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Built environment characteristics and perceived active park use among older adults: Results from a multilevel study in Bogotá

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ABSTRACT

Objective: Examine the associations between selected built environment (BE) attributes and perceived active park use among older adults in Bogota.
Methods: A cross-sectional multilevel study was conducted. Participants included 1966 older adults in 50 neighborhoods. Socio-demographic covariates and BE attributes were measured. Multilevel logistic regression models were used for the analyses.
Results: Residents from areas with higher park density and high land-use mix were more likely to report active park use while those from areas with high connectivity were less likely.
Conclusions: This study suggests that objective attributes of the residential BE are associated with perceived active park use. However, our study also points to the importance of surrounding environment, with the result of an inverse relationship between connectivity and physical activity, which highlights the potentially necessary interventions in the realm of traffic and pedestrian safety.

1. Introduction

With an ever-aging global population, researchers and policy makers are questioning if older adults are living healthier, and not just longer lives (Schwartz and Walter, 1997). Several studies suggest that older adults who are physically active are more likely to preserve functional capacity and independence, thereby reducing chronic illness and disability, and attaining greater levels of health-related quality of life (Nelson et al., 2007; Peel et al., 2007).

Promoting physical activity during leisure time among older adults has particular relevance because of the numerous benefits to mental health and perceived health status (Wendel-Vos et al., 2004). Physical activity during leisure time can also contribute to increased social interactions and social support, as well as a greater sense of community cohesion (Bedimo-Rung et al., 2005; Lindstrom et al., 2001). Despite these recognized benefits, a large proportion of the world population is inactive. In Colombia, 42.6% of the population does not meet recommended levels of physical activity for health, and only 5.9% are regularly active during their leisure time (InstitutoColombianodeBienestarFamiliar, 2005).

Recently, there has been an increased research interest in identifying the potential effects of the built environment on active living, primarily guided by socio-ecological models (Frank et al., 2003; Owen et al., 2004; Saelens et al., 2003; Sallis et al., 2006). Specifically, the importance of public parks in promoting active recreation and social interaction for the older adult population has been highlighted (Kaczynski et al., 2008; Saelens et al., 2003). Some studies have found that adults who live in areas with a large availability of spaces for recreation and park density are more likely to engage in physical activity (Baker et al., 2008; Bedimo-Rung et al., 2005; Diez Roux et al., 2007). A study conducted by Takano et al. (2002) found that urban areas with walkable green spaces had an influence on longevity, after controlling for individual risk factors. Takano et al. (2002) highlight that it is not only the accessibility of spaces that matters for the promotion of physical activity, but also the quality and maintenance of these spaces (Takano et al., 2002).

In addition to the evidence documenting the relationship between lower levels of physical activity in areas with less green space, it is also hypothesized that because people need to walk through surrounding areas in order to access parks, some natural and built environment attributes, such as street connectivity, the different types of land-use and the slope of the terrain, could be relevant determinants of parks use (Bedimo-Rung et al., 2005). However, most of the studies in this area have been conducted in

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developed countries (Diez Roux et al., 2007; Humpel et al., 2004; Huston et al., 2003; Owen et al., 2004). In a region like Latin America, one of the most urbanized areas in the world that is also experiencing rapid aging, the study of urban form and its relationship with health-promoting behaviors, such as park use, has a special relevance and warrants exploration (Palloni et al., 2006). In consequence, this study aims to explore this relationship in Bogota, a highly urbanized city of almost 8 million inhabitants and a population density of approximately 3912 inhabitants per square kilometer. Bogota has experienced important transformations in its urban environment, including an increase in green space (parks) from 2.5 to 4.12 m per inhabitant (Parra et al., 2007). However, this indicator is still well below the recommended international standard of 10 m^2 per inhabitant (Gebre-Egziabher, 2004).

The objective of this paper is to assess the relationship between perceived active park use and objective measures of the neighborhood built environment, such as park density, connectivity index, land-use mix index and the slope of the terrain in Bogota.

2. Methods

2.1. Study design

The present study used data from the Built Environment and Older Adults Project of Bogotá (BEOAP), a multilevel cross-sectional study conducted in 2007 in Bogotá (Gomez et al., 2007). The aim of the study was to examine the role of the built environment on walking patterns and health-related quality of life among Bogotá citizens 60 years and older. The study used a two-stage random sampling framework, described below.

A neighborhood was defined as a small geographic area of same socio-economic status (SES), similar urban environment characteristics and delimited by natural geographic boundaries. GIS and aerial-photography restitution were used to identify the neighborhoods. A total of 1734 neighborhoods were classified in low, middle-low and middle-high SES according to the classification used by the city administration (Alcaldia Mayor de Bogota, 2005). In the first sampling stage, 58 neighborhoods were selected using a systematic selection technique with oversampling of middle-high SES in order to increase the variability of urban forms. Eight neighborhoods were not included in the final sample due to small cell sample size. A mean of 39 (SD 31.3) older adult residents was surveyed in each neighborhood. Only participants 60 years and older with at least one year of residence in the address were interviewed. The final response rate was 67.8% (1966 older adults residing in 50 neighborhoods).

2.2. Outcome variable

Perceived active park use was based on a single item from the instrument designed by Fuzhong et al. (2005), using a Likert response scale of five categories. The questions were translated into Spanish and back translated to English to compare accuracy and consistency. The question was translated into Spanish and back translated to English to compare accuracy and consistency; and was also culturally adapted through cognitive interviews (Forsyth and Lessler, 1991; Jobe and Mingay, 1990). The question was: *How often do you visit the parks from the area where you reside to go for a walk, exercise or perform any other physical activity*? Response options were: never, rarely, sometimes, frequently and very frequently. For analytic purposes, responses were dichotomized as perceived active park use (frequently and very frequently) versus no active park use (never, rarely and sometimes). This cut-point was defined based on convergent validity tests, which compared these two categories with the selected IPAQ items of this study, showing that this cut-point made the best discrimination between regularly and not regularly active respondents (La Importancia de Los Ambientes Urbanos en Patrones de Actividad Fisica y Calidad de Vida en Adultos Mayores en la Ciudad de Bogota, 2009).

2.3. Built environment variables

Data from 2004 (connectivity, land-use mix and slope) and 2006 (park density) were provided by the Cadastral Department and the Sports and Recreation Institute of Bogotá, respectively Variables, such as park density, connectivity index, land-use mix and slope of the terrain, were selected based on prior evidence from built environment studies in Bogota (Cervero et al., 2009). The built environment variables were measured in a crow-fly buffer of 500 m around the centroid of each neighborhood. GIS indicators (built environment attributes and SES of the neighborhoods) were assigned to individuals based on their neighborhood of residence. ArcGIS software was used to process the geographic information (ESRI, 2006). Table 1 describes the operational definition of the built environment variables, their cut points, classification and their distribution in the sample.

2.4. Individual covariates

Individual covariates included gender, age, education level (elementary education or less and more than elementary education) and having a limitation to engage in physical activity. This last individual covariate was determined through a question from the SF8, an instrument used to measure quality of life in the

Table 1
Built environment measures obtained by GIS in the selected neighborhoods.

Variable	Definition/formula	Mean or %	Median	SD
Land-use mix index[a]	$1((\sum i(pi)(\ln pi))/\ln k)$ (Cervero and Kockelman, 1997) where p=proportion of total land uses, i=category of land use, ln=natural logarithm and k=number of land-use categories	0.64	0.64	0.09
Park density[b]	Park area/land area (500 m) × 100	6.61	6.14	5.49
Connectivity[c]	Number of streets (links) divided by the number intersections (nodes)	1.77	1.77	0.11
Slope[d]	Vertical distance in meters × 100/horizontal distance in meters	3.05	1	4.08

[a] This index ranges from 0 (when there is one single land use) to 1 (when there is maximum heterogeneous land use).
[b] Small parks, also known as "pocket parks" were not included as part of this indicator because they are less than 1000 m^2 and were not originally designed for the practice and promotion of physical activity.
[c] This index ranges from 1 to 2, with 1 indicating the lowest connectivity and 2 indicating the highest connectivity.
[d] This calculation was obtained by averaging the degrees of slope in a triangulated irregular network (TIN) previously created in the terrain levels. Based on the urban criteria for building pedestrian ramps two categories were created: less than 5% of slope and 5% or more of slope (for example, a 5% slope means that the elevation of the terrain raises 5 m for every 100 m).