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Environment and Behavior published online 7 January 2013
DOI: 10.1177/0013916512470134

The online version of this article can be found at:
http://eab.sagepub.com/content/early/2013/01/03/0013916512470134

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
Environmental Design Research Association

Environment and Behavior
XX(X) 1–33

DOI: 10.1177/0013916512470134
http://eab.sagepub.com

Park Use Among Youth and Adults: Examination of Individual, Social, and Urban Form Factors

Perver K. Baran[1], William R. Smith[1], Robin C. Moore[1], Myron F. Floyd[1], Jason N. Bocarro[1], Nilda G. Cosco[1], and Thomas M. Danninger[1]

Abstract

This article examines park use in relation to neighborhood social (safety and poverty) and urban form (pedestrian infrastructure and street network pattern) characteristics among youth and adult subpopulations defined by age and gender. We utilized System for Observing Play and Recreation in Communities (SOPARC) and Geographic Information Systems to objectively measure park use and park and neighborhood characteristics in 20 neighborhood parks. Heterogeneous negative binomial regression models indicated that the relationship between park use and types of activity settings, and park use and neighborhood attributes vary by age and gender. In general, the study found that park and activity setting size; activity settings such as playgrounds, basketball courts, pool and water features, shelters, and picnic areas; and availability of sidewalks and intersections in the park's neighborhood were positively associated with park use, whereas crime, poverty, and racial heterogeneity of the surrounding neighborhood were negatively associated with park use.

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Keywords

neighborhood park use, crime, urban form, street connectivity, pedestrian infrastructure

Urban parks have been recognized as key neighborhood features that provide residents with leisure-time opportunities (Cohen et al., 2007; Giles-Corti & Donovan, 2002) as well as utilitarian physical activity (Zlot & Schmid, 2005), including walking to the park and engaging in a variety of active recreation opportunities there. Parks are important sites for both organized and informal activities (Floyd, Spengler, Maddock, Gobster, & Suau, 2008a) and also support psychological health (Tinsley, Tinsley, & Croskeys, 2002) and social well-being (Prezza & Pacilli, 2007). Typically, municipal parks are available without charge to individual users and thus are particularly important in enabling "active living" across diverse population groups. In addition, their provision, design, and management are policy sensitive.

Because park use is linked to both recreational and utilitarian physical activity (Ding, Sallis, Kerr, Lee, & Rosenberg, 2011), a wide range of potential determinants, including those influencing walking, may play a role in park use. Research on walking has demonstrated that recreational walking among adults is consistently related to access to parks and trails (Giles-Corti et al., 2005; Hoehner, Brennan Ramirez, Elliott, Handy, & Brownson, 2005) and aesthetics of recreation facilities and neighborhoods in general (Burton, Turrell, Oldenburg, & Sallis, 2005; McGinn, Evenson, Herring, & Huston, 2007). In contrast, utilitarian walking is consistently associated with land-use mix, street connectivity, and residential density (Baran, Rodríguez, & Khattak, 2008; Frank, Schmid, Sallis, Chapman, & Saelens, 2005; Moudon et al., 2006). Limited research findings on youth walking suggest similar results (Frank, Kerr, Chapman, & Sallis, 2007). However, these findings may not be generalized directly to park use. Hence, they have limited applicability in informing policy and design interventions that promote park use. To date, only one study has examined specifically how much walking participants do only when walking to and within public open space, which included parks and playgrounds (Koohsari, Karakiewicz, & Kaczynski, 2012). The study found that perceptual qualities of the built environment, including safety from crime and traffic and aesthetics, were associated with greater walking, whereas street integration (syntactical accessibility) was associated with less walking.

However, research on park use has demonstrated that park accessibility and residential proximity are strongly associated with physical activity and park use for adults (Cohen et al., 2007), whereas neighborhood age composition has been shown to relate to park use for older adults (S. Moore et al., 2010). Additional attributes that may encourage park use include safety, aesthetics, amenities, and maintenance (McCormack, Rock, Toohey, & Hignell, 2010). Similarly, youth studies suggest that park use is associated with the existence of active recreation facilities, park landscape, park size, active recreation programs, level of maintenance (Loukaitou-Sideris & Sideris, 2010), as well as perceptions of greater park availability, quality, and use by friends (Ries et al., 2009). In spite of the recognition that park use is influenced by a combination of individual and socioecological variables (Bedimo-Rung, Mowen, & Cohen, 2005), extant studies on park use usually have examined a limited number of factors while focusing on a single subpopulation (e.g., 10- to 13-year-old children). Few studies have assessed actual park use among children, adolescents, and adults along with the specific park and neighborhood characteristics that may relate to park use.

Given the increasing evidence that parks and features within them influence youth and adult physical activity (Kaczynski & Henderson, 2007), understanding park and neighborhood conditions that are associated with park use is crucial. Models of park use that do not take into account demographic variables will be miss-specified and lead to wrongful conclusions and policies. While it is not surprising that activities in parks are gender specific (Loukaitou-Sideris & Sideris, 2010) and age specific (S. Moore et al., 2010), prior research has neither shown how neighborhood crime and poverty levels have differential associations with park use, depending on age and gender, nor has extant research delineated how age and gender moderate the relationships between park use and pedestrian infrastructure or park use and street network pattern. The present study addresses this knowledge gap by investigating how park and neighborhood attributes may relate to park use by examining differences among three youth age groups, as well as across genders for youth and adults, separately. The study also recognizes that different combinations of park attributes and neighborhood socioeconomic and urban form characteristics may account for youth and adult park use (Bedimo-Rung et al., 2005). It was hypothesized that park use is associated with (a) park and neighborhood size characteristics, (b) type of activity setting, (c) neighborhood safety and socioeconomic conditions, and (d) neighborhood urban form, including pedestrian infrastructure and street network pattern.

To our knowledge, this is the first study using gender- and age-differentiated models to examine park and neighborhood correlates of park use among youth and adults simultaneously. In addition, the study is unique in that it combines objective observational measures for park use (number of users) and neighborhood poverty and reported crime rates. Thus, the study addresses the recent call for further studies on built environment, neighborhood crime, and physical activity employing behavior and crime-specific measures in teasing out the inconsistent findings in extant studies (S. Foster & Giles-Corti, 2008).

Research Design and Methods

Study Setting

Data for this study are from a cross-sectional study of park users in 20 randomly selected parks and their surrounding neighborhoods in Durham, North Carolina, the United States. To ensure socioeconomic diversity of population and inclusion of minority/mixed neighborhoods, this study focused on the mostly residential central area of the city. Twenty parks were randomly selected from 38 available parks. Mean size of a park in the study area was 10.09 acres (4.08 hectares [ha]), whereas standard deviation (*SD*) of a park size was 4.85 acres (1.96 ha).

Park neighborhood was defined as the area within one-quarter mile (400 m—equating to a 5-min walk) along the road network (network buffer) and includes all parcels accessible from one-quarter mile network distance from each park entrance. One-quarter mile is a threshold for accessing public services within a walkable neighborhood (Duany, Plater-Zyberk, & Alminana, 2003; Kelbaugh, 1989), including neighborhood parks (Nicholls, 2001; Wolch, Wilson, & Fehrenbach, 2005). One-quarter mile is also comparable with that used in other physical activity and walkability research (Loukaitou-Sideris & Sideris, 2010; K. R. Smith et al., 2008; Wells & Yang, 2008).

Outcome Measure—Park Use

Information about all study variables, their definitions, and data sources is shown in Table 1. Park use was measured by number of park users in the park and was acquired through the System for Observing Play and Recreation in Communities (SOPARC; McKenzie, Cohen, Sehgal, Williamson, & Golinelli, 2006). Previous research has utilized data from similar park observations to examine park use, that is, count of users (Cohen, Marsh, Williamson, Golinelli, & McKenzie, 2012; Loukaitou-Sideris & Sideris, 2010; Tester & Baker, 2009). SOPARC consists of systematic momentary time sampling of predetermined park activity zones (area of a park with a distinct activity setting type) within parks. Park zones were scanned visually by trained observers (sweeping from left to right). Park users were coded by physical activity, gender, and age on a standardized form along with other contextual information. Prior to data collection and the implementation of the SOPARC protocol, each zone was mapped using existing Geographic Information System (GIS) park boundary data and high-resolution aerial photography. Maps were corroborated with park visits by the research team. A total of 134 park zones were selected for observation (*M* = 8.4 per park). In this study, the original SOPARC protocol was modified to account for physical activity among youth in different childhood age groups: young child (0-5 years), middle child (6-12 years), and adolescent (13-18 years). This allowed calculating number of park users by different childhood age groups. Paired observers systematically rotated through the activity areas and recorded number of youth using the park by activity zone, gender, age, and activity level during 8 weeks in two observation sessions, 10:00 a.m. to 2:00 p.m. (Eastern Daylight Time [EDT]) and 3:00 p.m. to 7:00 p.m. (EDT). Number of adults by gender was also recorded. As activity areas were scanned by a pair of observers, to avoid multiple observations of the same people at short-time intervals and to address the reliability of number of park users observed, for this study, the count of users in a park zone is averaged for the two observers. SOPARC also provided information on the type of activity occurring in each park zone (soccer or baseball field, basketball court, swimming pool, picnic area, etc.). Data were collected on all weekend days and 16 randomly selected weekdays between May and July, 2007. Kappa statistics were calculated to assess interrater reliability for all count variables. Among youth, the mean kappa was 0.85 for number of girls observed and 0.78 for number of boys observed. The mean kappa for young children (aged 0-5 years) was 0.81, for middle-child group (aged 6-12 years) 0.81, and for adolescents (aged 13-18 years) 0.69, respectively. Among adults, the mean kappa was 0.88 for women and 0.83 for men. Analysis of individual and socioenvironmental correlates of physical activity within park have been reported elsewhere (Floyd et al., 2011).

Independent Variables

Park features. Park feature variables include size of park zone, size of all zones in the park, and size of the park (in acres). Activity setting type and the number of zones in the park were also included (Table 1). Size of zone was obtained by calculating the area of the polygon comprising the activity zone in GIS. Activity setting type, assessed using SOPARC, was measured by a set

Table 1. Study Variables, Definitions, and Data Sources

	Definition/measurement	VT	Data source
Dependent variable			
Park use			
Number of youth			
Girls	Number of girls observed in a park zone	Cnt	SOPARC
Boys	Number of boys observed in a park zone	Cnt	SOPARC
Young children (0-5 years)	Number of young children observed in a park zone	Cnt	SOPARC
Middle children (6-12 years)	Number of middle children observed in a park zone	Cnt	SOPARC
Adolescents (13-18 years)	Number of adolescents observed in a park zone	Cnt	SOPARC
Number of adults			
Women	Number of women observed in a park zone	Cnt	SOPARC
Men	Number of men observed in a park zone	Cnt	SOPARC
Independent variable			
Park feature			
Park zone	Area of a park with a distinct activity setting type		City/county park GIS data set, high-resolution aerial photography, and park visits
Activity setting type	Type of activity usage of a park zone		
Soccer or baseball field	Presence of soccer or baseball field	D	SOPARC
Basketball court	Presence of basketball court	D	SOPARC
Handball or tennis court	Presence of handball or tennis court	D	SOPARC
Playground area	Presence of playground area	D	SOPARC
Pool or water feature	Presence of pool or water feature	D	SOPARC
Shelter	Presence of shelter	D	SOPARC
Picnic area	Presence of picnic area	D	SOPARC
Trail or walking path	Presence of trail or walking path	D	SOPARC
Open space[a]	Presence of open space	D	SOPARC

(continued)

Table 1. (continued)

	Definition/measurement	VT	Data source
Exercise station/area	Presence of exercise station/area	D	SOPARC
Park zone size	Area of the polygon comprising the zone in acres	C	GIS
Size of all park zones in park	Area of all park zones in a park in acres	C	GIS
Park size	Park area in acres	C	City/county park GIS data set
Number of park zones in park	Number of all park zones observed in a park	Cnt	SOPARC
Park neighborhood characteristic			
Park neighborhood	Area within one-quarter mile (400 m) along the road network (network buffer) that includes all parcels accessible from one-quarter mile network distance from each park entrance		City/county park, parcel, and street centerline GIS data
Park neighborhood size (acres)	Area of park's neighborhood and the park it comprises in acres	C	GIS data
Neighborhood social attribute			
Total population	Total population of a park's neighborhood	Cnt	Census block 2000
Population by age	Population of young children (0-5years), middle children (6-12 years), and adolescents (13-18 years) in a park's neighborhood	Cnt	Census block 2000
Population by gender	Population of girls, boys, women, and men in a park's neighborhood	Cnt	Census block 2000
Racial heterogeneity	Proportion White population × proportion African American population multiplied by 100 to convert to a percentage	C	Census block 2000
Ethnic composition	% Hispanic population in a park's neighborhood	C	Census block 2000
Poverty index[b]	Standard scores (summed and divided by the number of items) for the following items:	C	
	% population below poverty	C	Census block 2000
	Average median household income (reverse coded)	C	Census block 2000

(continued)

Table 1. (continued)

	Definition/measurement	VT	Data source
	% single-parent household	C	Census block 2000
	% owner-occupied housing units (reverse coded)	C	Census block 2000
	% African American population	C	Census block 2000
	Average building value (reverse coded)	C	City/county tax assessment GIS data
Crime index[c]	Standard scores (summed and divided by the number of items) for count of robbery, weapon possession, simple assault, prostitution, and aggravated assault within the park's neighborhood	C	Durham Police Department 2004-2006 point crime-incident data at address level
Neighborhood urban form attribute			
Pedestrian infrastructure			
Sidewalks	Sum of sidewalk length in feet in the park's neighborhood divided by 1,000	C	City/county sidewalk GIS data
Street network pattern			
Street intersections	Number of vehicular street intersections with more than two branches (three-way and above) within the park's neighborhood	Cnt	City/county street centerline GIS data
Culs-de-sac	Number of street culs-de-sac (dead ends) contained in the park's neighborhood	Cnt	City/county street centerline GIS data

Note: VT = variable type; Cnt = count variable; SOPARC = System for Observing Play and Recreation in Communities (McKenzie, Cohen, Sehgal, Williamson, & Golinelli, 2006); GIS = Geographic Information System; D = dummy variable; C = continuous variable.

[a]Open space includes grassed area that was not part of any other activity setting but had potential for unorganized or organized activities, such as picnicking, playing tag, and soccer.

[b]Cronbach's $\alpha = .916$.

[c]Cronbach's $\alpha = .953$.

of dummy variables indicating the presence of a soccer or baseball field, a basketball court, a handball or tennis court, a playground area, a pool or water feature, a shelter, a picnic area, a trail or walking path, an exercise station/area, and an open space. An open space included grassed area that was not part of any other activity setting but had potential for unorganized or organized activities, such as picnicking, playing tag, and soccer. Research suggests that activity setting type should determine the number of users present (Reed et al., 2008). For example, a baseball or soccer field should have more users than a basketball court, which in turn should have more users than a tennis court. The number of activity zones reflects the diversity of the facilities and programs offered (Bedimo-Rung et al., 2005), which supports increased active and passive park use (McCormack et al., 2010).

Park neighborhood characteristics. Park neighborhood characteristics include three indicators: neighborhood size, neighborhood social attributes, and neighborhood urban form, all developed using ArcGIS 9.1. Neighborhood size is calculated summing the acreage of the park's neighborhood and the park area in GIS. Although the neighborhood area is expected to be proportionate to the park size (r = .445), because the neighborhood of each park is determined by a network buffer from each park entrance, in some instances, this was not the case. For example, residential area adjacent to a park may not be included in the neighborhood if the distance to the closest entrance is more than 400 m.

Neighborhood social attributes included total population, population by age and gender group, poverty level, racial heterogeneity, ethnic composition, and reported crime (Table 1). Census block data were used to calculate total population and population by age and gender for each neighborhood (Forsyth, 2010). Poverty level was measured by an index (Cronbach's α = .916) calculated by standard scores for percentage of population below poverty, average median household income (reverse coded), percentage of single-parent households, percentage of owner-occupied housing units (reverse coded), percentage of African American, and average building value (reverse coded). Racial heterogeneity is calculated by proportion White × proportion African American (then converted to a percentage). Ethnic composition is measured by percentage of Hispanics.

Reported crime includes 3-year (2004-2006) point crime-incident GIS data, recorded at an address level, obtained from the Durham Police Department, and is measured by a crime index (Cronbach's α = .953) consisting of the standard scores summed for count of robbery, weapon possession, simple assault, prostitution, and aggravated assault within the neighborhood area. All indices have been divided by the number of items in the index so as to achieve the same metric as a single standardized variable.

Neighborhood urban form was measured by two indicators, pedestrian infrastructure and street network pattern (connectivity). Both measures point to the degree of neighborhood accessibility, which contribute to overall neighborhood walkability. Pedestrian infrastructure was measured by the sum of sidewalk length in feet (Forsyth, 2010) in the park's neighborhood divided by 1,000. Street network pattern comprises street connectivity and was measured by the number of vehicular street intersections with more than two branches (three-way and above) and the number of street culs-de-sac (dead ends) contained in the park's neighborhood (Wells & Yang, 2008). Street connectivity captures the degree to which destinations can be reached in a direct, rather than an indirect, pathway and predicts the relative ease of walking (Frank et al., 2005) between home and a park. For interpretational ease, count variables are used rather than density measures.

Statistical Analysis

To examine the relationship between park and neighborhood characteristics and park use, models were estimated in which the number of youth by age (three variables: 0-5, 6-12, and 13-18 years old), number of youth by gender (two variables: male and female), and number of adults by gender (two variables: male and female) in park zone were the dependent variables. The unit of analysis is the activity zone because people are generally drawn to an area within a park due to the various types of activities that those areas are designed for (picnicking, playing basketball, etc.). Initially, ordinary least square (OLS) regression models were utilized to identify collinearity and dispersion problems (i.e., unduly influential cases) in data. Because the dependent variables were highly skewed and suffer from heteroskedasticity in the residuals, count regression models, such as Poisson and negative binomial models, were applied. These models are the most appropriate modeling techniques for count data (Cameron & Trivedi, 1998).

Initial tests of the models revealed that a Poisson regression was inadequate due to overdispersion of the dependent variables. Consequently, heterogeneous negative binomial regression (HNBR) models were estimated, in which the overdispersion parameter is modeled as a linear combination of various covariates. After testing all of the independent variables as possible sources for overdispersion, only population size of the surrounding neighborhood was found to consistently influence this parameter across subpopulations. In addition to addressing the overdispersion issue, we also conceptualize and measure the population with a higher probability of being observed in the activity setting (a so-called "exposure" variable), that is, the population of the age- or gender-relevant group (e.g., those 6- to 12-year-old residents in the park's neighborhood are more likely to be observed in the park activity setting than those living further away). Similar exposure variables were used for each subpopulation resident in the park's neighborhood: girls, boys, children aged 0 to 5 years, children aged 6 to 12 years, adolescents, women, and men.

In the statistical analysis, the variables have been "winsorized" (Dueck & Lohr, 2005; Tukey, 1977) so that unduly influential values do not result in dropped cases. Rather, those cases were given the maximum value more proximate to the remaining distribution of a variable, resulting in more stable estimates (Tukey, 1977; Wilcox, 2010). Leaving such cases unchanged in the analysis produces results that are less likely to be safely generalized to other samples because the results have been determined or "driven" by just a few cases. All results presented use the Huber/White/sandwich estimator of variance in place of the traditional calculation and clustered estimates, because usually multiple activity zones are found within the same parks. All models presented here result from using Stata 11 (StataCorp, 2009).

Descriptive Statistics

Table 2 reports the "unwinsorized" descriptive statistics for all dependent variables used in the regression analysis. These variables have been winsorized at 30 for the analysis to follow, except for adolescents where 20 is used as the maximum value. Overall, 1,301 youth and 1,080 adults were observed. In general, the average number of youth and adults observed in activity zones was low, with the majority observed being males for both youth and adults. The majority of the youth observed were classified as young or middle child (M = 4.00 and 4.11, respectively).

Table 3 reports "winsorized" descriptive statistics and nonwinsorized maximum values for all independent variables. Park size in the study area ranges from a half acre (0.2 ha) to 45.86 (18.56 ha). Mean size of a zone was 0.36 acres (0.15 ha), whereas mean number of zones in a park was 8.4, with a range of 1 to 14. A park's neighborhood area ranged from 35.44 (14.34 ha) to 305.26 acres (123.53 ha). Total population of census blocks within park's neighborhood ranged from 32 to 1,796, with a mean of 813. The racial and ethnic composition of parks' neighborhood reflects higher concentrations of White, non-Hispanic (M = 36.09%, range = 0%-96.90%), and African American (M = 55.14%, range = 1.4%-100%) residents (not shown in the table) than Hispanic residents (M = 8.33%, range = 0%-32.43%). The maximum possible value for racial heterogeneity is 25%, whereas the highest observed value is 12.98 with a mean of 5.93, indicating most neighborhoods

Table 2. Descriptive Statistics for Dependent Variables Across Park Zones (N = 134)

	Minimum	Maximum	*M*	*SD*
Number of youth				
Girls	0	78	4.28	9.42
Boys	0	82	5.35	10.49
Age 0-5	0	71	4.00	9.79
Age 6-12	0	85	4.11	9.46
Age 13-18	0	22	1.52	3.41
Number of adults				
Women	0	38	3.84	7.27
Men	0	40	4.16	6.40

studied here are rather racially homogeneous within a city that is quite heterogeneous. The average variation in the poverty index and in the crime index (both based on standard score metrics) is 0.84 and 0.91, respectively, indicating substantial variation in these dimensions across the sample of neighborhoods studied here. The mean sidewalk length is 11,354 feet (3,461 m) ranging from 10 feet (3 m) to 24,173 feet (7,368 m). The number of street intersections with more than two branches (i.e., three-way and above) varied between 7 and 35, with a mean of 24. Five of the 20 park neighborhoods do not have culs-de-sac, whereas the range across the neighborhoods is from 0 to 10.

Results

Because independent variables were correlated, analysis was conducted in four stages to show the changes in relationships among variables associated with introducing predictor variables on the coefficients for those variables in the earlier models. In four stages, four separate HNBR models were estimated for each of the seven outcome measures: number of youth by age (three variables), number of youth by gender (two variables), and number of adults by gender (two variables). The first stage considered only park and neighborhood size variables as factors associated with the number of youth and adults in the park zone. The second stage included both area size variables and type of activity setting variables. The third stage introduced neighborhood social attributes. The last, fourth, stage added neighborhood urban form measures. As the results did not vary that much across the four stages—thus indicating that the correlations among the independent variables do not

Table 3. Descriptive Statistics for Independent Variables (*N* = 134)

Independent variable	Minimum	Maximum	*M*	*SD*
Park and neighborhood size				
Park zone area (acres)	0.01	1.90	0.36	0.45
All park zones area (acres)[a]	0.28	4.00 (7.86)	2.62	1.09
Park area (acres)[a]	0.50	18.00 (45.86)	10.09	4.85
Number of park zones in park	1	14	8.40	2.99
Park neighborhood area (acres)[a]	35.44	170.00 (305.26)	125.36	37.49
Activity setting type[b]				
Soccer or baseball field (12)	0	1	0.09	0.29
Basketball court (12)	0	1	0.09	0.29
Handball or tennis court (7)	0	1	0.05	0.22
Playground area (26)	0	1	0.21	0.41
Pool or water feature (6)	0	1	0.05	0.21
Shelter (5)	0	1	0.05	0.21
Picnic area (26)	0	1	0.19	0.40
Trail or walking path (19)	0	1	0.14	0.35
Open space (26)	0	1	0.16	0.37
Exercise station/area (2)	0	1	0.02	0.12
Neighborhood social attribute				
Population of park neighborhood[a]	32.00	1,274.00 (1,796.00)	812.69	389.74
Racial heterogeneity	0.00	12.98	5.93	4.06
% Hispanic	0.00	32.43	8.33	8.50
Poverty index	−1.32	1.00	0.00	0.84
Crime index	−1.07	1.78	0.00	0.91
Neighborhood urban form attribute				
Sidewalk length in feet divided by 1,000	0.01	24.17	11.35	7.26
Number of street intersections three branches and more[a]	7.00	35.00 (54.00)	24.31	7.80
Number of culs-de-sac	0.00	10.00	2.82	2.65

[a]Nonwinsorized maximum values are shown in parentheses.
[b]Number of activity setting types in the study (shown in parentheses) sum to 141 as seven park zones have two activity components.

greatly affect the results—only the final seven models are discussed (Table 4).

The number of activity zones and the size of all zones within a park were not significant and were dropped across the models. In initial models, we also included a variable percentage of Hispanic but found that it was collinear

Table 4. Heterogeneous Negative Binominal Regression Models for Seven Subpopulations, Standardized IRRECs (N = 134)

	Number of youth										Number of adults			
	Girls		Boys		Age 0-5		Age 6-12		Age 13-18		Women		Men	
Independent variable	IRREC	95% CI	IRREC	95% CI	IRREC	95% CI	IRREC	95% CI	IRREC	95% CI	IRREC	95% CI	IRREC	95% CI
Size														
Park zone size	1.18	[0.81, 1.71]	1.52*	[0.98, 2.38]	1.35	[0.91, 1.99]	1.27	[0.86, 1.86]	1.75	[0.88, 3.48]	1.16	[0.82, 1.66]	1.42*	[0.95, 2.12]
Park size	1.21	[0.85, 1.73]	0.97	[0.68, 1.39]	1.12	[0.67, 1.87]	1.31*	[0.99, 1.75]	1.52***	[1.17, 1.97]	1.26	[0.95, 1.67]	1.08	[0.89, 1.31]
Neighborhood size	1.10	[0.68, 1.77]	1.08	[0.73, 1.61]	1.50	[0.85, 2.66]	0.82	[0.56, 1.20]	0.53**	[0.30, 0.95]	1.15	[0.81, 1.63]	1.17	[0.90, 1.51]
Activity setting[a]														
Basketball court	1.03	[0.77, 1.38]	1.43***	[1.14, 1.79]	0.93	[0.61, 1.41]	1.18	[0.92, 1.52]	2.06***	[1.53, 2.77]	0.88	[0.62, 1.24]	1.28**	[1.00, 1.65]
Handball or tennis court	0.81*	[0.65, 1.01]	0.77*	[0.59, 1.01]	0.80*	[0.62, 1.03]	0.59***	[0.43, 0.81]	1.14	[0.74, 1.76]	0.85*	[0.71, 1.02]	1.12	[0.92, 1.36]
Playground	2.11***	[1.45, 3.09]	1.70***	[1.19, 2.44]	2.48***	[1.46, 4.23]	1.80***	[1.28, 2.52]	1.03	[0.47, 2.26]	1.63**	[1.07, 2.47]	1.25	[0.90, 1.72]
Pool or water feature	1.27	[0.87, 1.86]	1.10	[0.80, 1.51]	0.75	[0.39, 1.44]	1.18	[0.87, 1.61]	1.54***	[1.12, 2.11]	1.06	[0.78, 1.44]	1.08	[0.83, 1.40]
Shelter	1.09	[0.89, 1.34]	1.05	[0.89, 1.24]	1.02	[0.66, 1.58]	1.02	[0.83, 1.26]	1.46***	[1.26, 1.68]	1.28**	[1.00, 1.64]	1.18***	[1.07, 1.29]
Picnic area	1.16	[0.86, 1.56]	1.03	[0.75, 1.41]	1.24	[0.79, 1.95]	0.84	[0.65, 1.08]	1.54*	[0.99, 2.39]	1.30*	[0.97, 1.73]	1.32**	[1.05, 1.65]
Trail or walking path	1.16	[0.77, 1.74]	1.08	[0.77, 1.53]	1.37	[0.74, 2.52]	0.99	[0.68, 1.44]	1.04	[0.71, 1.53]	1.15	[0.70, 1.87]	1.12	[0.85, 1.49]
Neighborhood attribute														
Racial heterogeneity	0.87	[0.57, 1.33]	0.80	[0.56, 1.16]	0.72	[0.36, 1.44]	1.05	[0.73, 1.51]	0.97	[0.60, 1.57]	0.66**	[0.44, 1.00]	0.79**	[0.63, 0.98]
Crime index	0.42***	[0.27, 0.65]	0.49***	[0.34, 0.70]	0.32***	[0.18, 0.57]	0.44***	[0.31, 0.64]	0.76	[0.54, 1.06]	0.48***	[0.31, 0.72]	0.66***	[0.55, 0.78]
Poverty index[b]	0.48***	[0.39, 0.60]	0.62**	[0.41, 0.94]	0.35***	[0.21, 0.60]	0.60**	[0.38, 0.95]	0.95	[0.67, 1.35]	0.53***	[0.41, 0.69]	0.70***	[0.57, 0.86]
Sidewalk length in feet	1.51	[0.84, 2.71]	1.33	[0.76, 2.35]	1.73	[0.65, 4.62]	1.89***	[1.19, 3.00]	0.99	[0.60, 1.63]	1.75*	[0.97, 3.13]	1.30	[0.90, 1.88]
Number of street intersections	1.44	[0.91, 2.27]	1.59**	[1.05, 2.40]	1.78*	[0.97, 3.29]	1.24	[0.84, 1.83]	1.25	[0.83, 1.87]	1.39*	[0.94, 2.07]	1.06	[0.73, 1.53]
Number of culs-de-sac	1.05	[0.68, 1.63]	1.03	[0.66, 1.61]	1.09	[0.47, 2.55]	0.79	[0.54, 1.14]	1.07	[0.67, 1.70]	1.39	[0.87, 2.23]	0.96	[0.73, 1.28]

Note: IRRECs = incident rate ratio effect coefficients; CI = confidence interval. For each regression equation in the table, the exposure variable consists of the population count of the age- or gender-relevant group in the surrounding neighborhood. For each model, the overdispersion parameter is modeled using the total population count of the neighborhood.

[a] Soccer/baseball fields, exercise areas, and open spaces are referent categories for activity setting type.

[b] Poverty variable is omitted from the regression equation initially due to collinearity with crime. Then poverty replaces crime as an independent variable in each regression equation, and its effects are listed here across the models. The effects of other variables remain similar (not shown).

*p < .10. **p < .05. ***p < .01.

with other variables in the models, and we opted to drop it from the models. Similarly, collinearity between poverty and crime was observed. Because of our interest in assessing the role of these two variables, models were estimated with one variable in the regression equation, then the other. Results indicate that poverty and crime are largely redundant in their relationships with park use. One variable can be substituted for the other with few differences in terms of other variables' relationships with the dependent variables.

The results of the HNBR models are summarized in Table 4. As the dependent variable is modeled to produce the expected log-number of people observed in the activity zone, the coefficients must be exponentiated to get the relative ratio of people observed in an activity zone, given a one-unit change in the independent variable. Those exponentiated values are the incident rate ratios (IRRs). In Table 4, we present a standardized version of the exponentiated values, obtained by multiplying the HNBR coefficients by the *SD* of each independent variable and exponentiating that value. Thus, the IRRs in the table represent effect coefficients—incident rate ratio effect coefficients (IRRECs; the ratio of change given a one *SD* increase in the independent variable). Values above 1 represent a proportionate increase in the dependent variable with a one *SD* increase in the independent variable. Values below 1 represent a proportionate decline in the dependent variable with a one *SD* increase in the independent variable. These values are calculated by multiplying the *SD* of each independent variable (both dummy and continuous) by the regression coefficients in the models. IRRs that are not standardized by the *SD* are included in the online appendix.

The results indicate that park size is predictive of park use for 6- to 12-year-old child group and adolescents. A one *SD* increase in the size of a park (4.85 acres, i.e., 1.96 ha) is associated with a 52% increase in the number of adolescents, IRREC = 1.52, $p = .002$, 95% confidence interval (CI) = [1.17, 1.97], and a 31% increase in the number of children categorized in the 6- to 12-year age group, IRREC = 1.31, $p = .062$, 95% CI = [0.99, 1.75]. For park size, none of the other subpopulations have an IRREC that is statistically significant at the .10 level or below.

Neighborhood size and zone size variables were each statistically significant only for select subpopulations, namely, neighborhood size is negatively related to the presence of adolescents, and zone size is positively associated with boys' and men's presence. A one *SD* increase in the size of the park neighborhood is associated with a 47% decrease in the number of adolescents present in the park zones, IRREC = 0.53, $p = .032$, 95% CI = [0.30, 0.95]. Whereas, a one *SD* increase in park zone size is associated with a 52%

increase in the number of boys, IRREC = 1.52, p = .063, 95% CI = [0.98, 2.38] and, with a 42% increase in the number of men, IRREC = 1.42, p = .084, 95% CI = [0.95, 2.12].

As for activity setting type, there were 10 possible uses that a park zone may have. At least 1 must be omitted from the regression equation and serve as the referent category. Often, an "average" category is chosen as a referent category. Here, as what is average varies across subpopulations, we have chosen to omit 3: soccer/baseball field, open area, and exercise area categories. These approximate an average use across subpopulations. This referent category provides the advantage of comparing the other setting types with these "average" settings, thus allowing for some to be higher or lower than the average.

Basketball courts were associated with a large proportionate use by boys and men and an even larger proportionate use by adolescents but not other subgroups. Fewer people were observed using handball or tennis courts, not surprisingly, than most other zone uses, in part because the sports require fewer participants. In the table, IRRECs below 1 are observed for the majority of subpopulations. Statistically significant coefficients were found for all groups but adolescents and men. Playgrounds appear to be attractive to most of the subpopulations, adolescents and men excepted. Moreover, it can be seen that the coefficients are rather large, as playground areas are the most popular activity setting type in the parks studied here. Pool or water features were attractive to adolescents, but none of the IRRECs for the other subpopulations reached statistical significance. Shelters and picnic areas were also popular with adolescents, as well as with women and men. As for trails or walking paths, they are no more or less likely than the referent category to have any from the subpopulations present, although almost all the IRRECs across the models are above 1.

The results for neighborhood social attributes are surprising in that they indicate that higher neighborhood racial heterogeneity is associated with fewer people observed in an activity zone for adolescents and adults (women and men) but not for younger subgroups. Thus, racial mix, often a barrier to the use of public space, seems largely confined to older subpopulations, although all but one of the coefficients reported are below 1. As noted above, poverty and crime indices are rather highly correlated with each other (r = .680), as well as with other variables in the model, so when entered in a regression equation together, one of them tends to make the other statistically insignificant, and to inflate the standard errors considerably. Thus, all the models were rerun omitting the other variable. Table 4 presents the coefficients for the models with crime in the regression equation. Higher levels of crime in the surrounding neighborhood are associated with a reduction in park presence for all subpopulations, except adolescents. Similar results were observed if poverty in the surrounding neighborhood is included and crime is omitted in the models. There were no important substantive differences in coefficients for the other variables in the models when we omitted crime and included poverty (not shown). In effect, the poverty index could be substituted for crime index with almost the same results. Overall, the results indicate that either crime or poverty is related to fewer people observed in a park zone, with the only exception being for adolescents where neither the crime nor poverty coefficient is statistically significant.

In general, the neighborhood urban form variables have positive associations with the number of youth and adults observed in park zones, although only the number of street intersections was statistically significant for most subpopulations (boys, young children, and women). Middle-child group and women were more likely to be found in a park zone if there were more sidewalk footage in the surrounding neighborhood. Similarly, boys, children below 6 years, and women were more likely to be present when there were more street intersections. The presence of culs-de-sac did not have any statistically significant relationships with park use for any of the subpopulations. Interestingly, for girls, adolescents, and men, neither sidewalks nor street intersections reached statistical significance, but at least one of those two measures was significant for the other subpopulations. Note also that none of the neighborhood social or urban form attributes were statistically significant for adolescent park use.

Discussion

This study examined how individual attributes, park characteristics, and neighborhood social and urban form characteristics are associated with youths' and adults' use of parks. In particular, relying on direct observation in 20 parks and GIS, the study examined the relationship between park and neighborhood size, type of activity setting, neighborhood racial and ethnic composition, neighborhood poverty and crime levels, and neighborhood urban form and park use for youth and adults.

In the present study, considerably more men, boys, and children categorized in the 6- to 12-year age group were observed in park zones. This finding is consistent with previously published research illustrating gender (Cohen et al., 2007; Jago, Anderson, Baranowski, & Watson, 2005; Reed et al., 2008) and age (S. Moore et al., 2010; Zick, Smith, Brown, Fan, & Kowaleski-Jones, 2007) differences in park use or physical activity. Similarly, the results revealed that certain activity settings within parks were utilized more than others. Previous study of park use involving adults (Reed et al., 2008) also showed that certain activity settings were used more (e.g., paved trails, softball and basketball fields, and swimming pools) compared with other settings (e.g., frisbee golf). The present study examines the variations in park use for youth and adults across gender and age groups simultaneously, and finds not only that there are age and gender differences in park use but also that age and gender are important moderators of the relationship between activity setting type and park use, as well as various neighborhood attributes and park use.

Park and Neighborhood Size and Park Use

It is not surprising, perhaps, that size of the park zone and park are related to park use, although here they are predictive of more use by boys and men, and youth older than 5 years, respectively. In general, this finding parallels previous research demonstrating that greater area devoted to parks in a neighborhood is positively associated with physical activity among children (Roemmich et al., 2006) and adults (Kaczynski, Potwarka, Smale, & Havitz, 2009; Li, Fisher, Brownson, & Bosworth, 2005; Sugiyama, Middleton, Owen, & Giles-Corti, 2010). The finding that proximity and accessibility to large neighborhood parks is related to increased use of such parks on the part of youth has policy and planning implications.

Activity Setting Type and Park Use

Examining the variation in park use across activity setting types also revealed noteworthy associations. For example, organized sport settings (i.e., basketball courts) attracted men, boys, and more so, adolescents, but not girls, women, nor youth younger than 13 years of age. These findings reflect a well-known gender-specific differentiation in physical activity in children (Jago et al., 2005). Similarly, sedentary activity settings (i.e., shelters and picnic areas), which support social functions, generally were attractive to the older subpopulations in the study: adolescents, men, and women. Among all activity settings, playground areas were the only activity setting that attracted both boys and girls equally, and they were also the settings that attracted the most diverse park user groups (i.e., women, girls, boys, and the youngest two groups). Some of the above findings are consistent with previous research that found that the presence of playgrounds within 800 m of participants' homes was positively associated with younger boys' (aged 8-9 years) weekend physical activity but not with adolescents' physical activity (Timperio et al., 2008). In general, our findings suggest that free play and unstructured activities appeal to younger children (Mota & Esculcas, 2002), who are more dependent on adults for their mobility (Churchman, 2003).

Overall, the above findings indicate that youth of different ages and gender vary widely in the use of type of activity settings. The results point to a difficulty in generalizing associations between park settings and park use from studies conducted within a specific age and/or gender group of youth to all youth users (Aarts, Wendel-Vos, van Oers, van de Goor, & Schuit, 2010). Such findings are important in supporting efforts for park design so they serve youth across both genders and all ages.

Neighborhood Social Attributes and Park Use

An objective measure of violent crime in neighborhoods surrounding a park was consistently associated with less park use both for children and adults, except for adolescents. Perhaps the "invincibility" hypothesis is relevant: Adolescents often discount risk, thinking "it can't happen" to them. Thus, in relatively high-crime areas, adolescent park use is unaffected, but every other subpopulation uses the parks less; perhaps because they see more risk to themselves than adolescents do. Although many studies have identified lack of neighborhood safety and parental concerns about safety as a potential barrier to children's free play (Valentine & McKendrck, 1997; Veitch, Bagley, Ball, & Salmon, 2006), use of local parks (Miles, 2008), and physical activity (Carver, Timperio, & Crawford, 2008; Weir, Etelson, & Brand, 2006), previous research on crime and park use or physical activity has reported mixed results. Whereas few studies have found negative associations (Gómez, Johnson, Selva, & Sallis, 2004; Koohsari et al., 2012; McGinn, Evenson, Herring, Huston, & Rodriguez, 2008), others have reported no association (Miles, 2008; Ries et al., 2009).

Overall, the study results support research on vulnerability in which those who are more vulnerable are subject to more fear (Roman & Chalfin, 2008; W. R. Smith & Torstensson, 1997) and likely to take protective action, such as avoidance behavior (i.e., avoiding walking in the neighborhood and hence staying out of the parks when there is more threat present; Carver, Timperio, Hesketh, & Crawford, 2010; Mowen, Payne, & Scott, 2005; W. R. Smith, Torstensson, & Johansson, 2001). These associations are, however, not necessarily independent of poverty and other possible underlying causes of crime not included in the model. In our models, poverty was too highly collinear with violent crime to independently assess each in the same model. So, we cannot say with as much certainty as for other variables in the model that it is the crime as opposed to aspects of poverty that account for less park use. Research has demonstrated that those living in lower income neighborhoods have lower levels of perceived safety (Gielen et al., 2004; Giles-Corti & Donovan, 2002) and higher levels of concern about child safety (Sallis & Kerr, 2006), whereas they are also more likely to perceive that their neighborhood has a lot of traffic and busy roads (Giles-Corti & Donovan, 2002). All these conditions will lead to perceiving less favorable walking conditions within the neighborhood, which ultimately will deter park use.

Similarly, research on disparities in urban environments has also indicated that poor areas have unattractive environments for walking (Neckerman et al., 2009), poor street quality (Zhu & Lee, 2008), and poorer park and open-space quality (Coen & Ross, 2006; Crawford et al., 2008), which could also discourage park use. These findings suggest that the lower quality of the walking environment in the neighborhood as well as the lower quality of parks may also account for reduced use of parks observed in high-crime and high-poverty neighborhoods. In general, the collinearity of crime and poverty may explain some of the mixed results found in research examining physical activity and crime levels (Sallis & Kerr, 2006; Williams, 2007). Questions about the interaction of crime and poverty and their influence on park use represent a promising area for future research, assuming they are sufficiently independent to assess their unique explanation of park use.

The present study found that the associations between neighborhood racial heterogeneity and park use were not significant for the two younger youth subpopulation; however, they were consistently negative across models for adolescents and adults. A long line of ecological research on neighborhoods (Park, Burgess, & McKenzie, 1984; Shaw & McKay, 1971) as well as more recent scholars of the "social disorganization" perspective (Bursik & Grasmick, 1993) have claimed that "perceived value differences" trigger neighborhood withdrawal behaviors, reinforcing patterns of disengagement in the community. Although studies have addressed the differences in park use and physical activity by racial and ethnic groups (Floyd, Spengler, Maddock, Gobster, & Suau, 2008b; Paxton, Sharpe, Granner, & Hutto, 2005), to our knowledge, only a few studies have examined explicitly neighborhood racial heterogeneity in relation to park use (Ravenscroft & Markwell, 2000).

Neighborhood Urban Form and Park Use

Only two of the three neighborhood urban form variables (i.e., sidewalks and street intersections) were generally facilitative of park use. Moreover, only men, adolescents, and, somewhat surprisingly, girls were unaffected by the urban form variables. Because previous research has demonstrated that boys typically play further from home than girls—suggesting that girls' territorial range is narrower than boys' (R. Moore & Young, 1978; Sobel, 2002)—the study's findings may indicate that adolescents and men, who have substantial territorial range, use the parks regardless of urban form variables, whereas girls, who have narrower territorial range, tend not to use the parks regardless of urban form. Overall, the limited explanatory power of neighborhood urban form variables may be due to the fact that many park users may not walk to the park. It should also be noted that the present study does not examine the role of more microlevel design attributes (such as pedestrian amenities or aesthetics of the neighborhoods) in park use, which are believed to support walking and other physical activities (Brown, Werner, Amburgey, & Szalay, 2007; Day, Boarnet, Alfonzo, & Forsyth, 2006).

The availability of sidewalks in the park's neighborhood was supportive of park use for middle-child group (aged 6-12 years) and women. Although several studies have detected positive and significant correlations between access to sidewalks and walking or physical activity (Boarnet, Forsyth, Day, & Oakes, 2011; Lee & Moudon, 2006; Reed, Wilson, Ainsworth, Bowles, & Mixon, 2006), a number of studies concluded that sidewalks do not matter (Gomes et al., 2011; Mota, Almeida, Santos, & Ribeiro, 2005). As research suggests that sidewalks in urban areas provide protection for pedestrian safety (Retting, Ferguson, & McCartt, 2003), it is very likely that women have higher levels of concerns about traffic safety than men do, and hence, they may prefer to visit a nearby park if sidewalks are present. Likewise, the middle-child group (6-12 years old) may be more aware about traffic safety concerns than the younger children, who are dependent on adults for their mobility. Adolescents, who gain more independence in their mobility than middle-aged children (Churchman, 2003), may be less affected by sidewalk constraints.

This study also found that the number of street intersections within a park neighborhood was predictive of park use only for boys, women, and young children (aged 0-5 years), yet all the coefficients across subpopulations are in the positive direction. Although research with adults has consistently shown that higher street connectivity is related to increased utilitarian walking and physical activity (Frank et al., 2005; Marshall & Garrick, 2010; Troped, Wilson, Matthews, Cromley, & Melly, 2010), evidence for recreational walking is less clear (Saelens & Handy, 2008). For example, a recent study found a negative association between street connectivity as measured by space syntax and walking to or within public open space (Koohsari et al., 2012). Similarly, results for youth are also mixed. Several studies using objective measures of street connectivity determined positive associations with walking or physical activity (Bungum, Lounsbery, Moonie, & Gast, 2009; Frank et al., 2007), whereas others reported negative associations (Norman et al., 2006; Timperio et al., 2006), or no associations (Roemmich et al., 2006). The present study indicates that street connectivity is particularly important for boys, women, and younger children, but not for other groups, pointing to gender and age as variables that moderate the relationships between street connectivity and park use. It is important to emphasize that these findings stand up despite the numerous other variables in the model. So, regardless of park size, type of activity settings, and all of the neighborhood crime and social attributes studied here, the connectivity of the street network pattern in the surrounding areas makes a difference for these groups. These findings are somehow contradictory to previous research, which suggest that the role of walkability, that is, street connectivity, is perhaps less important for younger children and more important for older children (Aarts et al., 2010; Churchman, 2003), which is explained by the fact, as mentioned above, that older children gain more independence in their mobility (Churchman, 2003), whereas younger children are often not allowed to cross a street alone (Roemmich et al., 2006). However, similar to sidewalks, in addition to increasing access to parks, street connectivity may calm traffic (Loon & Frank, 2011), and thus increase traffic safety. Hence, streets leading to parks can be made safe, thus making parks attractive for women and younger children who may now walk to nearby parks. Similarly, street connectivity may be more important for boys than girls, because previous research has suggested that girls' use of urban space is more restricted than boys (O'Brien, Jones, Sloan, & Rustin, 2000).

Contrary to some studies, the findings indicated that culs-de-sac are not associated with park use. Limited research suggests that culs-de-sac, often associated with low density, single family, and poorly connected streets would be associated with less walking/cycling (Saelens, Sallis, & Frank, 2003; Wells & Yang, 2008). However, one study found that adults living on streets that were least accessible within the immediate surroundings (e.g., culs-de-sac) reported higher number of leisure walking trips than those living in locally more accessible streets (Baran et al., 2008). Similarly, research has found that culs-de-sac, through perceived safety, are among key neighborhood characteristics that influence younger children's outdoor play (Handy, Cao, & Mokhtarian, 2008). Consequently residential culs-de-sac, through the "spillover" effect from use of public space associated with them, may encourage walking within the neighborhood and hence increased park use. Our results do not support these previous findings. Hence, the role of the culs-de-sac, as an urban form variable, in park use is a promising area for future research.

It is important to observe that none of the three neighborhood urban form variables played a role in park use by men; however, two of them (sidewalks and street intersections) were important for women. Comparable results have been reported in a nationwide study, which found that neighborhood variables were more highly correlated with physical activity among women than among men (Brownson, Baker, Housemann, Brennan, & Bacak, 2001). One explanation for this may relate to the fact that men and women have different perceptions of their neighborhoods (Bengoechea, Spence, & McGannon, 2005; C. Foster, Hillsdon, & Thorogood, 2004), and hence improved neighborhood accessibility may become more important for women than men in their decision to use a neighborhood park. As gender appears to be a potential moderator of the link between the urban form and park use, the results suggest the possibility of differential policies to increase park use based on factors associated with gender.

Overall, the above findings on association between park use and urban form characteristics can be translated into policies and design guidelines for neighborhood planning and design to support increased park use, and ultimately physical activity.

Study Limitations and Strengths

There are two limitations to the present study. First, the data are cross-sectional and do not allow for more strict causal inferences. A second limitation is that the data were collected during late-spring and early-summer months, which may not be representative of total park use. This limits the generalizability of the findings beyond the study seasons.

Nevertheless, the strengths of the study include the modeling park use by different gender and age groups for youth as well as different gender groups for adults. The use of the SOPARC to provide objective measures of youths' and adults' actual park use is also the strength of the study. To date, few studies have reported on actual use of parks based on direct observation of children (Loukaitou-Sideris & Sideris, 2010) and adults (Cohen et al., 2012; Reed et al., 2008). Finally, the statistical modeling for this study not only took into account both park-level variables and neighborhood-level social and urban form variables but also examined how these variables were related to park use across demographic groups.

Conclusion

Overall, this study addresses the knowledge gap in understanding the associations between individual, social, and urban form attributes and park use among different age and gender groups. Study results support the socio-ecological perspective (McLeroy, Bibeau, Steckler, & Glanz, 1988; Sallis et al., 2006) indicating that social (i.e., racial heterogeneity, poverty, and crime) and urban form attributes (i.e., pedestrian infrastructure and street network pattern) are likely to act together to affect park use. As expected, the study underscores the importance of examining park use by different user groups, including children, adolescents, and adults. Age and gender matter. They often moderate the relationships between types of activities and the presence of people in urban parks. Moreover, they moderate the relationship between social attributes and urban form characteristics of the surrounding neighborhood and park use. Important variations were observed for all independent variables, including zone, park and neighborhood size, activity setting type, and all neighborhood social attributes and urban form variables. Specifically, the study found that park and activity setting size; activity settings such as playgrounds, basketball courts, pool and water features, shelter, and picnic areas; and availability of sidewalks and intersections in the park's neighborhood were positively associated with park use, whereas crime, poverty, and racial heterogeneity of the surrounding neighborhood were negatively associated with park use. Additional studies are needed on the social and urban form characteristics that encourage and hinder park use to inform policy and design interventions that promote park-based physical activity and health for youth and adults.

Authors' Note

Views expressed in the manuscript do not represent opinions of the sponsor or the Durham Parks and Recreation Department.

Acknowledgment

The authors thank the City of Durham, NC, Parks and Recreation Department for its assistance with this study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by a grant from Active Living Research (59449), a research program of the Robert Wood Johnson Foundation.

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