=impossible, and were summed and averaged after reverse scoring.

Use of community facilities

Girls also completed a revised Three Day Physical Activity Recall (3DPAR) (Pate et al., 2003; McMurray et al., 2004) which indicated where they did PA (i.e., home/neighborhood, school, other outdoor public area, other, and community facilities). Community facilities included parks, playgrounds, recreation centers, churches, dance studios, and fields or gyms. For the present study, girls who reported using community facilities on any of the 3 days were considered “community facility” participants.

Other measures

Girls reported their race/ethnicity on the survey questionnaire and parents reported girls’ date of birth on the consent form. Age was calculated as time between the date of birth and the questionnaire completion date. Height and weight were measured using standardized procedures. Body mass index (BMI) of the girls was calculated by dividing weight in kilograms by height in meters squared. A high percent (30%) of girls did not respond or reported ‘don’t know’ for parental education for both parents. SES was therefore measured by several other methods. The first of these was a calculation of a standardized neighborhood SES index. Three different block-group-level indicators from the 2000 US Census (US Census, 2000) were standardized: the percentage of households above the poverty line, the percentage of employed persons in the labor force over 16 years of age, and the percentage of persons over the age of 25 with more than a high school diploma (Cronbach’s α=0.88). These three factors were then combined into an index and interpolated for the area delimited by a 1-mile radius (values across block groups were weighted proportionately by each block group’s area within the buffer) around each girl’s geocoded residence. A second SES variable was the percentage of students who received free or reduced price lunch at each of the 36 schools. Generally, students whose families earned less than 200% of poverty were eligible for this program.

Two other neighborhood variables were derived using the 2000 US Census ([US Census, 2000]). Population density was divided into quartiles, and the median construction years the census tract homes of the girls were built were divided into quartiles (prior to 1968prior to 1968 to 1975 to 1976 to 1983 to 1984 and later).

Statistical analyses

Initial analyses examined distributions for characteristics of the girls, including age, PA, BMI, and race/ethnicity. Frequencies were identified for types of commercial facilities and the number and percentage of girls living within 1 mile of each type of facility were calculated.

A multi-level approach was used to model the relationships among the dependent variable, non-school MW-MVPA and all the covariates. This allowed for control of geographic clustering by both site and by school.

The first level (girl level) of the model was defined as:

$$Y_{ijk}=\beta_{0jk}+\beta_{1i}X_{ijk}+e_{ijk}$$

where Y_{ijk} represented the vector of each girl's individual outcomes as a function of β_{0jk}, a random intercept determined by school-level characteristics, and all girl-level covariates including BMI, age, race, family and friend support, ease of transportation, and the SES of her immediate neighborhood. The second level (school level) was defined as:

$$\beta_{0jk}=¥_{0k}+¥_{1j}X_{jk}+\mu_{jk}$$

where the random intercept in level one, β_{0jk}, is expressed as a function of another random intercept determined by site-level characteristics and the school-level variable for percent of students receiving free or reduced price lunch. The third level (site level) was specified as:

$$¥_{0k}=\Gamma_{00}+\lambda_{0k}$$

where the school-level intercept is the grand mean of the outcomes variables for each of the six sites. Substitution was then used to collapse these equations, separate out fixed and random effects, and translate the model into code for the mixed procedure in SAS version 9.1 (Murray, 1998).

Because the first-level residuals for the dependent variables were not normally distributed, log-transformed versions were used to run the final analyses. Thus, the parameter estimates are in terms of percent changes in the dependent variables per unit change in covariates. The magnitude of the change was also calculated for the "average girl" by multiplying the estimates by the mean of each dependent variable.

Results

Of the 1556 girls, 42.9% were white, 21.7% Hispanic, 19.9% black and 15.0% multi-racial or from other races. Their mean age was 11.8 years (SD=0.5) and their mean BMI was 20.9 kg/m^2 (SD=4.9). After deletions (n=31) for missing race, BMI and social variables, 1525 girls were available for further multivariate analyses (Table 1). They were similar to the original sample (n=1556) with regards to race/ethnicity, age, BMI, and PA.

68% of girls had a least 1 commercial PA facility within 1 mile (Table 2) of their homes, 23% percent had 1, 16.5% had 2, and the remainder had from 3 to 19 facilities. Compared to other sites, more girls (83%) at the Maryland site lived near a commercial PA facility and Minnesota had the fewest (56%). Hispanic girls were more likely to have a commercial PA facility near their home than others. Girls in the highest standardized neighborhood index SES quartile, those in areas built after 1976, and those in the lowest population density quartile were the least likely to have a commercial facility near their home.

Table 3 groups the 510 commercial PA facilities found within a 1-mile radius of girls' homes into 10 categories. About 29% of girls had a dance/gymnastic studio within 1 mile of their home, while fewer than 3% had a place for yoga instruction. The percent of girls with a facility in a specific category within a 1-mile radius of her home varied by site. For example, 45% of girls in Louisiana had a dance/gymnastic studio within 1 mile of their home, as compared to only 8% of girls in Arizona.

Table 4 presents the regression analysis, and shows that girls with higher levels of MW-MVPA were more likely to be younger, be white or black as compared to Hispanic or other race/ethnicity, have higher friend support, and have at least one commercial PA facility within a 1 mile of their homes. Girls with the mean number of MW-MVPA minutes (611 over 6 days) and with at least 1 commercial PA facility within a mile of their home accumulated an additional 27.5 MW-MVPA minutes over a 6-day period. Although not shown, a second regression analysis for the 1381 girls who indicated whether or not they had visited a community facility was run (37.5% did visit such a facility). Having at least one commercial PA support remained significant for girls' MW-MVPA (accumulated an additional 19.4 min over 6 days, $p<.001$), after adjusting for reporting physical activity at a community facility. Such facilities included free facilities such as parks, fields, gyms and churches. Girls who reported visiting a community facility engaged in an average of 53.2 more minutes of MW-MVPA then girls who did not.

Discussion

Children should participate in at least 60 min of MVPA on most days of the week (Strong et al., 2005), but school programs and youth sports may not provide all the PA that adolescents need for health purposes. Additionally, standard programs may not provide the types or levels of activities that some individuals prefer, so access to additional venues needs to explored. Our study provides some evidence that having commercial venues for PA within the local environment is associated with increased PA in adolescent girls.

A second major finding is that the availability of commercial PA facilities varied by study location, race/ethnicity, SES index, median year of construction for the girls' census tract, and population density. White girls and those in the highest neighborhood quartile had less access to a commercial PA facility than their counterparts. There have been mixed findings regarding access to PA facilities. Estabrooks et al. (2003) found no difference by neighborhood SES groups for pay-for-use facilities, but others (Gordon-Larsen et al., 2006; Powell et al., 2006) found commercial PA-related facilities were less likely to be present in lower SES areas and in those with greater proportions of African American residents (Estabrooks et al., 2003). In the present study, Hispanic girls and those in the other race/ethnic group had more proximal access to commercial facilities, but they were less active than white and black girls. Thus, while access is important, other factors such as affordability may play a role in whether girls use a commercial facility even when it is conveniently located (Centers for Disease Control and Prevention, 2003).

Increased use of commercial facilities might be facilitated by using economic incentives, such as sponsorship for those from low-income families, underwriting PA equipment and clothing (Centers for Disease Control and Prevention, 1997), and reduced fees for adolescents (Task Force on Community Preventive Services, 2002). Changing hours of operation to attract more youth to participate at the facility might also increase their PA (Task Force on Community Preventive Services, 2002).

Findings from the present investigation are consistent with two recent studies (Gordon-Larsen et al., 2006; Norman et al., 2006) that used GIS methods to examine the relationship between PA facilities and adolescents' PA. For example, the relative odds of achieving ≥5 bouts of MVPA per week were increased when adolescents had one or more PA facilities within a 8.07-km buffer around their residence as compared to adolescents with zero facilities (Gordon-Larsen et al., 2006). In the present study, an objective measure of PA was used and personal variables and perceived support from family and friends were controlled. As found in adults (Giles-Corti and Donovan, 2002; Duncan and Mummery, 2004), access to facilities was significantly related to PA even after controlling for selected personal and social variables.

The current analysis is cross-sectional, included only 6th grade girls, and it was not possible to determine whether a girl used a specific commercial PA facility while wearing the ActiGraph, and may not be generalizable to girls of other ages or in other areas. But the study has several strengths. An objective measure of PA was used, girls were from six diverse states and they fell into a wide range of race/ethnicity, BMI, and SES groups. Also, rather than simply relying on self-report of facilities, GIS technology was used to determine the availability and types of commercial supports near the girls' homes, and were verified through phone calls and visitations.

In the present study, girls living within a mile of a commercial PA facility accumulated an average of 27.5 MW-MVPA more minutes over a 6-day period than girls who did not. The difference in MV-MVPA attributed to having a commercial PA facility nearby was similar to 1 year of age or one unit change in friend support, but less than differences attributed to race/ ethnicity. The findings suggest the availability of commercial PA facilities is important to the accumulation of PA among adolescent girls. Parents are encouraged to find activities that their children may enjoy and to provide instrumental support for their participation (Strong et al., 2005). Changing policies in the use of commercial PA facilities (e.g., reducing or supplementing fees, adding girl-friendly programs with structure and supervision) may promote PA in girls and are worthy of investigation.

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Table 1

Characteristics of girls, mean (SD) or percent data, 2003 from girls in Arizona, California, Louisiana, Maryland, Minnesota, and South Carolina

Characteristic	***N*=1525**
Age, years	11.8 (0.5)
BMI, kg/m^2	20.8 (4.9)
Race/ethnicity	
White	42.9%
Black	20.2%
Multi-race/Other	15.0%
Hispanic	21.9%
MW-MVPA minutes[a]	611.0 (408.5)
Family support	3.2 (1.2)
Friend support	2.9 (1.2)
Ease of transportation	3.2 (0.8)
Used community facility (*n*=1381)	
Yes	37.7%
No	62.4%
School level % free/reduced lunch	37.5%
Standardized SES [b] Index	−0.01 (1.0)
Population density	3383.1 (2452.2)
Median year built	1975.2 (11.4)

[a]MET-weighted moderate to vigorous physical activity minutes, accumulated over 6 days.

[b]Socio-economic status.

Table 2

Percentage of girls (2003, from girls in Arizona, California, Louisiana, Maryland, Minnesota, and South Carolina) with one or more facilities within 1-mile radius of their home

Group	*N*	Percent with ≥ 1 facility (%)
Site		
Maryland	223	83.4
South Carolina	270	63.5
Minnesota	272	55.5
Louisiana	263	69.2
California	292	74.3
Arizona	205	65.4
Race		
Hispanic	334	80.5
Black	308	69.5
Other	229	65.5
White	654	62.4
Neighborhood Standardized SES [a] Index		
Quartile 1 – Lowest	383	72.3
Quartile 2	387	74.4
Quartile 3	385	77.1
Quartile 4 – Highest	370	48.4
Median year built		
Quartile 1 (before 1968)	381	92.1
Quartile 2 (1968–1975)	351	77.2
Quartile 3 (1976–1983)	414	53.4
Quartile 4 (1984 and after)	379	52.2
Population density		
Quartile 1 – Lowest	371	43.1
Quartile 2	384	62.5
Quartile 3	386	75.9
Quartile 4 – Highest	384	90.6
Total	1525	68.3

[a] Socio-economic status.

Table 3

Availability of commercial facilities within 1 mile of girls' homes (2003, from girls in Arizona, California, Louisiana, Maryland, Minnesota, and South Carolina)

Facility	Number of facilities	Percent of girls with ≥1 facility	Site with lowest percentage		Site with highest percentage	
			Site	% of girls	Site	% of girls
Dance/gymnastics	121	29.3	AZ	8.3	LA	44.9
Martial Arts	105	27.5	MN	10.7	CA	44.5
Exercise/health clubs[a]	107	25.8	MN	1.5	LA	45.7
Swimming/diving	65	23.4	LA	5.3	MD	42.2
Golf[b]	38	11.2	LA	0.8	MN	22.8
Youth organizations[c]	18	10.2	MN	0.0	MD	24.7
Bowling	22	5.1	LA, MN	0.0	MD	17.0
Stables	16	4.2	CA	0.0	AZ	13.7
Racquet/tennis	6	3.0	LA, MN, SC	0.0	CA	13.0
Yoga	12	2.5	LA, MN, SC	0.0	CA	11.0

[a] Fitness, soccer, and health clubs.

[b] Public, private, miniature, and practice ranges.

[c] YMCA, YWCA, and others.

Table 4

Results of regression analysis (Proc Mixed) for MW-MVPA [a] (2003, from girls in Arizona, California, Louisiana, Maryland, Minnesota, and South Carolina)

Independent variable	**Non-school MW-MVPA (6 days)**		
	Coefficient	**SE[b]**	**Magnitude of change [c]**
Intercept	1098.59***	0.39	
1 or more PA supports	0.05***	0.01	27.56
BMI	−0.01***	0.00	−8.95
Age	−0.05*	0.03	−28.63
Race			
African American	−0.05	0.05	−32.80
Hispanic	−0.11***	0.03	−68.89
Other	−0.16***	0.05	−98.93
White	0.00	0.00	0.00
Friend support	0.04**	0.02	23.42
Family support	0.03	0.04	17.56
Ease of transportation	−0.02	0.02	−9.54
Standardized SES Index	−0.03	0.03	−18.95
Percent free/reduced school lunch	0.00	0.00	0.03

All models are adjusted for geographic clustering by both site and school.

[a] MET-weighted moderate to vigorous physical activity minutes.

[b] Standard error.

[c] Magnitude of change for the "average girl".

* $p<.05$.

** $p<.01$.

*** $p<.001$.