Journal of Healthy Eating and Active Living
2023, Vol.3, No. 1, pgs. 19-35

Availability of Recreation Facilities and Parks In Relation to Adolescent Participation in Organized Sports and Activity Programs

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Abstract

Most adolescents do not meet physical activity guidelines, so understanding facilitators and barriers is important. This study used surveys and geocoded location data to examine associations of availability of parks and recreation facilities with adolescent-reported participation in organized team sports and physical activity classes. The study was conducted with 928 adolescents aged 12-17 years, plus one parent/caretaker, recruited from two regions of the US. Adolescents' participation in teams and classes was positively associated with parents' perceptions of multiple available recreation environments, but not with objectively-measured availability. Having multiple nearby parks and recreation facilities may provide adolescents with more options for participating in preferred organized team sports and activity classes.

Keywords: physical activity, exercise, built environment, geographic information systems (GIS)

Introduction

Physical activity is important for youth due to the array of well-documented physical, mental and academic benefits (Physical Activity Guidelines Advisory Committee, 2018). However, only about 50% of children and 10% of adolescents in the U.S. meet national guidelines for physical activity, based on accelerometer data (Troiano et al., 2008). Due to low participation in physical education programs in middle and high schools (Clennin et al., 2018) and variable quality of programs, there is a need for adolescents to also engage in physical activity outside of school (Centers for Disease Control and Prevention (CDC), 2013; Institute of Medicine, 2013).

The American Academy of Pediatrics recommends youth sports as a way for adolescents to meet physical activity guidelines (Logan et al., 2019). Adolescents who participate in organized team sports and physical activity classes generally are more physically active than non-participants (Mandic et al., 2012). Adolescents who participate in organized team sports get 23% to 60% of their moderate-to-vigorous physical activity (MVPA) from sports (Machado-Rodrigues et al., 2012; Marques, Ekelund, Sardinha, et al., 2016; Wickel & Eisenmann, 2007). However, only 54 percent of US youth reported participating in a sports team in 2017 (US Department of Health and Human Services, 2019). While data on youth participation in the wide range of physical activity classes outside of school could not be found, there appears to be potential for increasing participation in both youth sports and organized activity classes.

Participation in team sports and physical activity classes generally depends on having access to a suitable space (Lee et al., 2019). Private and public recreation facilities can offer a variety of indoor and outdoor sports, exercise and fitness classes, dance classes or walking spaces. Recreation facilities often have staff who can monitor adolescents, organize and supervise activities, and make both adolescents and parents feel safe (Gavand et al, 2019; McGrath et al., 2015; Scott & Jackson, 1996). Proximity to recreation facilities and programs was associated with more after-school physical activity in adolescents (Gavand et al, 2019; Giles-Corti et al., 2005; Rosenberg, et al., 2009). Numerous studies have found proximity to parks and recreation facilities was associated with higher physical activity for children and adolescents (Ding et al, 2011; Edwards et al., 2015; Norman et al., 2006). For example, adolescents who had access to 7 or more parks or recreation facilities in their census block group were 26% more likely to be physically active than those living in block groups with fewer facilities (Durant et al, 2009).

Though recreation facilities are among the most-used places for youth physical activity, a review found mixed results on whether there is a difference between the sexes for usage of recreation facilities for physical activity (Kelso et al., 2021). For example, in one study, girls were more likely to report doing physical activity at commercial facilities than boys (Cohen et al., 2006). Other studies showed boys used recreation facilities more than girls, due to boys having greater interest in fitness and sports (Eccles & Harold, 1991). Though girls and boys tend to prefer low-cost, well-maintained facilities that provide preferred activities near home, safety from crime was particularly important for girls (Reis et al., 2008). To assist in interpreting results of associations of recreation facility variables with adolescent participation in team sports and activity classes, it would be useful to know how often adolescent girls and boys used the types of recreation facilities assessed in the present study.

Limited research exists on the difference between perceived proximity and objectively measured proximity to parks and recreation facilities in their associations with adolescent physical activity. This distinction is important for interpreting research results and selecting measures to use in assessing access to facilities and inequities in access. Measures developed from a geographic information system (GIS) might reveal recreation resources that are actually proximate to adolescents' residences, but adolescents and parents may not be aware of them. We could not locate studies that examined both objective (GIS-based) and subjective (self-reported) access and proximity to recreation facilities and how these measurement modes may differ in associations with adolescent use of facilities.

Although previous research examined environmental correlates of overall youth physical activity (Ding et al., 2011), no studies could be found that specifically investigated the association of access to recreation facilities and parks with adolescents' participation in organized sport teams or physical activity classes, which are recommended by The American Academy of Pediatrics (Logan et al., 2019). Improved understanding of environmental correlates of these common modes of adolescent physical activity could lead to better interventions to promote MVPA through greater participation in teams and classes.

The main aim of the present study was to evaluate associations of objective and perceived availability of (a) public parks, (b) private recreation/sports facilities, and (c) the combination of parks and recreation/sports facilities with adolescents' participation in organized sports teams and physical activity classes. The hypothesis was that greater availability (e.g., shorter distances, higher counts, shorter walk times) of recreation resources in the participant's neighborhood would be associated with higher adolescent participation in organized sports teams and physical activity classes, adjusted for demographics. The secondary descriptive aim was to examine self-reported frequency of adolescents' physical activity at multiple types of recreation facilities. These results can provide evidence about whether the types of recreation facilities evaluated in the main aim are frequently used sites for adolescent physical activity.

Methods

Data from the TEAN (Teen Environment And Neighborhood) Study was used in analyses. The study was conducted from 2007 to 2011, and the primary goal was to examine associations of neighborhood built and social

environment variables with adolescent physical activity and weight status (Sallis et al., 2018). The study was approved by appropriate Institutional Review Boards.

Target Population and Neighborhood Selection

Households in the King County-Seattle, WA and Baltimore, Maryland regions that had adolescents aged 12-16 years were the targeted population. Adolescent-parent pairs were recruited from neighborhoods selected to represent a wide range of built environments and socioeconomic conditions. Four types of neighborhoods (quadrants) were defined by high/low walkability crossed with high/low income in both regions, as described previously (Sallis et al., 2018).

Census block groups were categorized as high or low median household income relative to the region-wide median household income, as reported in the 2000 Census. Census block groups were also categorized as having high or low walkability based on a calculated walkability index for each region, as described previously (Frank et al, 2010; King et al., 2011). The walkability index for each block group was calculated from four macro-level built environment measures: 1) net-residential density, 2) intersection density, 3) retail floor-to-land area ratio (FAR) and 4) land use mix. Spatial environmental databases were retrieved from regional and local government agencies for King County, Washington and Baltimore, Maryland (Baltimore City, and Baltimore, Howard, Montgomery, and Prince George's counties). Data were acquired at multiple periods based on availability and to align as closely as possible with participant measurement periods: Seattle region (2006-2009) and Baltimore region (2003-2006). (Sallis et al., 2018). Each variable was normalized for each region using z-scores. A walkability index was created by summing the z-scores. The index was categorized as either high or low walkability by median split. The income and walkability index categories were crossed to create four study quadrants: lower-walkability/lower-income, lower-walkability/higher-income, higher-walkability/lower-income, and higher-walkability/higher-income (Frank et al 2010; Sallis et al., 2018).

Participant Selection and Recruitment

Adolescents were 12-16 years of age at the time of enrollment. Recruitment goals were to have approximately equal numbers of adolescents at each age, approximately equal representation of boys and girls, and distributions of participants' ethnicity/race similar to distributions in the neighborhoods selected for the study. Adolescents were excluded if parents reported their child had: (a) any psychological or medical condition that would preclude full participation, (b) any disability or illness that would prevent the adolescent from engaging in at least moderate-intensity physical activity (e.g., walking), and (c) any eating disturbance indicative of significant eating disorder psychopathology or a medically prescribed dietary regimen. The adolescent and one parent had to be able to complete surveys in English, but not necessarily as a first language, and the adolescent had to attend middle or high school or be home-schooled.

Parent-adolescent pairs were recruited between 2008 and 2010 from eligible census block groups. Eligible households with adolescents were randomly selected from a list purchased from a marketing company. Potential participants were contacted by mail, then called via telephone to recruit adolescent and parent/guardian pairs. Those who expressed interest in the study were mailed parent consent and adolescent assent forms. Participants received a follow-up phone call from a research assistant to answer questions. Data collection was only conducted during school year periods (i.e., not during summer or holiday breaks), and data were collected over a one-year period in each region, with simultaneous recruitment in all four study design quadrants, to limit seasonal bias.

Data Collection Procedures

Once signed consent/assent forms were received for both adolescents and parents, participants were asked to complete surveys (both parent and adolescent versions) with the option of completing them online or by mailed paper copies. GIS data access and variable creation were conducted independently of participants.

Measures

Self-reported participation in organized sport teams or physical activity classes (outcome variable). Adolescents were asked to report on a single item "In the past year, how many sports teams or physical activity classes have you participated in outside of school?" The combined number of organized sport teams and activity classes was reported as 0, 1, 2, 3, 4 or more (coded 4), and it was used as the primary outcome variable.

Parents perceived access to recreation facilities and parks. As described in Table 1, the parent-reported Neighborhood Environment Walkability Scale for Youth (NEWS-Y) survey (Rosenberg et al., 2009) was used to construct measures of perceived proximity to parks and recreation facilities. Proximity was indicated by parents estimating walking times from home to each of the following venue types: small park, large park, indoor recreation or exercise facility, basketball court, other playing fields/courts, and school with available recreation facilities. Two measures were constructed to reflect perceived proximity and availability, respectively, of parks, recreation facilities, and parks plus recreation facilities combined (six variables total). Parents estimated walk times from home to each venue type using a 5-point scale: (1) 1-5 minutes, (2) 6-10 minutes, (3) 11-20 minutes, (4) 21-30 minutes, and (5) 31+ minutes. The NEWS-Y items used were selected because they included parks (large and small) and four types of recreation facilities associated with organized sport teams or physical activity classes that can be located at publicly accessible recreation facilities, whether fees were required or not. Swimming pools were not included because they could have been in someone's

backyard or apartment complex rather than in an accessible recreation facility.

While only a subset of the survey items was used for the present analysis, the original NEWS-Y built environment scales have previously been shown to be generally comparable between parents and adolescents (intraclass correlation coefficients [ICCs] ranged from .72 to .93). The parent-reported full Recreation Facilities scale showed good average test-retest reliability (ICC) = .67 and Cronbach α coefficient = .83 (Rosenberg et al., 2009).

Table 1: Description of Recreation Environment Variables from NEWS-Y and GIS

Recreation Environment Variables	Definition of Measures
Based on Parent-reported NEWS-Y:	
Parks	
Nearest Park based on Walking Time Codes	Nearest park variable was created by making it equal to the self-reported walking-time code for the closest park, either small park OR large park (lower code = fewer 'minutes to walk there' = shorter distance from home). Walk-time codes used to rate each park were: 1) 1-5 minutes to walk there, (2) 6-10 minutes, (3) 11-20 minutes, (4) 21-30 minutes or (5) 31+ minutes to walk there from home. [Range of scores: 1 – 5]
Availability of Large and Small Parks	Self-reported walking-time codes were reversed for the small and large parks and their *sum* was computed (higher score = better availability/access = closer to small and large parks based on walk times from home). The reversed response codes used to rate each park were: (1) 31+ minutes to walk there, (2) 21-30 minutes, (3) 11-20 minutes, (4) 6-10 minutes or (5) 1-5 minutes to walk there from home. [Range of 2 summed scores: 2 – 10]
Recreation Facility	
Nearest Recreation Facility based on Walking Time Codes	Nearest recreation facility variable was created by making it equal to the self-reported walking time code for the nearest recreation facility selected from indoor recreation or exercise facility, basketball court, playing fields, or school recreation facilities. (lower code = fewer 'minutes to walk there' = shorter distance from home). Walk-time codes used to rate each of the four facilities were: 1) 1-5 minutes to walk there, (2) 6-10 minutes, (3) 11-20 minutes, (4) 21-30 minutes or (5) 31+ minutes to walk there from home. [Range of scores: 1 – 5]
Availability of Recreation Facilities	Self-reported walking-time codes were reversed for the four recreation facilities and their *sum* was computed (higher score = better availability/access = closer recreation facilities based on walk times from home). The four facilities assessed were indoor recreation or exercise facility, basketball court, playing fields, and school recreation facilities. The reversed proximity response codes used to rate each facility's nearness or "availability" were: (1) 31+ minutes to walk there, (2) 21-30 minutes, (3) 11-20 minutes, (4) 6-10 minutes or (5) 1-5 minutes to walk there from home. [Range of 4 summed scores: 4 – 20]
Combined Parks and Recreation Facilities	
Nearest Park and Recreation Facility based on Walking Time Codes	The combined variable was computed by taking the sum of the walking time codes for nearest park and the nearest recreation facility variables described above. [Range of 2 summed scores: 2 – 10]
Combined Availability of Parks and Recreation Facilities	The combined variable for availability was computed as the *sum* of the reversed self-reported walking time codes for both parks (large and small) and all four recreation facilities (indoor recreation or exercise facility, basketball court, playing fields, and school recreation facilities). Higher scores on this scale indicated parents perceived having more parks and recreation facilities available near home (i.e., within shorter walk times). [Range of 6 summed scores: 6 – 30]

Based on GIS:	
Parks	
Distance to Nearest Park (km)	Street-network distance to the nearest park from participant's home
Total Park Count	Total count of parks within the 1 km street network buffer from the participant's home
Recreation Facility	
Distance to Nearest Recreation Facility (km)	Street-network distance to the nearest recreation facility from participant's home
Total Recreation Facility Count	Total count of recreation facilities within the 1 km street-network buffer from the participant's home
Combined Parks and Recreation Facilities	
Distance to Nearest Park or Private Recreation Facility (km)	Street-network distance to the nearest park OR recreation facility from participant's home. The closer facility (park or recreation facility) was chosen.
Average Distance to Nearest Park and Recreation Facility (km)	Average distance to the nearest park and nearest recreation facility from participant's home. This is an indicator of availability of multiple facilities, in this case, a park and a recreation facility.
Total Count of Parks and Recreation Facilities	Total count of parks and recreation facilities within the 1-km street network buffer from the participant's home.

Self-reported places for physical activity. Adolescents were asked to respond to 15 items on "How often are you physically active in/at the following locations?": 1) indoor recreation or exercise facility; 2) beach, lake, river or creek; 3) bike/hiking/walking trails, paths; 4) basketball court; 5) other playing fields; 6) indoor swimming pool; 7) small public park; 8) large public park; 9) public open space that isn't a park; 10) friend's house or relative's house; 11) School grounds (during non-school hours); 12) outdoor swimming pool; 13) ski or other winter recreation area; 14) skatepark; 15) parking lot. Response options were: 0 = never, 1 = once a month or less, 2 = once every other week, 3 = once a week, 4 = 2 or 3 times per week, or 5 = 4 or more times per week. Item test-retest reliabilities ranged from about .40 to .70 in prior studies (Millstein et al., 2011).

GIS-based proximity and counts of parks and recreation facilities. Availability of private recreation facilities and public parks was objectively measured using a GIS. These measures were created by 1) geocoding participants' residential addresses, 2) creating 1-kilometer (km) street network buffers defined by walkable roads (i.e., those that permit pedestrian travel) around each resident's location, and 3) linking databases with recreation facilities and parks to the participant's buffer, as described in a technical report (Frank et al., 2012). The 1-km buffer size is commonly used in physical activity research (Brownson et al., 2009), has evidence of being effective in explaining physical activity (e.g., Frank et al., 2017), and GIS-based measures using this buffer size were related to physical activity and other outcomes in prior analyses from the TEAN Study (Sallis et al., 2018). The completion of these three steps allowed identification of the number (counts or "availability") of parks and recreation facilities in the 1-km buffer around each participant's home as well as distances ("proximity") to the nearest park and recreation facility (either in or outside the buffer).

A comprehensive database of park polygon boundaries was compiled for both study regions from sources including local government (counties and municipalities) park inventories, tax assessor parcels identified as parks, ESRI (Redlands, CA) park data, and manual digitizing from online listings in Google Maps (Mountain View, CA) and Bing Maps (Redmond, WA). Park access points were generated at 500 feet intervals at the boundaries of park polygons and then snapped to the road network within a distance of 150 feet to identify valid entry points proximal to walkable streets. Only parks of one acre or greater were considered, on the assumption that very small parks would be infrequently used by adolescents for organized physical activity.

An enumeration of private recreation facilities including location address and facility attribute information for both study regions was performed using business listing data acquired from InfoUSA (Dallas, TX), MapQuest (Denver, CO), Switchboard and Yellow Pages (InfoSpace, Irving, TX). The inventory of recreation facilities used for analysis included sports fields, tennis courts, swimming pools, skating rinks, equestrian facilities, gyms, and locations for dance, martial arts, yoga, and Pilates classes. ESRI Premium Geocoding Service (Redlands, CA) was used to geocode participant and recreation facility addresses. ArcGIS Network Analyst version 10.0.4 (ESRI, Redlands, CA.) was used to create 1-km buffers and compute network-based distances to these destinations. All measures

were based on a walkable road network including centerline links where pedestrians were permitted to traverse, with limited access roadways, ramp entrances/exits and private roads removed. Seven built environment variables were created in GIS. See Table 1 for explanations and Table 2 for descriptive statistics of all measures examined.

Table 2. Descriptive Statistics for Participants' Number of Sport Teams and Physical Activity Classes, Demographic Covariates, and Recreation Environment Variables

	Mean (SD) or %	Minimum	Maximum
Outcome Measure			
Number of Sport Teams and Physical Activity Classes (mean, SD)	1.52 (1.37)	0	4
0	30.2 %		
1	25.2 %		
2	20.5 %		
3	10.6 %		
4+	13.5 %		
Demographic Covariates			
Adolescent Age (mean, SD)	14.1 (1.40)	12	17
Neighborhood Income (census-based) (%)			
High Income	50.1 %		
Low Income	49.1 %		
Site/Region (%)			
Maryland	52.3 %		
Seattle/King County, WA	47.7 %		
Sex (%)			
Boys	49.6 %		
Girls	50.4 %		
Race/Ethnicity (%)			
Nonwhite and/or Hispanic	33.4 %		
Non-Hispanic white	65.8 %		
Marital/partner Status (%)			
Not Married or Living with Partner	15.9 %		
Married or Living with Partner	83.4 %		
Highest Household Education (%)			
Some College or Less	24.5 %		
College Degree or More	74.9 %		
Recreation Environment Correlates			
Based on GIS:	Mean (SD)		
Parks			
Distance to Nearest Park (km)	.888 (.869)	0	8.10
[a] Median:	.634		
Total Park Count (within 1-km)	1.46 (1.65)	0	9
[a] Median:	1.00		
Recreation Facilities			
Distance to Nearest Recreation Facility (km)	.934 (.977)	.003	14.10
[a] Median:	.710		
Total Recreation Facility Count (within 1-km)	3.01 (4.81)	0	62
[a] Median:	1.00		
Combined Parks and Recreation Facilities			
Distance to Nearest Park or Private Recreation Facility (km)	.603 (.610)	0	8.10
[a] Median:	.453		
Average Distance to Nearest Park and Recreation Facility (km)	.911 (.781)	.034	10.90
[a] Median:	.719		
Total Count of Parks and Recreation Facilities (within 1-km)	4.46 (5.60)	0	66
[a] Median:	3.00		
Distance codes based on NEWS-Y (parent-reported):	Mean (SD)		
Parks			
Nearest Park (low walking time code = closer) *	2.36 (1.34)	1	5
Availability of Large and Small Parks (higher number = greater availability) **	6.03 (2.37)	2	10

Recreation Facilities			
Nearest Recreation Facility (low walking time code = closer)*	1.99 (1.08)	1	5
Availability of Recreation Facilities**	12.36 (4.00)	4	20
Combined Parks and Recreation Facilities			
Nearest Park and Recreation Facilities (low walking time codes = closer) *	4.34 (2.13)	2	10
Availability of Parks and Recreation Facilities**	18.39 (5.79)	6	30

Note:
[a] Median also provided for GIS measures because distributions were skewed (>1.5 skewness).
**Parent-reported walking-time codes: (1) 1-5 minutes from home, (2) 6-10 minutes, (3) 11-20 minutes, (4) 21-30 minutes, (5) 31+ minutes.*
*** Availability score is based on the sum of reversed walking-time codes, such that higher scores reflect more parks and/or facilities closer to home: (1) 31+ minutes walking time, (2) 21-30 minutes, (3) 11-20 minutes, (4) 6-10 minutes, (5) 1-5 minutes walking time from home.*

Covariates

Covariates included adolescents' self-reported age, sex (male or female), race/ethnicity (recoded as non-Hispanic white, or nonwhite and/or Hispanic or multi-race/ethnicity). Household covariates included highest household education (recoded as some college or less, or college degree or more), and caregiver marital/partner status (recoded as living with partner/married or other). Area socioeconomic status was based on census block group median household income and categorized by county-level median split (recorded as low vs. high median household income) (Sallis et al., 2018). The study site was coded (Seattle/King County, Washington or Baltimore, Maryland regions). Census block group number was included as a random effect in all models to adjust for geographic clustering of participants in the recruitment procedures.

Statistical analysis

The primary outcome was the combined number of organized sports teams and classes participants reported engaging in, measured by the single item measure ranging from 0 to 4 or more. Linear mixed regression analyses were conducted to evaluate associations between the adolescent-reported number of organized sports and fitness classes outcome with (a) the GIS-based built environment measures of parks and recreation facilities, and (b) the parent-reported perceived proximity and availability measures for parks and recreation facilities. Because the GIS-based measures were skewed (skewness values ranging from 1.54 to 6.41), the ln-transformed versions of these measures were used in the models. All models were adjusted for study design (geographic region and high/low census-based neighborhood income) and five demographic covariates (adolescent's age, sex, race/ethnicity, highest household education, parent's marital/partner status), and adjusted for participant clustering within census block groups as a random effect. A total of 13 mixed regression models were computed. To achieve the secondary descriptive aim, independent t-tests were computed to compare self-reported frequency of physical activity at each of 15 selected physical activity locations by sex (see Table 5). Data were analyzed using IBM SPSS Statistics for Windows, version 27 (IBM Corp., Armonk, NY, US).

Results

Participants

A total of 928 adolescent-parent pairs completed both adolescent and parent surveys, of whom 485 and 443 were from the Baltimore and Seattle regions, respectively. The adolescents were 50.4% (n=468) girls and 49.6% (460) boys; 66.3% were non-Hispanic white and 33.7% were nonwhite and/or Hispanic. The average age was 14.1 (SD = 1.4) years.

Parents were 79.1% (731) women and 20.9% (193) men; 74% non-Hispanic white and 26% nonwhite or Hispanic; and average age was 47.2 (SD = 6.7) years. Most parents had completed a college degree or higher (64%), and 84% were married or living with a partner. Mean of census-based median household income was approximately $77,500 per year.

Results for Covariate Associations with Teams and Classes Participation

Because all 13 models included the same covariates, each of which had similar associations with the outcome across models, covariates were estimated in a separate model and are presented once in Table 3. Results from the separate models of associations for each of the 13 parks and recreation facilities measures with adolescent team sports and activity class participation are presented in Table 4.

Table 3: Summary of Linear Mixed Regression Model Results for Study Design and Demographic Covariates Explaining Adolescent Participation in Organized Teams and Classes.

Covariates	Estimates (Std. Error)	Lower Bound	Upper Bound	*t*	*p*
Neighborhood Income (0=Low income; 1=High income (REF))	-.151 (.093)	-.334	.032	-1.62	.106
Site/Region (1=Seattle; 2=Baltimore region (REF))	-.262 (.090)	-.429	-.085	-2.91	.004
Adolescent Age	-.174 (.031)	-.236	-.113	-5.56	<.001
Adolescent Sex (M=0; F=1 (REF))	.052 (.088)	-.120	.224	.591	.555
Adolescent Race/Ethnicity (0= Nonwhite or Hispanic; 1=non-Hispanic, white (REF))	-.092 (.095)	-.278	.095	-.964	.335
Parent Marital Status (0=not married/living with partner; 1=married/living with partner (REF))	-.131 (.124)	-.373	.112	-1.06	.291
Highest Household Education (0=some college or less; 1=college degree or more (REF))	-.292 (.108)	-.503	-.080	-2.71	.007

Note: REF specifies the reference group to which the other group(s) were compared.

Table 4: Summary of Linear Mixed Regression Model Results Explaining Adolescent Participation in Organized Sports Teams and Classes from GIS-Based and NEWS-Y Measures of Parks and Recreation Facilities.

		95% Confidence Interval			
Recreation Environment Predictors	**Estimates (Std. Error)**	**Lower Bound**	**Upper Bound**	***t***	***p***
Based on GIS [a]:					
Parks					
Distance to Nearest Park (km)	-.137 (.121)	-.376	.102	1.131	.259
Total Park Count	025 (.073)	-.118	169	.345	.730
Recreation Facilities					
Distance to Nearest Recreation Facility (km)	.092 (.133)	-.171	.354	.689	.491
Total Recreation Facility Count	.061 (.052)	-.041	.163	1.168	.243
Combined Parks and Recreation Facilities					
Distance to Nearest Park or Private Recreation Facility (km)	-.007 (.156)	-.314	.300	.044	.965
Average Distance to Nearest Park and Nearest Recreation Facility (km)	-.042(.150)	-.338	.254	.280	.780
Total Count of Parks and Recreation Facilities	.036 (.052)	-.066	.137	.688	.492
Based on NEWS-Y (parent report):					
Parks					
Nearest Park (low walking time code = closer) *	-.043 (.033)	-.108	.022	-1.30	.195
Availability of Large and Small Parks **	.050 (.019)	.013	.087	2.66	.008
Recreation Facilities					
Nearest Recreation Facility (low walking time code = closer) *	-.073 (.041)	-.153	.007	-1.79	.074
Availability of Recreation Facilities**	.038 (.011)	.016	.060	3.46	.001
Combined Parks and Recreation Facilities					

Nearest Park and Recreation Facilities (low walking time codes = closer) *	-.036 (.021)	-.076	.005	-1.72	.086
Availability of Parks and Recreation Facilities**	.027 (.008)	.012	.042	3.49	.001

Note: Each row presents results of a separate model, which adjusted for all study design and demographic variables (i.e., covariates) in Table 3.
Note: Covariates adjusted for in all models were: neighborhood income, site/region, adolescent's age, sex, and race/ethnicity, parent's marital status, and highest household education. Participant clustering within census block groups was adjusted for as a random effect in all models.
[a] Due to skewness values >1.5 for all GIS measures, ln-transformed versions were used in the mixed regression analyses.
** Parent-reported walking-time codes: (1) 1-5 minutes from home, (2) 6-10 minutes, (3) 11-20 minutes, (4) 21-30 minutes, (5) 31+ minutes.*
*** Availability score is based on the sum of reversed walking-time codes, such that higher scores reflect more parks and/or facilities closer to home: (1) 31+ minutes walking time, (2) 21-30 minutes, (3) 11-20 minutes, (4) 6-10 minutes, (5) 1-5 minutes walking time from home.*

As shown in Table 3, adolescents in the Maryland region participated in more organized team sports and physical activity classes than those in the Seattle region. Adolescents with an adult in the household having a college degree or more as the highest level of education participated in more organized teams and classes than those in less-educated households. Older adolescents participated in significantly fewer organized teams and classes, but participation was not significantly associated with neighborhood income, adolescents' sex or race/ethnicity, or parents' marital/partner status.

Results for GIS Variables

None of the GIS-based park or recreation facilities measures were related to adolescents' reports of participation in sports teams or physical activity classes. (See Table 4).

Results for NEWS-Y Variables

Parks

There was no association between adolescent participation in organized sports teams and classes and parent-reported walking time score to the nearest park (large or small) (See Table 4). However, greater parent-perceived availability of large and small parks combined was associated with higher adolescent participation in teams/classes (p=.008).

Recreation Facilities

There was a nonsignificant but marginal association between adolescent participation in organized teams and classes and lower parental self-reported walking-time score to the nearest recreation facility (p=.074). Greater parent-perceived availability of the sum of four types of recreation facilities was associated with higher adolescent participation in teams/classes (p=.001).

Combined Parks and Recreation Facilities

There was a nonsignificant but marginal association between adolescent participation in organized teams and classes and lower parent-reported sum of walking time codes for the nearest park and nearest recreation facility (p=.086). However, greater parent-perceived availability of the sum of a small and large park and four types of recreation facilities was associated with higher adolescent participation in teams/classes (p=.001).

Places Where Adolescents are Physically Active, by Sex

The five most frequently reported places for boys' physical activity were friend's or relative's house, other playing field, basketball court, school grounds and outdoor swimming pool. Girls' most frequently reported places for physical activity were outdoor swimming pool, friend's or relative's house, other playing field, school grounds and biking/hiking/walking trails/paths.

Table 5 shows the means (SD) separately for boys and girls of the adolescent-reported frequency of use of each facility type for physical activity. Boys were significantly more likely to use the following facilities for physical activity: basketball courts, small parks, large parks, public open spaces, ski or other winter recreation areas, and skateparks. Girls were significantly more likely to use a friend's or relative's house for physical activity. There were no significant differences for reported frequency of adolescent use for physical activity at the other locations.

Table 5: Means, Standard Deviations (SD), and Independent *t*-Test Results for the Reported Frequency With Which Places Were Used for Physical Activity Among Adolescents, by Sex.

Places for Physical Activity	Girls Mean (SD)	Boys Mean (SD)	*t* (*p*)
Indoor Recreation or Exercise Facility	1.37 (1.73)	1.47 (1.74)	.880 (.424)
Beach, Lake, River or Creek	.880 (1.10)	.930 (1.14)	.652 (.704)
Bike, Hiking, Walking Trails, Paths	1.41 (1.42)	1.55 (1.46)	1.48 (.158)
Basketball Court	1.01 (1.46)	1.89 (1.79)	8.16 (<.001)
Other Playing Fields (like football, softball, tennis)	1.67 (1.78)	2.15 (1.80)	4.08 (.369)
Indoor Swimming Pool	.790 (1.26)	.790 (1.18)	.063 (.245)
Small Public Park	1.35 (1.38)	1.45 (1.48)	1.04 (.046)
Large Public Park	1.13 (1.33)	1.38 (1.53)	2.63 (<.001)
Public Open Spaces (like plaza, square, or undeveloped land)	.750 (1.16)	1.16 (1.54)	4.64 (<.001)
Friend's House or Relative's House	1.96 (1.50)	2.27 (1.56)	3.12 (.041)
School Grounds (during non-school hours)	1.61 (1.81)	1.82 (1.77)	1.83 (.800)
Outdoor Swimming Pool (during warmer months)	2.05 (1.84)	1.73 (1.74)	-2.73 (.058)
Ski or Other Winter Areas (during colder months)	.720 (1.11)	1.07 (1.38)	4.33 (<.001)
Skatepark	.180 (.72)	.530 (1.22)	5.21 (<.001)
Parking Lot	.500 (1.07)	.990 (1.52)	5.63 (<.001)

Note: Frequency response options were: 0 = never, 1 = once a month or less, 2 = once every other week, 3 = once a week, 4 = 2 or 3 times per week, or 5 = 4 or more times per week.

Discussion

Participation of urban and suburban adolescents in team sports and physical activity classes was associated with most of the parent-reported measures of availability of recreation resources, but none of the GIS-based measures. There was a clear pattern within these perceived environment measure results. Reported walking-time estimates to the nearest single park or recreation facility had either non-significant or marginally-significant associations with adolescent participation in team sports and organized classes. However, composite availability scores for large and small parks, four types of recreation facilities, and the combined availability of parks and recreation facilities all had significant positive associations with adolescent participation. The implication of this pattern of findings is that adolescents who had better availability of multiple parks and recreation facilities around their homes were more likely to participate in organized team sports and physical activity classes. Having multiple nearby recreation resources seemed to be more important than having at least one resource very close to the adolescent's home. Availability of multiple parks and recreation facilities near home could give adolescents options to choose safer or more attractive areas for their teams or classes and allow them a greater range of choices for types of organized teams and classes to match their preferences.

The lack of associations between GIS-based proximity of recreation resources with adolescent participation in teams and classes was unexpected. However, it should be noted that the GIS availability measures were counted within a 1-km buffer of one's residence, which would have excluded parks and recreation facilities still relatively close to home and possibly perceived as close by parents (e.g., less than a mile away). Though it is likely objective GIS databases would identify more recreation resources than parents would be aware of, the quality of GIS databases for public parks and other recreation facilities has been criticized for incompleteness (Brownson et al., 2009; Cavnar et al., 2004; Rigolon & Németh, 2018). Though multiple data sources were assembled to create the park and recreation facilities variables used in the present study, an incomplete GIS database and use of a relatively small buffer size around homes could have contributed to the absence of associations found with adolescent team and class participation. It is possible parents considered the quality of nearby facilities or relevance to their adolescent's physical activity interests in responding to NEWS-Y items. Such considerations could have made parent reports of walking time to recreation resources more likely to yield expected associations.

Similar to previous studies that used broader physical activity outcomes, the present study found reported proximity to multiple parks and other recreation facilities was associated with participation in organized teams and classes, which are common categories of adolescent physical activity (Gavand et al., 2019; Norman et al., 2006; Sallis et al., 2018). Present results add evidence specific to the role of built environments in adolescent participation in sports teams and physical activity classes.

The frequency with which adolescents reported being active at a variety of places, as reported in Table 5, is relevant for interpreting the primary results. The locations that had the highest frequency of use for boys and girls were friend's or relative's house, playing field, basketball court, outdoor swimming pool, and school grounds. Only some of these locations were likely to be assessed in the present study by parent report (playing field, basketball court) and GIS (all except friend's or relative's house and school grounds). However, all of the most-commonly-used locations, except at friend's or relative's house, are places where youth could participate in organized sport teams and physical activity classes. Thus, measurement limitations could have led to underestimated associations in the present study. We encourage inclusion of all these frequently-used locations for adolescent physical activity in future studies using reported measures of availability of recreation environments.

Potential interventions conceptually consistent with present results can be suggested for development and evaluation. Because of mixed evidence of inequitable access to parks and other recreation facilities in communities of color and low-income communities, it could be especially important to create plans for ensuring equitable access to multiple recreation facilities in every neighborhood (Rigolon et al., 2016). Additional interventions could focus on encouraging and facilitating even greater use of commonly-used physical activity locations by more adolescents. To increase adolescent participation in organized teams and physical activity classes, communication campaigns could be tailored to promote use of existing local physical spaces where youth already participate in physical activity. Program leaders could improve promotion of organized sport teams and physical activity classes at these locations, because programs are important predictors of high park use (Cohen et al., 2010). Organizers of youth sports and physical activity classes could develop additional programs to appeal to a wider range of adolescents and make efforts to overcome barriers, such as transportation and program costs, which could enhance equity of access.

Similar to extensive research on adolescent physical activity in general (Armstrong et al., 2018; Sallis et al., 2000; Whitt-Glover et al., 2009), demographic variables such as age, sex, and household education were associated with adolescents' participation in team sports and physical activity classes in the present study. A recent review summarized multiple inequities that might affect youth sport participation among youth of color, especially those living in lower-income communities (Kuhn et al., 2021). These indications of disparities in teams and classes participation support the need for targeted interventions to reduce such inequities. For example, the older the adolescent's age, the fewer organized sport teams and physical activity classes they reported. Higher age of youth is a well-documented correlate of less total physical activity (Farooq et al., 2018; Metcalf et al., 2015; Sallis et al., 2000). As children get older, many sport programs become more competitive, which can discourage youth from participating if they are not motivated by competition or not skilled enough to compete at high levels (Merkel, 2013). Offering sports and activity programs that focus on broad participation and de-emphasize competition and advanced skills are likely to be more effective at attracting older adolescents to be physically active at nearby parks and recreation facilities.

There is extensive evidence that teen boys are more physically active and more likely to engage in sports than adolescent girls, in most countries (Armstrong et al., 2018; Cohen et al., 2006). Surprisingly, in the present study, sex was not associated with adolescent participation in organized team sports and physical activity classes. Although the present study did not assess the specific types of organized sports or physical activity classes, it is possible girls and boys participated at similar rates, though in different types of sports and classes. Perhaps there are equal opportunities to participate in teams and classes in the geographic regions we studied, but equity of opportunities for teams and classes attractive to girls and boys should be studied in additional geographic areas.

Consistent with prior research, we found living in households with higher parent education was associated with greater adolescent participation in organized sport teams and physical activity classes (Muñoz-Galiano et al., 2020). Households with higher parent education likely had more ability to pay for organized sports or classes, and adults in these households could have more time and transportation options to support their adolescents' participation (Black et al., 2020; Merkel, 2013). Adults with a college degree are more likely to be physically active themselves, and active parents could be both role models and more-enthusiastic supporters of their adolescents' participation in sports or physical activity classes (Mäkinen et al., 2012; Merkel, 2013). Previous studies showed low-income was a barrier to adolescents' participation in sports or physical activity (Armstrong et al., 2018; Merkel, 2013; Sallis et al., 2011). In one study, 76 percent of youth from households with incomes of at least 400 percent of the Federal poverty threshold participated in a sports team or lesson after school or on weekends within the last 12 months, compared to 41 percent of youth from households at less than 100 percent of the poverty threshold (US Department of Health and Human Services, 2019). Without safe, accessible places to be physically active, many youth struggle to be active (Babey et al., 2015; Durant et al., 2009; Grow et al., 2008). However, the neighborhood income variable used in the present study was not associated with adolescent participation in organized teams and classes, possibly because this measure did not necessarily indicate household-level incomes. Perhaps physical activity class or sport team fees were lower in lower-income neighborhoods, thus providing more equitable opportunities for local adolescents. Further study is needed to evaluate equity-oriented programming strategies (Rigolon et al., 2022).

In prior papers we reported on disparities in proximity to parks and recreation facilities (Abercrombie et al., 2008) and quality of parks (Engelberg et al., 2016) in these same regions. It is notable that a variety of patterns of differences

were found across socioeconomic strata, but not all patterns indicated inequities. It is possible race/ethnic or socioeconomic disparities in access to, and quality of, recreation spaces could help explain disparities in organized team and class participation in the present study. Prior findings justify further study of recreation environment equity that can inform strategies to create more equitable environments to support physical activity for residents of all ages.

Limitations

The present study was based on cross-sectional observational data. Thus, only associations can be interpreted, and we cannot infer causality. "Reverse causality" is possible with the results based on parent-reports of walking time to recreation resources, because parents of adolescents who are active in teams and classes may be more familiar with local recreation resources or may under-estimate walking time to familiar places. Similarly, associations could be partially explained by parents who are more supportive of adolescent team sport and activity class participation being more likely to choose to live near recreation facilities. The single-item measure of team and class participation had not been psychometrically evaluated. However, it is reasonable to expect higher validity for reporting a salient behavior such as participation in organized teams and classes, compared to quantitative estimates of overall physical activity that are more cognitively challenging. The single-item outcome measure did not differentiate team sports from physical activity classes, did not identify specific types of teams or classes, did not provide details on frequency or duration of participation, did not indicate where the team or class was located, and did not indicate how adolescents traveled to the site. We urge investigators to develop and evaluate more detailed measures of participation in organized teams and classes for use in future studies, because correlates and determinants are likely to differ across diverse types of physical activity. Organized teams and classes are also common at school, but the present study did not examine those opportunities. This is a valuable topic for future studies. Use of GPS data integrated with detailed GIS and accelerometry data, along with sports and activity class information, would allow future studies to identify the times and places where young people are physically active. Such data could identify how active young people are in specific types of organized sports and physical activity classes. Though NEWS-Y included 6 types of recreation resources that were examined here, some important types of facilities may be missing. As mentioned above, GIS-based measures of parks and recreation facilities are only as good as the source databases created by others. Substantial shortcomings in these databases have been documented, and accuracy and recency of data are likely to vary across jurisdictions (Brownson et al., 2009). Neither the NEWS-Y nor GIS measures of recreation resources provided information about the quality of the facilities (which is known to be related to park use; Geremia et al., 2019; Giles-Corti et al., 2005; Scott & Jackson. 1996) nor the nature or cost of organized teams and classes. The present study can be considered an initial effort to identify environmental correlates of adolescent participation in organized sports teams and physical activity classes. We encourage investigators to continue research on this topic that takes into consideration the complexity of the behavior and its likely environmental, policy, social, and individual correlates (potential determinants).

Conclusion

Greater parent-perceived availability of multiple types of nearby recreation resources was associated with more adolescent participation in organized sports teams and physical activity classes. Simply living a short walking distance from home to the closest park or recreation facility was not associated with more adolescent participation in teams or classes. Credibility of the findings was supported by descriptive data indicating several of the most frequently-used locations for physical activity were assessed in the current study's NEWS-Y reported measures, though other frequently-used locations were not assessed. If current findings are confirmed in further research, especially intervention studies, they would justify policies to ensure multiple recreation resources are available in all neighborhoods, as a means of adding opportunities for increasing adolescent sport or physical activity class participation on an equitable basis.

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Acknowledgment

This work was supported by National Institutes of Health Grant R01 HL083454.

Conflict of Interest:

We have no conflicts of interest to disclose.

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