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Perceived neighborhood environmental attributes associated with adults' leisure-time physical activity: Findings from Belgium, Australia and the USA

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ABSTRACT

The study purpose was to examine the strength, direction and shape of the associations of environmental perceptions with recreational walking and leisure-time moderate-to-vigorous physical activity, using pooled data from four study sites (Baltimore [USA], Seattle [USA], Adelaide [Australia] and Ghent [Belgium]). Moreover, site- and gender-specificity of the associations were examined. In total, 6014 adults (20–65 years, 55.7% women) completed the Neighborhood Environmental Walkability Scale and the International Physical Activity Questionnaire. Both a 'recreational walking-friendliness' index and a 'leisure-time activity friendliness' index had a positive linear association with recreational walking and leisure-time moderate-to-vigorous physical activity, respectively. The associations were significant in all study sites except Ghent. Present findings were clearly site-specific, imposing possible challenges for built environment recommendations. In Belgium, interventions to promote leisure-time activity may need to target promotion of existing opportunities rather than built environment improvements.

1. Introduction

A large proportion of the adult populations of developed countries does not engage in sufficient physical activity to gain health benefits (Hallal et al., 2012). Since physical inactivity is associated with elevated risk of major chronic diseases, interventions to promote healthy and active lifestyles need to be improved and implemented (Garber et al., 2011). In that context, ecological models of health behaviors emphasize the importance of taking into account multiple levels of influence when developing interventions. In addition to individual and social attributes, built environment and policy factors are expected to affect physical activity in different domains (e.g., transport or leisure) and different settings (e.g., neighborhoods, parks) (Sallis et al., 2008).

A growing body of evidence shows that objective and perceived built environment factors are positively associated with physical activity in adults (Brownson et al., 2009; Butler et al., 2011; Heath et al., 2006; Wendel-Vos et al., 2007; Wong et al., 2011). However, built environment correlates are behavior-specific and the factors associated with leisure-time physical activity are less understood than those associated with active transportation. Proximity to recreation facilities and aesthetic-related features have been consistently related to leisure-time physical activity (Cerin et al., 2008a; Kondo et al., 2009; Owen et al., 2004; Van Dyck et al., 2011), but the role of other environmental variables, such as residential density, the availability of walking and cycling infrastructures, crime, and traffic safety is less understood (Inoue et al., 2010; Kondo et al., 2009; Saelens and Handy, 2008; Van Dyck et al., 2011).

Most previous studies of associations of built-environment attributes with physical activity have been conducted in one or perhaps two regions and nearly all are from single countries. Furthermore, with the exception of a few recent African and Latin American studies (Gomes et al., 2011; Oyeyemi et al., 2011; Parra et al., 2011), most previous studies have been conducted in the USA, Australia and Europe. Limited within-region, within-country and between-country variability in built environment attributes and physical activity levels can potentially contribute to an

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underestimation of strength of associations. Findings from multiple regions and countries are needed to provide a wider range of variability, which will better inform national and regional policies shaping communities and to develop international guidelines for improving built environments to stimulate 'active living'.

A recent study combined data from 11 environmentally-diverse countries to examine perceived environmental correlates of overall physical activity, using common methods, and found several environmental variables to be linearly and positively related to meeting activity guidelines (Sallis et al., 2009a). Associations were stronger than those reported in single-country studies, probably because data from multiple countries provides a wider range of environmental variability. To gain further insight in the strength, shape and directions of the associations between built environment characteristics and health behaviors, we recently examined the relationship between environmental perceptions and sitting time in four study sites in three diverse countries (USA, Australia and Belgium), using common protocols and pooled analyses (Van Dyck et al., 2012). Site- and gender-specific associations between perceived environmental attributes and overall sitting time were found and the relationship between perceived land-use mix and motorized transport was curvilinear.

Based on these promising findings and the added value to be gained by conducting built environment studies in multiple regions/countries using the same methods, we conducted the present analyses on pooled data from the same three countries. We examined the strength, direction and shape of the associations of environmental perceptions with leisure-time activity (recreational walking and leisure-time moderate-to-vigorous physical activity). In addition, we examined whether these associations differed by study site and gender. We chose to focus specifically on leisure-time physical activity, because the built-environment correlates of this type of physical activity remain unclear (Wendel-Vos et al., 2007).

2. Methods

2.1. Procedures and participants

Data from three countries (four study sites) were pooled for present analyses: USA (Neighborhood Quality of Life Study [NQLS] in Seattle-King County and Baltimore-Washington DC regions), Australia (Physical Activity in Localities and Community Environments [PLACE] study in Adelaide), and Belgium (Belgian Environmental Physical Activity Study [BEPAS] in Ghent). Detailed information on the protocols, procedures and other results of these three studies can be found elsewhere (Owen et al., 2007; Sallis et al., 2009b; Van Dyck et al., 2010).

Briefly, in each country, participants (20–65 year old adults) were recruited in high- and low-walkable and high- and low-income neighborhoods (32 neighborhoods in NQLS and PLACE; 24 neighborhoods in BEPAS). The neighborhoods were chosen to maximize within-country variance in walkability and income. In all countries, neighborhoods consisted of clusters of administrative units (block groups in USA; Census Collectors' Districts in Australia; statistical sectors in Belgium). These administrative units were the smallest geographical units for which information on income and other demographic factors was available.

Neighborhood-level walkability was determined objectively, using a Geographic Information Systems (GIS) based walkability index, including three (BEPAS) or four (NQLS and PLACE) environmental attributes previously found to be related to physical activity (Frank et al., 2010): net residential density, land use mix, intersection density, and retail floor area ratio. Retail floor area ratio was not available for BEPAS. A detailed description of the calculation of the walkability index is given elsewhere (Frank et al., 2010). To determine neighborhood-level income, census-based median annual household income data were used (Australian Bureau of Statistics, 2001; National Institute of Statistics – Belgium, 2007; United States Census Data, 2000). The neighborhood selection procedure resulted in an equal number of neighborhoods ($n=8$ for NQLS and PLACE; $n=6$ for BEPAS) among four types, stratified as follows: high-walkable/high-income, high-walkable/low-income, low-walkable/high-income, and low-walkable/low-income.

In the USA, NQLS data collection took place between May 2002 and June 2005. In total, 8504 adults living in the 32 neighborhoods were randomly selected from lists supplied by a marketing company, contacted by phone and mailed a survey if they agreed to participate. In total, 2199 participants completed the mailed survey (response rate=25.9%; 1287 participants in Seattle and 912 participants in Baltimore). Response rates did not differ significantly by study quadrant (range from 23% to 29%). In Australia, PLACE data collection was conducted between July 2003 and June 2004. A simple random sampling procedure was used to select possible participants from residential locations identified within the 32 selected neighborhoods. Invitation letters and surveys were mailed to each residence. In total, residents from 2650 of the 23,128 identified addresses returned a completed survey (response rate=11.5%). Response rates did not differ significantly by study quadrant (range from 10.5% to 12.8%). In Belgium, BEPAS data collection took place between May 2007 and September 2008. In each neighborhood, 250 randomly selected adults received an invitation letter and were visited at home two-to-six days after posting the letter. Recruitment continued until 50 participants per neighborhood were recruited (response rate=58.0%); 1165 adults participated in BEPAS. Response rates did not differ significantly by study quadrant (range from 57.5% to 58.7%). In all studies, data were collected throughout the year to take seasonal variation into account.

All participants completed a written informed consent form. NQLS was approved by Institutional Review Boards at participating academic institutions, PLACE was approved by the Behavioral and Social Sciences Ethics Committee of the University of Queensland, and BEPAS was approved by the Ethics Committee of the Ghent University Hospital.

2.2. Measures

2.2.1. Environmental perceptions

To measure perceived neighborhood built- and social-environmental factors, the Dutch and English versions of the previously validated Neighborhood Environmental Walkability Scale (NEWS) were used (Cerin et al., 2008a; De Bourdeaudhuij et al., 2003; Saelens et al., 2003). Before data analysis, comparability of the NEWS items across the three countries was assessed by two independent raters and only comparable NEWS items were analyzed. Scales and items were selected according to their conceptual relevance to recreational walking and leisure-time moderate-to-vigorous physical activity. Neighborhood environment scales included in the analyses were residential density (5 items), a land use mix-diversity scale potentially relevant to recreational walking (6 items on proximity to parks, recreational/fitness facilities and shops; only included in the analyses with recreational walking as outcome measure), land use mix-diversity items potentially relevant to leisure-time moderate-to-vigorous physical activity (2 items on parks and recreational/fitness facilities; named proximity to recreation facilities and only included in the analyses with leisure-time moderate-to-vigorous physical