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How much are built environments changing, and where?: Patterns of change by neighborhood sociodemographic characteristics across seven U.S. metropolitan areas

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ABSTRACT

Investments in neighborhood built environments could increase physical activity and overall health. Disproportionate distribution of these changes in advantaged neighborhoods could inflate health disparities. Little information exists on where changes are occurring. This paper aims to 1) identify changes in the built environment in neighborhoods and 2) investigate associations between high levels of change and sociodemographic characteristics. Using Geographic Information Systems, neighborhood land-use, local destinations (for walking, social engagement, and physical activity), and sociodemographics were characterized in 2000 and 2010 for seven U.S. cities. Linear and change on change models estimated associations of built environment changes with baseline (2000) and change (2010–2000) in sociodemographics. Spatial patterns were assessed using Global Moran's I to measure overall clustering of change and Local Moran's I to identify statistically significant clusters of high increases surrounded by high increases (HH). Sociodemographic characteristics were compared between HH cluster and other tracts using Analysis of Variance (ANOVA). We observed small land-use changes but increases in the destination types. Greater increases in destinations were associated with higher percentage non-Hispanic whites, percentage households with no vehicle, and median household income. Associations were present for both baseline sociodemographics and changes over time. Greater increases in destinations were associated with lower baseline percentage over 65 but higher increases in percentage over 65 between 2000 and 2010. Global Moran's indicated changes were spatially clustered. HH cluster tracts started with a higher percentage non-Hispanic whites and higher percentage of households without vehicles. Between 2000 and 2010, HH cluster tracts experienced increases in percent non-Hispanic white, greater increases in median household income, and larger decreases in percent of households without a vehicle. Changes in the built environment are occurring in neighborhoods across a diverse set of U.S. metropolitan areas, but are patterned such that they may lead to increased health disparities over time.

List of abbreviations: ACS, American Community Survey; ANOVA, Analysis of Variance; GIS, Geographic Information Systems; HH, Statistically significant cluster of high increases surrounded by high increases; IQR, Interquartile Range; NETS, National Establishment Time Series; SIC, Standard Industrial Classification.

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1. Introduction

Numerous reviews have documented associations of multiple attributes of the built environment, especially neighborhood walkability (defined by residential density, proximity of shops and services, and street connectivity) with active transport and physical activity (Bauman and Bull, 2007; Frank et al., 2005; Gebel et al., 2007; Owen et al., 2004; Rossen and Pollack, 2012; Saelens and Handy, 2008; Transportation Research Board, 2005). Investments in the built environment may be an important point of intervention for increasing physical activity and health across broad populations. Specifically, longitudinal increases in destinations to walk to or be social at have been associated with increased walking (Hirsch et al., 2014a,b), higher physical activity (Ranchod et al., 2014), and decreased obesity (Hirsch et al., 2014a,b). Indeed, since the mid-1990s a number of scientific, political, and popular movements have emerged that support change in the built environment, including the National Complete Streets Coalition (http://www.completestreets.org), Smart Growth America (http://www.smartgrowthamerica.org), Transportation for America (http://t4america.org), Robert Wood Johnson Active Living Research (http://www.activelivingresearch.org), and Bikes Belong Coalition (http://www.bikesbelong.org). In September 2015, the U.S. Surgeon General's Call to Action, "Step It Up," identified community design and the creation of walkable communities, where physical activity is not only easier but also more engaging, as a priority for preventing chronic disease (U.S. Department of Health and Human Services, 2015). However, little information exists on how built environments may be changing or the factors associated with these changes.

Since the creation of walkable communities entails modifications of large physical structures and neighborhood layouts, this process may take a long period of time. While some changes to built environment features, such as street networks and transportation systems, require large-scale infrastructure development occurring over numerous decades, other features, such as density of destinations (e.g. places to walk to, socialize at, or exercise in) and zoning of land-uses, may be more dynamic or amenable to change. As such, these more dynamic features may reflect recent efforts by communities to increase walkability. By examining which neighborhood built environment features have experienced change in recent decades, we may gain a better understanding of how our communities are transforming into more walkable neighborhoods. Additionally, understanding whether change is occurring is important to contextualize changes we may see in physical activity and health outcomes in upcoming years.

Furthermore, identifying where change is occurring will have important implications for health promotion. Specifically, knowing the sociodemographic characteristics of neighborhoods experiencing large improvements in the built environment will allow a better comprehension of the way the built environment might play into health equity. If changes in the built environment are not implemented equally, they may have large implications for health behavior and health disparities. Neighborhood sociodemographic characteristics may influence individual behavior through unequal distribution of physical environment characteristics (Cerin et al., 2009). Some evidence supports this hypothesis, indicating low-income and minority neighborhoods have worse aesthetics or safety (Giles-Corti and Donovan, 2002; Lovasi et al., 2009; Sallis et al., 2011; Zhu and Lee, 2008), and fewer opportunities for physical activity (Abercrombie et al., 2008; Estabrooks et al., 2003; Gordon-Larsen et al., 2006; Powell et al., 2006). Little is known about whether changes in the built environment are also associated with neighborhood sociodemographic characteristics. Such associations may contribute to either equalizing conditions across neighborhoods or to magnifying existing inequalities over time.

To provide critical knowledge of where and how the built environment is changing, this paper aims to 1) identify changes in the built environment in neighborhoods and 2) investigate associations between high levels of built environment change and sociodemographic characteristics. We describe changes in the built environment using zoned land-use codes and destinations between 2000 and 2010 in a sample of neighborhoods (n = 8383 census tracts) from seven U.S. metropolitan areas. Using both linear models and spatial methods, we investigate whether baseline levels of, and changes in, four neighborhood sociodemographics (percent over 65, percent Non-Hispanic white, median household income, and percent without a vehicle) are associated with changes in the built environment.

2. Methods

2.1. Sample

Census tracts were used to delineate neighborhoods and study boundaries were drawn based on land-use data availability by county (Supplemental Fig. S1). Census tracts were excluded if they were missing information on built environment or sociodemographic variables (n = 164, 1.9%). The final sample consists of 8383 census tracts from seven U.S. metropolitan areas: Los Angeles, CA (n = 3325); Chicago, IL (n = 1798); Baltimore, MD (n = 399); St. Paul, MN (n = 685); Hinds County, MS (n = 63); Forsyth County, NC (n = 75); and New York, NY (n = 2038). Census tract boundaries are delineated to capture a set of people, so they can vary in size by population density, resulting in different number of tracts by study area. Although census tract geographies are intended to remain stable over time, physical changes in street patterns or large population growth or decline occasionally require that they be redrawn; this study uses census tract geographies from 2000 to maintain uniform boundaries across time. This accounted for the fusion and assimilation of tracts over time and reduces the potential effect of geography errors on the findings of this study (Gotway and Young, 2002).

2.2. Built environment measures

Neighborhoods were characterized during the Multi-Ethnic Study of Atherosclerosis (MESA) (Bild et al., 2002) and Jackson Heart Study (JHS) (Taylor et al., 2005) Neighborhood ancillary studies. Information on neighborhood environments was obtained from regional governments and national commercially available business listings and then linked to 2000 census tracts using Geographic Information Systems (GIS). The following built environment measures were investigated in these analyses: percent of land-use parcels zoned as retail, percent of land-use parcels zoned as residential, count of number of destinations for social engagement (e.g. entertainment, museums, political clubs, religious locations), count of number of walking destinations (e.g. post offices, drug stores, banks, food stores), and count of number of physical activity facilities (e.g. indoor conditioning).

The land-use zoned in individual parcels was obtained from various sources including local planning departments, city governments, and regional entities (e.g. Southern California Area Governance, SCAG, for Los Angeles, CA; Metro GIS for St. Paul, MN). While the coverage of these files varied by city (some only the city boundaries, some the county, and some the region), we used