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Spatial patterning of supermarkets and fast food outlets with respect to neighborhood characteristics

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ABSTRACT

A large body of literature has reported differences in exposure to environments supporting either healthy (e.g. supermarkets) or unhealthy (e.g. fast food outlets) dietary choices by neighborhood characteristics. We explored the associations of both supermarkets and fast food outlets availability with neighborhood characteristics, and clustering of these two outlet types in a largely rural state. Compared to block groups without a supermarket, those with a supermarket had a significantly higher income, higher housing value, larger population with high school education and above, lower minority population and lower population living below poverty even after controlling for urbanicity and population density of census block groups. Surprisingly, a similar relationship was found for block groups with and without fast food outlets. This was due to spatial co-occurrence and clustering of fast food outlets around supermarket locations. Hence, future studies exploring the associations of food environment with diet or diet-related health outcome should concurrently examine all aspects of food environment (healthy and unhealthy).

1. Introduction

Despite the importance of diet in maintaining good health as well as in the management of various diseases, a large proportion of individuals fail to meet the dietary guidelines. The diet of children and adolescent is quite poor due to excess intake of fat, sugar, snacks, soda and fast food (Nielsen et al., 2002; Troiano et al., 2000) and lower than recommended intake of fruit, vegetables and fiber (Guenther et al., 2006; Neumark-Sztainer et al., 2002; Nicklas and Johnson, 2004; Striegel-Moore et al., 2006). Various studies have noted socio-economic or racial differences in dietary intake (Giskes et al., 2002; Goodwin et al., 2006; Shimakawa et al., 1994) and burden of diet-related diseases (Freid et al., 2003). A national study in the United States reported that non-Hispanic black youth, youth from rural non-metropolitan areas and youth from the southern US were 2.3, 2.1 and 1.9 times more likely to have lower-quality diets when compared to non-Hispanic white youth, youth from metropolitan and the Northeast US, respectively (Goodwin et al., 2006). Similarly, another national level study also suggested that a difference in food accessibility and availability is a major determinant of morbidity and mortality in metro and non-metro areas (Ahern et al., 2011). Furthermore, evidence indicates that rural children are more overweight or obese compared to urban children, with the highest likelihood of overweight/obesity in the rural South compared to other parts of the country (Liu et al., 2007, 2008, 2012). However, very little is known about the underlying causes for these differences.

Recently, increased attention has been given to contextual factors such as individual's neighborhood of residence as a factor contributing to disparities in dietary intake and health outcomes through availability or lack of health promoting resources. Majority of the evidence comes from studies performed in the northern United States encompassing largely metropolitan urban and suburban neighborhoods. These studies suggest that residents of poor and minority neighborhoods have lower access to environments supporting healthy dietary choices and greater access to environments supporting unhealthy dietary choices than affluent and white neighborhoods. For instance, fewer supermarkets were located in or near black compared to white neighborhoods (Morland et al., 2002; Morland and Filomena, 2007; Powell et al., 2007; Zenk et al., 2005), and low-income compared to the wealthiest neighborhoods (Moore and Diez-Roux, 2006; Powell et al., 2007). In terms of fast food outlets, studies suggested that low-income or predominantly black neighborhoods had higher

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densities of fast food outlets (Block et al., 2004; Cummins et al., 2005; Kwate, 2008; Kwate et al., 2009; Reidpath et al., 2002), compared to higher income or predominantly white neighborhoods. However, a recent study from a six-county rural region of Texas has reported that the most deprived neighborhoods with the greatest proportion of minority residents had better spatial access to supermarkets and grocery stores (Sharkey and Horel, 2008) and also fast food outlets and opportunities (Sharkey et al., 2011) compared to the least deprived neighborhoods.

Given these contrasting regional findings regarding spatial food retail access by neighborhood socioeconomic status, and inconsistencies in the association of availability of healthy food items in rural communities of South Carolina (Liese et al., 2007) compared to rural communities in the Northeast (Hosler et al., 2006; Hubley, 2011), there is a need for studies that encompass large rural environments. Particularly, it has been suggested that rural residents may face several barriers for physical access to food stores due to long travel distance, lack of transportation and limited financial resources (Sharkey et al., 2010). Furthermore, rural southern states have faced a higher burden of diet-related diseases such as obesity, diabetes and heart disease as compared to other regions of the nation, and have been identified as the stroke and diabetes belt (Barker et al., 2011; Lanska and Kuller, 1995).

Most of the existing studies relating neighborhood characteristics (e.g., median household income of block-group or census-tract) to distribution of food outlets, have focused on only one outlet type, either outlets supporting healthy dietary choices such as supermarkets (Moore and Diez-Roux, 2006; Morland et al., 2002; Powell et al., 2007) or outlets supporting unhealthy dietary choices such as fast food outlets. (Block et al., 2004; Cummins et al., 2005; Kwate et al., 2009; Reidpath et al., 2002) The exception are a few studies from New Zealand (Pearce et al., 2007), Canada (Smoyer-Tomic et al., 2008), and rural counties in Texas, USA (Sharkey et al., 2011; Sharkey and Horel, 2008). However, none of the studies have extensively explored the spatial clustering of food outlets supporting healthy dietary choices with outlets supporting unhealthy dietary choices.

The purpose of this study was to explore the availability of both supermarkets and fast food outlets in relation to neighborhood characteristics using spatial statistical methods in the entire State of South Carolina, a largely rural state from the Southeastern US with a high proportion of minority residents. Furthermore, we tested for the degree of spatial clustering of food outlets providing healthy and unhealthy food options using bivariate *K* function method (Dixon, 2013).

2. Methods

2.1. Study area

This study included the entire State of South Carolina, a rural state with higher than 30% of minority populations. We included 2857 census block groups, which are the smallest geographic units (approximate population of 1500) for which census data on social and economic measures is available. Previous researches on built food environment have also used block groups as unit of analysis (Gordon et al., 2011; Hill et al., 2012; Sharkey et al., 2009).

2.2. Neighborhood-level covariates

Demographic and socioeconomic data were obtained from the United States Census Bureau 2000 (Summary File 1 and Summary File 3) at the census block-group level for the State of South Carolina (Bureau of the Census, 2001a, 2001b). The data obtained for this study included demographic measures such as total population, race/ethnicity-specific population and population density. Socio-economic measures included median household income, median value of housing, population with high school education and above, and population living below the federally defined poverty level. These variables were used to derive several categorical variables for the analysis. The measure reflecting race composition of block groups was determined based on the proportion of various race/ethnic groups of the specific block-group. A block-group was identified as "Predominantly white" if the proportion of white population in the tract was more than 80% (Morland and Filomena, 2007). Similarly a block-group or census-tract was "Predominantly black" if the black population was more than 80%, and "Mixed" if the proportion of both race/ethnic group was 80% or less (Morland and Filomena, 2007). Similarly, the measure reflecting the poverty status of the neighborhood was determined based on the proportion of population living below the federally defined poverty line. A block-group or census-tract was identified as "Poor" if the tract has ≥20% of the population living below poverty and "Not poor" otherwise (Krieger et al., 2003). For variables such as median household income, median value of housing, and percent population with high school and above education, tertiles of variables were created with the highest tertile representing higher socio-economic status and higher proportion of population with high school education and above.

Variable representing urbanicity-level of neighborhoods such as 2000 Rural–Urban Commuting Area Codes (RUCA) are only available at the census-tract levels from the Economic Research Service (ERS)/United States Department of Agriculture (USDA) (2000). Hence for this study, block groups were assigned RUCA code of their respective census tracts. We used a four-tier consolidation of the RUCA system: (1) urban core; (2) sub-urban, (3) large rural town; and (4) small town/isolated rural (Washington State Department of Health, 2009).

2.3. Built food environment measures

For this study food outlets such as supermarkets (proxies of environment supporting healthy dietary choices) and fast food outlets (proxies of environment supporting unhealthy dietary choices) were selected (Gordon et al., 2011). Supermarkets in this study were defined as a large corporate owned franchised food stores selling groceries including fresh produce and meat, as distinguished from grocery stores and smaller non-corporate owned food stores (Morland et al., 2002, 2006) and included Bi-lo, Publix, Bloom, Earth Fare, Food Lion etc. Fast food outlets were defined as nationally or internationally known franchised limited service restaurants that sell inexpensive, quickly served foods such as hamburgers, pizza and fried chicken (Jeffery et al., 2006; Wang et al., 2007) with payment made prior to receiving food and expedited food service with limited or no wait staff (Block et al., 2004; Burdette and Whitaker, 2004; Hurvitz et al., 2009) and included Bojangles', Burger King, Chick-Fil-A, McDonald's etc.

Data on food outlets including geocodes were obtained from two sources including (1) the Licensed Food Service Facilities Database (LFSFD) from South Carolina Department of Health and Environmental Control (SCDHEC) (obtained in August 2008) and (2) InfoUSA Inc. (obtained in February 2009). After performing substantial data cleaning to remove typological errors and duplicate entries, we identified supermarkets and fast food outlets from both data sources based on the name of the facilities and merged them into a new analysis dataset. We identified a total of 686 supermarkets and 2624 fast food outlets in the State of South Carolina.

The geocoded locations of the food outlets were used to determine the specific block-group of each outlet. The function "counts point in polygons" available in ArcGIS 9.3 software (ESRI, 2008) was then used to count the number of supermarkets and fast food outlets in each census block group. Census block groups were identified to have supermarket availability if they contained at least one supermarket.