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Short Report

Relationships between neighborhood walkability and adults' physical activity: How important is residential self-selection?

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ABSTRACT

The study's aims were to examine whether residential self-selection differed according to socio-demographic characteristics and objectively assessed neighborhood walkability; and, whether objectively assessed walkability was a significant correlate of physical activity (PA) beyond residential self-selection.

In total, 412 adults (aged 20–65 years) completed a socio-demographic questionnaire, the long IPAQ, a neighborhood selection questionnaire and wore an accelerometer for seven days.

Walkability characteristics were an important reason for selecting the current neighborhood and were more important for women, older and less-educated adults, but not for high-walkable neighborhood residents. Both in the total sample and in participants with high residential self-selection scores, walkability was positively related to active transportation and objectively measured moderate-to-vigorous PA.

Designing walkable neighborhoods may help to increase adults' PA, even in those for whom walkability is an important criterion when choosing their neighborhood. However, findings from studies with longitudinal and controlled designs are required to provide more strongly causal evidence.

1. Introduction

Several studies have found neighborhood walkability (higher residential density, land use mix and street connectivity) to be positively associated with adults' physical activity (PA) behaviors, primarily physically active transport (Saelens et al., 2003; Sallis et al., 2009; Van Dyck et al., 2010). However, because almost all studies examining the associations between neighborhood characteristics and health outcomes have used observational designs, inherent differences (background characteristics, personal preferences, etc.) between residents of different neighborhoods are likely to bias these associations (Oakes, 2004, 2006). Ideally, studies should use controlled trials when investigating neighborhood effects on health outcomes; in absence of relevant control conditions, numerous possibilities for confounding exist. However, because of practical and ethical reasons and since most neighborhood effects are generated by the internal dynamics of neighborhoods and cannot be examined experimentally, observational designs are usually employed (Merlo and Chaix, 2006; Black, 1996), and studies aim to measure and control for potential confounding factors.

In environmental health research, 'residential self-selection' has been put forward as a possibly important confounder of the positive associations between walkability and PA, but the significance of self-selection in this context remains unclear. Residential self-selection implies that individuals are likely to select their neighborhood according to their lifestyle and personal preferences, so those already active or who want to be active may choose to live in a high-walkable neighborhood (Ewing and Cervero, 2010; Owen et al., 2007). Consequently, higher PA participation among high-walkable neighborhood residents might not be caused directly by walkability characteristics in these neighborhoods; those who attach importance to a physically active lifestyle might self-select a high-walkable neighborhood.

Some studies have controlled for residential self-selection in their analyses, resulting in mixed findings ranging from attenuation of the associations between walkability and PA to minimal effects on the associations (Cao et al., 2009; Owen et al., 2007; Pinjari et al., 2007; Sallis et al., 2009). One study found residential self-selection to strengthen the relationship between neighborhood walkability and PA (Chatman, 2009). Based on this pattern

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of findings, no definite conclusions about the possible importance of residential self-selection can be drawn yet.

To develop effective public-health policies and the relevant practical strategies, it is important to know whether the associations between neighborhood walkability and PA remain significant after controlling for residential self-selection. If this is the case, designing walkable neighborhoods is more likely to be effective for increasing PA. If not, targeting attitudes and preferences through public communication campaigns may be a preferable public-health strategy.

First, we examined whether residential self-selection (walkability characteristics as an important reason to move to the current neighborhood) differed according to gender, age, education and objectively assessed neighborhood walkability. Second, to assess the role of walkability independent of neighborhood selection, we examined associations of walkability with PA, both in the total study sample and in those for whom walkability characteristics were important for neighborhood selection.

2. Methods

2.1. Participants and procedures

Cross-sectional data were used from the Belgian Environmental Physical Activity Study (BEPAS), conducted in Ghent between May 2007 and September 2008. A detailed description of the procedures has been given elsewhere (Van Dyck et al., 2010). Briefly, 1200 participants (aged 20–65 years) were recruited from 24 neighborhoods. These neighborhoods were stratified on objectively assessed (using Geographic Information System [GIS] databases) walkability, resulting in 12 high-walkable and 12 low-walkable neighborhoods. In each neighborhood, 250 randomly selected adults received an information letter and were visited at home, two to six days after posting the letter. Recruitment continued until 50 participants per neighborhood were obtained. Overall response rate was 58%. Participants completed a written informed consent form, a socio-demographic questionnaire, the long International Physical Activity Questionnaire (IPAQ-interview version), and wore an accelerometer for seven consecutive days. A subsample ($n=420$) completed a neighborhood selection questionnaire (Frank et al., 2007). Complete data were collected for 412 adults; only these 412 were included in the present analyses. BEPAS was approved by the ethics committee of the Ghent University Hospital.

2.2. Measures

Self-reported PA data were collected using the validated long Dutch-language IPAQ (last seven days interview version). The interview version was chosen because adults tend to over-report their PA levels with the self-administration version (Rzewnicki et al., 2003). The IPAQ has good reliability (intra-class range from 0.46 to 0.96) and fair-to-moderate validity (assessed against the CSA accelerometer; Craig et al., 2003). Frequency (number of days in the last seven days) and duration (hours and minutes per day) of physical activity in different domains (work, transportation, recreation and household) are assessed. For the present study, minutes/week of walking and cycling for transport, recreational walking and moderate-to-vigorous leisure-time PA were calculated. Physical activity levels were also objectively assessed with accelerometers (model 7164, Computer Science Application). Accelerometers are valid and reliable for assessing PA in adults (Melanson and Freedson, 1995). The accelerometers were set to measure in epochs of one minute. Moderate-intensity PA corresponds to 1952–5724 counts per minute, and high-intensity PA to >5724 counts per minute (Freedson et al., 1998). The accelerometer data were reduced using MAHUffe Analyser 1.9.0.3 (www.mrc.epid.cam.ac.uk). Data from participants with at least ten hours of wearing time for at least four days (including one weekend day) were included in the analyses. Non-wearing time was defined as ≥ 60 min of consecutive zero counts.

A neighborhood selection questionnaire was used to assess the perceived importance of different reasons for moving to the current neighborhood (Frank et al., 2007). The questioned reasons included house price (one item), importance of living in the city center (one item), importance of living in a quiet neighborhood (one item), social/emotional reasons (e.g. living close to family and friends; four items; Chronbach's alpha [α]=0.67) and walkability-related reasons (e.g. importance of closeness to shops, closeness to work/school, traffic safety, amount and quality of sidewalks/footpaths; 13 items; $\alpha=0.77$). All self-selection items were scored on a five-point Likert scale from 'not important at all' to 'very important'.

A neighborhood-level walkability index, based on objectively assessed land use variables, was calculated using GIS. Geographical data were obtained through the Service for Environmental Planning in Ghent. Three environmental attributes found to be related to PA were included in the walkability index: residential density, intersection density (or connectivity) and land use mix (Leslie et al., 2007; Frank et al., 2010). The construction of the index was based on the procedure of Frank et al. (2010) and is described in detail elsewhere (Van Dyck et al., 2010). The walkability index was calculated for all neighborhoods in Ghent and neighborhoods were ranked, based on this index. In order to obtain maximal variation in walkability characteristics across neighborhoods, the top and bottom quartiles represented the high-walkable and low-walkable neighborhoods ($n=24$), from which participants were recruited.

2.3. Data analyses

To investigate whether neighborhood selection factors differed according to gender, age, education and neighborhood walkability (first study aim), independent sample t-tests were executed using SPSS 16.0. To examine the associations between neighborhood walkability and PA in the total sample and in the subsample for whom walkability characteristics were important for neighborhood selection (second study aim), multivariate regression analyses were conducted using MLwiN 2.10. Participants who scored higher than the median (i.e. 3.37, maximum score of 5) for the residential self-selection variable were considered as the subsample of participants for whom walkability characteristics were an important reason for neighborhood selection. Because the PA variables were positively skewed, logarithmic transformations were applied to improve normality (Keene, 1995). Multilevel modeling (two-level: participant-neighborhood) was used to take clustering of participants in neighborhoods into account. These models were applied to examine the associations between the dependent variables (objectively assessed MVPA and self-reported PA) and neighborhood walkability [independent variable; low/high]. All regression analyses controlled for gender, age and educational attainment. Statistical significance was set at 0.05.

3. Results

3.1. Importance of different reasons for neighborhood selection, according to gender, age, education and objectively assessed neighborhood walkability

The overall descriptive statistics identified house price, walkability characteristics and neighborhood quietness as the most important reasons for moving to the current neighborhood. As shown in Table 1,