Neighborhood environment and health behavior in Los Angeles area

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ABSTRACT

The objective of this research is to analyze the relationship between neighborhood characteristics and obesity among adults. Using data from 7200 adult respondents in the 2007 Los Angeles County Health Survey, a binary logistic regression model is tested to examine whether land use patterns and the built environment characteristics of residential neighborhoods are associated with one's probability of being obese. The result has shown that living in a neighborhood with higher household density, closeness to rail stations, and better bus services are associated with a lesser likelihood to be obese, which implies that people in a well-designed transit-oriented neighborhood tend to use active transportation modes to reach their daily activities and access transit services. Increased use of active transportation gives people an opportunity to engage in a moderate-level of exercise, so as to reduce their weight and enhance their health condition. This paper contributes an approach to analyze and estimate the health impact of an integrated land use-transportation plan. The model estimated in the paper can be used to analyze public health issues as a result of different land use policies, built environment improvements, and future demographic change.

1. Introduction

Obesity has become a major health concern in the U.S. It is a major contributor of many medical conditions such as heart disease, Type 2 diabetes, hypertension, stroke, and certain cancers (WHO, 2000). U.S. data shows that 35.7% of U.S. adults were obese in 2009–2010 (Ogden et al., 2012). In Los Angeles County, with approximately 9 million residents, the proportion of obesity among adults has increased from 13.6% in 1997 to 23.6% in 2011 (LADPH, 2012). The large amount and drastic growth of the obese population may lead to serious financial problems due to increasing medical expense. The prevalence of obesity has caused serious financial concerns to the U.S. In 2006, medical costs related to obesity in the U.S. were about $147 billion, which is almost double to $74 billion in 1998 (Finkelstein et al., 2009).

There is a recent growing interest in integrating transportation and land use planning policies to solve the issue of obesity. U.S. Centers for Disease Control and Prevention (CDC) acknowledges that transportation policies can have positive impacts on reducing obesity (CDC, 2012). Because lack of physical activities is an important reason for being obese, CDC has recommended two transportation policies: "Promote Active Transportation" and "Expand Public Transportation." These two policies encourage people to walk and bike more, thus reducing their weight and enhancing their health condition. CDC also recommended a land use policy called "Encourage Healthy Community Design" that encourages transit-oriented development (TOD). The main concept of TOD is that residential neighborhoods with higher densities, mixed use of land, better street connectivity, or closeness to transit services will encourage residents to walk or bike for accessing their daily activities, and therefore residents living in this type of community can reduce their weight.

Active transportation and public health is also becoming a major policy focus for regional planning agencies in California. The Southern California Association of Governments (SCAG), a metropolitan planning organization for six counties in Southern California, is responsible for developing a long-range regional transportation plan (RTP) and sustainable community strategies (SCS) to solve regional issues such as traffic congestion, air pollution, and greenhouse gas emissions. The integrated land use and active transportation strategies are included in the long-range plan to alleviate public health issues for the region.

The purpose of this research is to analyze how neighborhood environmental characteristics, including both land use and built environment, are associated with the likelihood of being obese. Through this analysis, we sought to understand how land use and built environment factors can contribute to the enhancement of

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public health in the SCAG region. We tested a binary logistic regression model to examine data from 7200 adult respondents in the 2007 Los Angeles County Health Survey (LACHS).

This paper has five sections. The next section describes relevant literature on built environment, physical activity and obesity. Section 3 describes research approach, methodology, and data sources. Section 4 summarizes model results. Section 5 summarizes conclusions and further analysis.

2. Review of past research and analysis

Previous research indicated that the prevalence of obesity declines with increasing income and education, and is more common for non-whites than whites. Obesity rate is different by race, ethnicity, and gender. Flegal et al. (2012) estimated the prevalence of adult obesity based on a sample of U.S. adults ($n = 5826$) from the 2009 to 2010 National Health and Nutrition Examination Survey (NHANES). They found that non-Hispanic African Americans have the highest rates of obesity (49.5%) compared with Hispanics (39.1%) and non-Hispanic whites (34.3%) nationwide. In Los Angeles County (LACPH, 2011), Latinos (29.4%) and African Americans (29.2%) have higher obesity rates than other racial groups. Based on the analysis of NHANES data from 1999 to 2008, the obesity rate for males has shown a significant linear growth trend over the 12-year period (Flegal et al., 2012).

Researchers have attempted to explain how land use characteristics and the built environment of residential neighborhoods are associated with the tendency of residents to engage in physical activity. Some studies analyzed descriptive statistics (Saelens et al., 2003; Brownson et al., 2009; Rahman et al., 2011), showing that land use or built environment characteristics are associated with the level of physical activity engagement. Those studies did not analyze direct relationships, due to lack of available data. Handy et al. (2002) also pointed out that analyzing the relationship between built environment and travel behavior is difficult due to data limitation.

Built environment factors, such as better transit services, are shown to have a negative association with higher levels of obesity. Rundle et al. (2007) analyzed the relationship between the built environment and obesity in New York City. This research assumed that more residents would walk to transit if better transit services were provided in a neighborhood. The result concluded that mixed land use, density of bus stops, density of subway stops, and population density are significantly inversely associated with higher levels of obesity. Hess and Russell (2012) also found that when the number of bus stops within half mile radius of residents is increased, the level of obesity is likely to be decreased.

Using 10,878 adult respondents of a travel survey from the Atlanta region, Frank et al. (2004) conducted a logistic regression to analyze how socioeconomic characteristics, residential location, and travel patterns are linked to the probability of being obese. They found that individuals who travel longer walking distances, spend less time in a car, or reside in a mixed-use neighborhood, tend to be less likely of being obese. The result seems reasonable: more use in active transportation modes and less in a car increases physical activity engagement; thus people are less likely to be overweight. However, multicollinearity might be an issue in this analysis because land use mix may be correlated with other independent variables, such as longer walking distance or less time in a car.

The fundamental cause of obesity is an energy imbalance between calories consumed and calories expended. Globally, there has been an increase in consuming energy-dense foods that are high in fat, salt and sugars; and a decrease in physical activity (WHO, 2012). To analyze the level of obesity, both eating behavior and physical activity engagement should be considered.

3. Research approach and data analysis

This study focuses on the relationship among land use, built environment, physical activity, and obesity. This research undertakes two analytical approaches. One is to examine descriptive statistics of health survey data to analyze the proportion of obesity and the level of physical activity by socioeconomic status and neighborhood characteristics. The second approach is to test a model that examines whether land use and the built environment are associated with the probability of an individual being obese. A binary logistic regression model is used in the analysis. The model estimates the probability as a function of four groups of factors: individual socioeconomic characteristics, individual health behavior, neighborhood quality and safety, and neighborhood land use/built environment.

3.1. Data source

The 2007 Los Angeles County Health Survey (LACHS) is used as the core data for this study. The LACHS is a population-based telephone survey of Los Angeles County households.[1] Households were selected by a random digit dial (RDD) sampling methodology. Within each selected household, one adult who is age 18 or older was randomly selected and interviewed via telephone (LADPH, 2008). A total of 7200 adults in Los Angeles County were sampled. The survey data for this analysis includes individual socioeconomic characteristics, residential location by Census tract and zip code, and health behaviors. Socioeconomic variables include each individual's age, gender, race and ethnicity, household income, and education. Health behavior variables include each individual's body mass index (BMI), individual's perceived neighborhood safety from crime, the frequency of an individual eating fast food, and the level of weekly physical activity.

To analyze the relationship between health outcomes and neighborhood environments, we applied variables at Census tract or zip code areas. Census tract was chosen because it was the smallest geographic variable available in the survey. Census tract is also appropriate to represent neighborhood environment. For respondents without Census tract information (about 20%), we used zip code as neighborhood geography. We created residential neighborhood variables from SCAG's transportation and socioeconomic database.

Household density, employment density and job diversity were calculated based on SCAG's year 2008 socioeconomic database that was developed as input data for SCAG's regional travel demand model. Data such as transit headway, transit stop density, and location of rail stations are developed based on SCAG transit network data.

3.2. Model formulation

The purpose of model analysis in this research is to examine whether neighborhood land use and built environment factors are associated with the probability of being obese. A binary logistic regression model is used to determine the probability of being obese. The model estimates the probability as a function of four groups of factors: individual socioeconomic characteristics, individual health behaviors, neighborhood quality and safety, and neighborhood land use and built environment.

The basic conceptual model is

$$Y_i = f(SE_i, HB_i, NQ_i, LB_i) \tag{3.1}$$

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[1] Data information about 2007 Los Angeles County Health Survey can be found at: http://www.publichealth.lacounty.gov/ha/hasurveyintro.htm.