Health & Place 17 (2011) 1274–1283

Contents lists available at ScienceDirect

Health & Place

journal homepage: www.elsevier.com/locate/healthplace

Income disparities in perceived neighborhood built and social environment attributes

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A R T I C L E I N F O

Article history:
Received 3 May 2010
Received in revised form
13 February 2011
Accepted 24 February 2011
Available online 9 March 2011

Keywords:
Built environment
Physical activity
Obesity
Health disparities
Environmental justice

A B S T R A C T

The present study explored whether perceived neighborhood environmental attributes associated with physical activity differ by neighborhood income. Adults aged 20–65 years ($n=2199$; 48% female; mean age=45 years; 26% ethnic minority) were recruited from 32 neighborhoods from the Seattle, WA and Baltimore, MD regions that varied in objectively measured walkability and neighborhood income. Perceived built and social environment variables were assessed with the Neighborhood Environment Walkability Scale. There were neighborhood income disparities on 10 of 15 variables. Residents from high-income neighborhoods reported more favorable esthetics, pedestrian/biking facilities, safety from traffic, safety from crime, and access to recreation facilities than residents of low-income areas (all p's <0.001). Low-income neighborhoods may lack amenities and safety attributes that can facilitate high levels of physical activity for both transportation and recreation purposes.

1. Introduction

Multiple reviews have documented consistent associations of multiple attributes of the built environment, especially neighborhood walkability (defined by residential density, proximity of shops and services, and street connectivity) and proximity to parks and recreation facilities, with physical activity for transportation and recreation purposes (Bauman and Bull, 2007; Gebel et al., 2007; Frank et al., 2005; Owen et al., 2004; Saelens and Handy 2008; Transportation Research Board–Institute of Medicine, 2005). These neighborhood characteristics also have been related to obesity (Black and Mackinto, 2007; Papas et al., 2007). However, inconsistent associations of walkability with physical activity and obesity across gender, racial, and income groups raise questions about the generalizability of findings. For example, an Atlanta region study found associations between neighborhood walkability and physical activity (Frank et al., 2005) and overweight/obesity (Frank et al., 2004) for non-Hispanic whites but not for African Americans. Further analyses suggested that walkability ranged from being the most powerful variable predicting walking among white men, to among the least significant factors in explaining walking for lower income and non-white residents (Frank et al., 2008). A study in New York City found similar inconsistencies among low-income, low-education, and non-white subgroups (Lovasi et al., 2009b). In contrast, a study in two regions of the U.S. reported associations of walkability with physical activity and overweight/obesity did not differ by income group (Sallis et al., 2009). In yet another study, access to parks and recreation facilities was positively related to physical activity among African Americans and Hispanics but not among non-Hispanic whites (Diez Roux et al., 2007). Thus, further study is needed to determine how built environment attributes may support physical activity in a variety of subgroups, particularly those shown to suffer from health disparities (LaVeist, 2005). An Australian study found neighborhood walkability partially explained income disparities in walking for transportation (Cerin et al., 2009a,b). Identifying people in high-risk sociodemographic groups who also live in the least health-promoting environments provides a way to geographically focus scarce resources on those most in need.

It could be that population subgroups are differentially responsive to built environment impacts. Alternatively, lack of amenities such as sidewalks and crosswalks may interact with social factors such as fear of crime and create barriers that reduce

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1353-8292/$ - see front matter © 2011 Published by Elsevier Ltd.
doi:10.1016/j.healthplace.2011.02.006

potential benefits from activity-supportive neighborhoods. Evidence is mounting that physical activity-supportive environmental attributes are not equitably distributed. It is important to consider the degree to which specific environmental attributes are modifiable and the amount of time required for change to occur. It is essential to know which "policy levers" are most effective to change specific aspects of the built environment. Bronfenbrenner (1979) identified three levels of social environments, with "micro" referring to interactions in specific settings, such as with work groups; "meso" referring to interactions among settings, such as family, school, and work; and "macro" or "exo" referring to the larger social system such as economic forces and cultural values. These terms also have been used to categorize built environment characteristics (Bauman and Bull, 2007; McMillan et al., 2010). For current purposes, "macro" refers to elements of overall community design related to walkability. These attributes of street connectivity, residential density, and mixed land use reflect land use and transportation policies, and with a few exceptions they are difficult to change quickly. "Macro" variables include access to specific land uses including common destinations such as retail and food stores as well as leisure-related uses like parks and private recreation facilities. "Micro" refers here to built environment factors that represent details that are smaller in scale and generally changeable more rapidly and with less cost, such as pedestrian/cycling facilities, street-crossing characteristics, traffic volume and speed, crime, incivilities like graffiti. We also classify social environment characteristics like traffic volume and speed, crime, and incivilities like graffiti as "micro" variables because they refer to characteristics of specific neighborhoods rather than the larger society.

Lower income communities have less disposable income to support local shops, services, and restaurants. Therefore the breadth and depth of destinations, including food stores and restaurants, is often related to sociodemographic factors (Frank et al., 2009; Lovasi et al., 2009a). A similar pattern of disparities has been found in which public and private recreation facilities are generally less common in low-income and racial/ethnic minority communities (Estabrooks et al., 2003; Giles-Corti and Donovan, 2002; Gordon-Larsen et al., 2006; Moore et al., 2008; Powell et al., 2006), though there are some exceptions (Abercrombie et al., 2008).

There is growing evidence that disadvantaged groups have less-favorable "micro" environments even when "macro" walkability characteristics are favorable (Lovasi et al., 2009a). For example, a study in Austin, TX found low-income and Hispanic neighborhoods were more walkable than high-income, mostly non-Hispanic white neighborhoods, when considering "macro" or structural attributes such as residential density, street connectivity, and mixed land use (Zhu and Lee, 2008). However, more-detailed or "micro" environmental attributes were inequitably distributed, with low-income and Hispanic neighborhoods having worse maintenance of sidewalks, roads, and buildings; worse esthetics such as tree shade; and higher crash and crime rates. Even among walkable neighborhoods in New York City, poorer neighborhoods had significantly fewer street trees and clean streets, and higher rates of felony complaints and vehicular crashes than higher income areas (Neckerman et al., 2009).

Based on the evidence to date, it appears low-income areas are disadvantaged in "micro" features such as esthetics, traffic safety infrastructure, and crime safety (Lovasi et al., 2009a), as well as selected "macro" attributes of breadth of desirable land uses, such as reduced access to food stores and places to exercise that are particularly relevant to health. These unfavorable attributes could blunt or negate the beneficial effects of neighborhoods deemed walkable based on "macro" attributes. Unfavorable safety and esthetic factors could also discourage businesses from entering or staying in the neighborhoods, reducing economic opportunities, access to walkable destinations, and access to local healthy foods.

The purpose of the present study was to extend previous studies of disparities in access to activity-supportive environments by examining a broader range of built and social perceived environment "micro" variables. Proximity to a variety of specific land uses that are expected to be related to physical activity for transport and recreation purposes, as well as dietary behaviors, was investigated. The present study filled gaps in the literature because some previous studies had a narrow range of walkability (Lovasi et al., 2009b) or had confounding of walkability and demographic characteristics (Zhu and Lee, 2008). The current study's design was well suited for present analyses because neighborhoods were systematically selected to balance neighborhood income across high and low levels of objectively measured macro-environmental walkability. This design permitted assessment of the distribution of "micro" environmental and specific land use variables across income in both high- and low-walkable neighborhoods.

2. Methods

2.1. Study design

The Neighborhood Quality of Life Study (NQLS) was an observational epidemiologic study designed to compare multiple health outcomes among residents of neighborhoods stratified on "walkability" based on Geographic Information System-based (GIS) characteristics and median household income (Sallis et al., 2009; Frank et al., 2010). Participants were recruited from two metropolitan areas in the United States (King County-Seattle, WA and Baltimore, MD-Washington DC regions). Data were collected from adults living in 32 neighborhoods: 16 from Seattle-King County and 16 from Baltimore-Washington DC regions. Table 1 illustrates the study design in which selected neighborhoods were categorized into quadrants representing low versus high walkability and low versus high median income. The study was approved by Institutional Review Boards at participating academic institutions, and participants gave written informed consent.

2.2. Neighborhood selection

A "walkability index" was computed (Frank et al., 2010) based on earlier conceptual work (Frank and Engelke, 2001) and empirical literature (Cervero and Kockelman, 1997; Saelens et al., 2003a,b). The walkability index was a weighted sum of four standardized measures in GIS computed at the census block group level: (a) net residential density (ratio of residential units to the land area devoted to residential use); (b) retail floor area ratio (retail building square footage divided by retail land square footage, with higher values indicating pedestrian-oriented design); (c) land use mix (diversity of 5 types of land uses—residential, retail, entertainment, office, institutional); and (d) intersection density (connectivity of street network measured as the ratio of number of intersections to land area). Detailed descriptions of the walkability index and its computation are provided in Frank et al. (2010) where the walkability index was validated by associations with journey to work travel data from the U.S. census. The index has been used to predict total physical activity and walking for transportation in the NQLS study (Sallis et al., 2009) and others (Frank et al., 2005; Owen et al., 2007).

Block groups were used as the unit for assessing walkability and median household income, because they are the smallest geographic unit for which sociodemographic information is available. Data from block groups were used to approximate "real"