Neighborhood Socioeconomic Status and Change in Built Environment Infrastructure

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Extended Abstract:

Background:

Neighborhoods play a critical role in population health, with residents of socioeconomically deprived neighborhoods faring poorly on a variety of health outcome measures [1, 2]. However, most neighborhoods are dynamic, experiencing change in socieconomics [3] as the result of broad social and economic forces acting on a local level, including everything from purposeful mortgage redlining to global forces of economic change [4] to more localized forces such as local land planning that encouraged population dispersal into the newly developed post-war suburbs [5]. Socio-economic changes also relate to physical changes in the neighborhood, such as change in built environment infrastructure elements, including bicycle lanes, bus routes, sidewalks, parks and other amenities, which relate to health [6-11]. Yet, there has been relatively little study of how neighborhoods change physically over time. Even the basic question — how much neighborhoods change physically?— is largely unanswered. Beyond that, though, there is the issue of how these physical improvements are distributed across neighborhoods.

Infrastructure investments are not distributed throughout neighborhoods randomly, but rather through the give-and-take of the political process that may advantage some and disadvantage others [12, 13]. Many factors influence the regional distribution of investment, including the general political environment, a commitment to equity, and the existence of judicial mandates that require equitable distribution of resources within and across regions [14]. However, there has been little research into the connection between a neighborhood's socioeconomic status and its public infrastructure [15]. Neighborhoods of higher socioeconomic status may have residents who advocate for new and improved amenities, while greater community involvement may garner political will [16, 17], and higher homeownership may relate to financial incentive to increase property values. On the other hand, political power may be won by coalitions that include the dispossessed and disadvantaged who may shift spending on infrastructure investments to their constituents' neighborhoods [15].

In this paper, we investigate the association between neighborhood socioeconomics and changes in physical infrastructure in four US cities. How does infrastructure change over time, and how is it distributed among different areas of the city? We then ask how the socioeconomic makeup of neighborhoods may influence the pace of infrastructure investment. This paper approaches these questions by analyzing change in the physical infrastructure (1985 to 2010) within neighborhoods in four US cities that are diverse in terms of geography, size and population diversity, making them ideal for examining whether particular socioeconomic factors are associated with infrastructure investments. We have been unable to locate any studies investigating how neighborhood infrastructure changes over time.

Methods

The geographic areas included in this study are the 2010 census Metropolitan Statistical Areas (MSAs) of Birmingham AL, Chicago IL, Minneapolis MN, and Oakland CA. Neighborhood boundaries used (n=400) are a combination of three data sources: neighborhood boundaries available for Chicago, Minneapolis, and Oakland downloaded from Zillow (www.zillow.com/howto/api/neighborhood-boundaries.htm), neighborhoods for Birmingham, Alabama obtained from the Regional Planning Commission of Greater Birmingham (www.rpcgb.org), and 2010 Census Places boundaries from ESRI Data & Maps 2012.

Infrastructure Measures

In each city, field audit data for bicycle lanes (total length of bicycle lanes accessible from the neighborhood), off-road trails (total length of off-road recreational trails accessible from the neighborhood), bus transit service (proportion of streets with bus service within each neighborhood), and parks (count of parks accessible within the neighborhood, count of parks per neighborhood with community centers, and number of parks within the neighborhood that were improved since the previous year, including refurbishings) were collected from 1985 to 2010. Our database was constructed from current and historic geospatial data, historic documentation including maps (e.g., bus and bicycle routes), Capital Improvement Plans, and Transportation Improvement Plans, and personal communication with local stakeholders and experts in each city. To the extent possible, we documented additions, removals, and significant changes of features throughout the study period, as well as attributes and amenities of each feature. Neighborhood infrastructure was calculated using ArcGIS 10.1 (ESRI, Redlands, CA), length measures are in meters, and all audited features and resources within 23 meters (75 feet)[1] of a neighborhood were attributed to that neighborhood.

Socioeconomic Measures

Neighborhood percentage of population below the poverty line, percentage of labor force unemployed, neighborhood household median income, and percent of housing occupied were taken from the U.S. Census Bureau decennial censuses for 1980, 1990, and 2000 and from the American Community Survey, 2007-2011 five-year estimates, with tract-level data assigned to neighborhoods. When tracts did not align with neighborhoods, data were assigned proportionally based on the area of tracts within the neighborhood.

Analysis

Descriptive statistics were calculated for all neighborhood built environment and socioeconomic variables in 1985 and average changes per 10 years for the full sample and by city. Linear mixed models were used to estimate the associations of changes in socioeconomic characteristics with changes in built environment infrastructure. We modeled repeated infrastructure measures on each neighborhood as a function of baseline socioeconomic measures, time in years since baseline (to capture the change in infrastructure over the study), a term for the interaction between baseline socioeconomic measures and time (potential impact of baseline socioeconomic on changes in infrastructure over time), change in socioeconomic since baseline, an interaction term between change in socioeconomic since baseline and time (to capture how changes in socioeconomic affect changes in infrastructure over follow-up), and both time-invariant (city, land area) and time-varying (population) confounders. Change in the built environment infrastructure was mapped and spatial patterns were assessed within each study area using a first-order, row-standardized, rook contiguity definition of neighborhoods. Global Moran's I was used to measure overall clustering and Local Moran's I was used to identify statistically significant clusters of high change surrounded by high change. Socioeconomic characteristics were compared between neighborhoods within and outside of high change clusters using Analysis of Variance (ANOVA) or Kruskal-Wallis as appropriate.

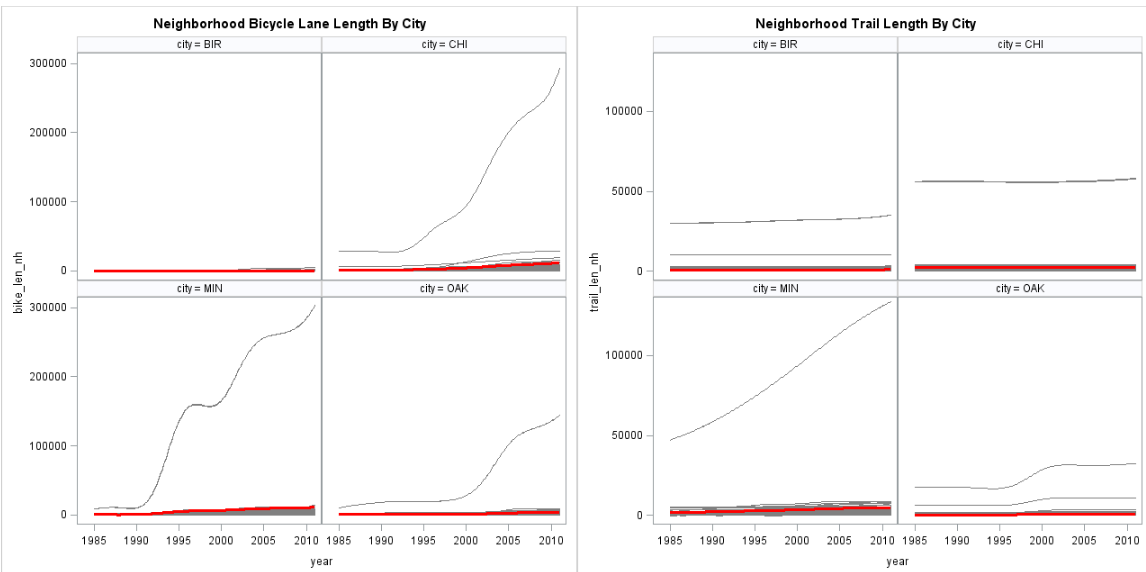
Preliminary Results/Implications

Early results show increases in the average length of bicycle trails within the neighborhoods of Chicago, Minneapolis, and Oakland but increases in the average length of off-road trails only within the neighborhoods of Minneapolis (figures 1 & 2). With the exception of Minneapolis and the later years in Birmingham, few changes occurred across the four cities in bus transit service, although this varied

[1] Twenty-three meters was chosen by summing the traffic and parking lane widths that might maximally separate two abutting neighborhoods.

greatly by neighborhood within each city (figure 3). While mean counts of parks accessible to the neighborhoods did not change much during the study (figure 4), parks with community centers increased in all four cities (figure 5) and counts of positive park changes from the previous year varied as well (figure 6). As expected, individual neighborhoods experienced large changes, for example bus transit service was clustered within neighborhoods (figure 7). We hypothesize that these changes in health amenities will be associated with and geographically clustered by socioeconomics. Increasing collaboration across disciplines has focused on better understanding how urban planning solutions implemented by local governments may improve health equity. Ensuring a fairer distribution of community health amenities including neighborhood infrastructure is a key component of the path towards health equity within cities [18].

Figures 1 & 2: Change over time in length of bicycle lane (left) and length of off-road trails (right) within neighborhoods by city.



Figures 3 & 4: Change over time in proportion of streets within neighborhoods with bus transit service (left) and count of parks accessible to neighborhoods (right) by city.

Figure 5 & 6: Change over time in count of parks with community centers (left) and with positive park changes from the previous year (right) accessible to neighborhoods by city.

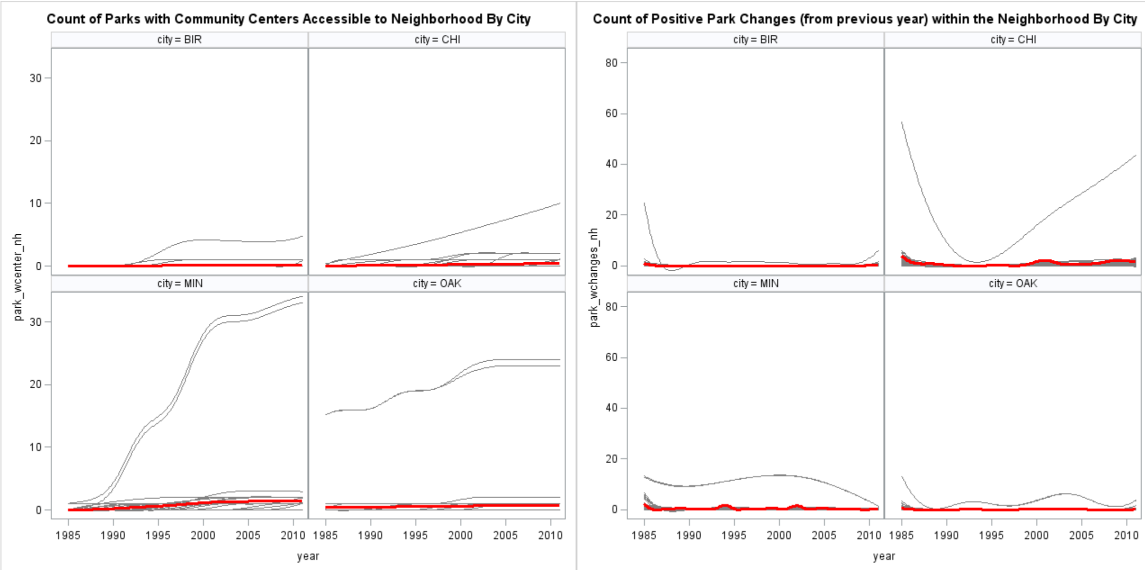
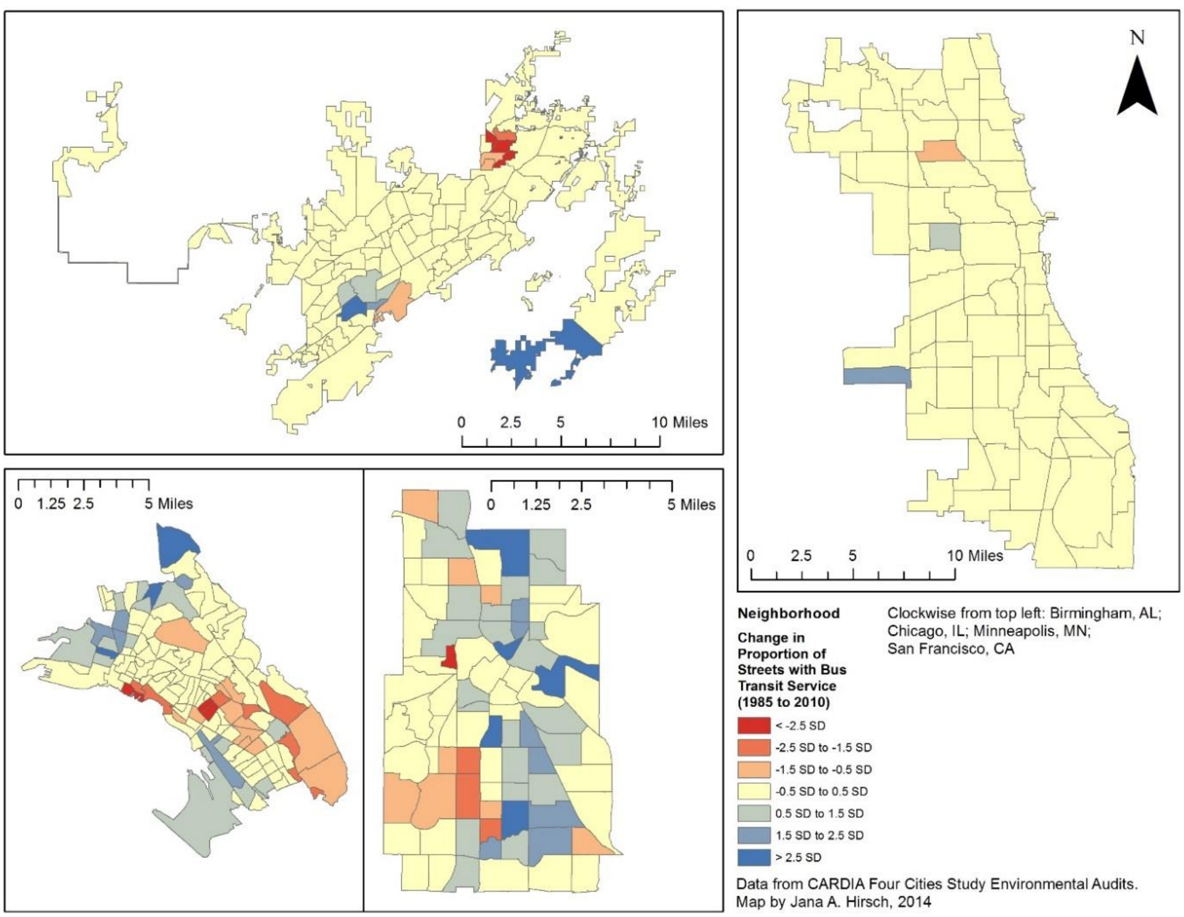


Figure 7: Change in proportion of streets with bus transit service between 1985 and 2010, Four Cities Study environmental audits (n=400 neighborhoods).



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