



Short Communication

Neighborhood factors and six-month weight change among overweight individuals in a weight loss intervention

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ABSTRACT

The purpose of this study was to examine the neighborhood environment and the association with weight change among overweight/obese individuals in the first six months of a 12-month weight loss intervention, EMPOWER, from 2011 to 2015. Measures of the neighborhood environment included neighborhood racial composition, neighborhood income, and neighborhood food retail stores density (e.g., grocery stores). Weight was measured at baseline and 6 months and calculated as the percent weight change from baseline to 6 months. The analytic sample ($N = 127$) was 91% female and 81% white with a mean age of 51 (± 10.4) years. At 6 months, the mean weight loss was 8.0 kg (± 5.7), which was equivalent to 8.8% ($\pm 6\%$) of baseline weight. Participants living in neighborhoods in which 25–75% of the residents identified as black had the greatest percentage of weight loss compared to those living in neighborhoods with <25% or >75% black residents. No other neighborhood measures were associated with weight loss. Future studies testing individual-level behavioral weight loss interventions need to consider the influence of neighborhood factors, and how neighborhood-level interventions could be enhanced with individual-level interventions that address behaviors and lifestyle changes.

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1. Introduction

For behavioral weight loss interventions to be successful, it is important to understand the various factors that may influence the individual's ability to self-regulate behavior and manage weight control. Behavioral weight loss interventions typically focus on lifestyle behaviors (e.g., eating and physical activity) and psychosocial factors such as self-efficacy, social support and problem-solving skills. While these factors are important, it may also help to consider the larger context or environment, and how it may affect weight change and the adoption of healthful behaviors for the long-term. Observational studies (e.g., cross-sectional), have demonstrated that the neighborhood environment plays an important role in the development of obesity (Auchincloss et al., 2013; Galster, 2012; Glass et al., 2006; Ludwig et al., 2011; Papas et al., 2007). Neighborhood environments may influence lifestyle and body weight through several pathways including

the service environment (i.e., grocery stores, amenities), the physical or built environment (i.e., exposure to toxins, access to parks/green space), and the social or economic environment (i.e., income inequality) (Ludwig et al., 2011; Culhane and Elo, 2005). However, it is unclear if the neighborhood environment influences weight change for overweight and obese individuals who are actively attempting to lose weight through organized behavioral interventions.

Few studies have examined the impact of neighborhood factors on the effect of behavioral interventions related to obesity or weight loss. Gustafson et al. (2012) and Wedick et al. (2015) investigated the influence of availability of healthy foods in the neighborhood on the effect of a dietary behavioral intervention focused on changes in diet and eating patterns, potential precursors to weight change. Gustafson et al. (2012) found that healthy food store environments increased fruit and vegetable intake among intervention participants, while Wedick et al. (2015) showed that living closer to stores that carried healthy foods was associated with an increase in consumption of fiber, fruits, and vegetables among obese adults with metabolic syndrome. Another study examined the effect of worksite neighborhood on employees enrolled in a randomized trial to prevent weight gain and found that a higher appraised value of the worksite's neighborhood was associated with increased

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walking among employees (Barrington et al., 2015). Other studies have demonstrated that environmental modification can enhance the success of weight loss interventions, but these studies were specifically among children (Fagg et al., 2014; Best et al., 2012; Epstein et al., 2012). However, none of these prior studies specifically examined the impact of neighborhood factors on weight loss among intervention participants, the focus of the present study.

Given that neighborhood factors are often overlooked in weight loss interventions, the purpose of this study was to examine the neighborhood environment and its association with weight change among overweight and obese individuals in the first six months of a 12-month weight loss intervention study. We hypothesized that individuals living in low-resource neighborhood environments (e.g., low income, absence of grocery stores, high racial segregation) would be less likely to lose weight over time compared to those who live in neighborhoods with more resources and that are health promoting.

2. Methods

2.1. EMPOWER study design and sample

EMPOWER is a longitudinal descriptive study (N = 151) that used ecological momentary assessment (EMA) (Shiffman, 1987; Shiffman, 2000; Burke et al., 2013) to understand participants' behavior in real time in their own environment to determine the triggers for lapses or relapse following intentional weight loss. Inclusion criteria were a body mass index (BMI) >27 and <44 kg/m², ≥18 years of age, no recent weight loss and not participating in any other weight loss treatment. All participants received a group-delivered behavioral weight loss intervention over 12 months. Participants set daily goals for energy and fat intake and weekly goals for energy expenditure. They self-monitored their diet and physical activity (PA) using an application (app) on a smartphone and weighed themselves daily on a Wi-Fi scale that was provided by the study. A total of 151 adults were enrolled in the study. For this secondary analysis, we used only baseline to 6-months data. Our final analytic sample (N = 127) including participants with complete data of all key variables. There were no significant differences in demographic factors or BMI comparing the full sample with the analytic sample. The parent study, EMPOWER, and the secondary analysis for this manuscript were both approved by the Institutional Review Board of the University of Pittsburgh.

2.2. Key measures

Weight was measured at baseline and 6 months using the Tanita digital scale. Percent weight change was calculated as weight at six months minus weight at baseline divided by weight at baseline times 100% [$((\text{Weight}_t - \text{Weight}_0) / \text{Weight}_0) \times 100\%$].

Neighborhood measures were calculated based on the residential address of EMPOWER participants at baseline and were geocoded using ArcGIS software and assigned the appropriate census tract. The neighborhood measures were linked to the EMPOWER individual data based on census tract. Several neighborhood measures were included in this analysis. Grocery store density was measured as the number of stores per census tract divided by the population (per capita) of the census tract. Similarly, restaurant density was measured per capita. There were several census tract level measures derived from the US census and these were categorized into quartiles: income (annual family income < \$30,000/year), education (<high school education), households in poverty, and the proportion of black residents. Neighborhood racial composition was operationalized as the proportion black because the tracts in the geographic region are either predominately black or white with limited representation from other racial categories at the neighborhood level. An index of neighborhood socioeconomic disadvantage (NSED) was also created, which is described further below.

2.3. Analytic method for development of NSED index

The measures included in the NSED index were percentages of unemployed individuals, houses with no cars, crowded housing, renters, males not in management and professional occupations, households in poverty, female headed households with dependents, public assistance, earning <\$30,000/year, <high school education, black residents, residents under the age of 16. The NSED index was derived using exploratory factor analysis (Tabachnick and Fidell, 2007) based on previous work in the same geographic region and indices used in health research that take into account material deprivation and concentrated disadvantage (Messer et al., 2006; Townsend et al., 1988; Sampson et al., 1997; Mendez et al., 2013). A maximum likelihood extraction method was used, and one factor was extracted with a weighted eigenvalue of 36.1 for the first factor explaining 81% of the total variance of the data.

2.4. Covariates

Several covariates were chosen as potential confounders in the association between neighborhood and weight outcomes based on previous studies (Auchincloss et al., 2013; Gary-Webb et al., 2010). Several demographic self-reported measures were collected at baseline such as age, sex, race/ethnicity (analytic sample only include black, white and Asian participants), relationship status, educational attainment, and household income. We did not include behaviors such as diet and physical activity as confounders, but considered them mediators in the association between neighborhood and weight change. The specific mediators we considered were participants' current smoking status, their baseline scores on the Barriers to Healthy Eating Scale (Fowles and Feucht, 2004), and at baseline the number of times per week over the past three months they engaged in excessive exercise.

2.5. Statistical analysis

SAS version 9.4 (Cary, NC) was used for analysis. We excluded 15 participants who lived outside of the study area or that did not have a complete residential address, and 9 who had missing weight data at 6 months for an analytic sample of 127 participants with complete data. Descriptive analyses were conducted for the key variables of interest. Analysis of variance (ANOVA) was conducted to test differences in the mean percentage weight change across the various individual-level and neighborhood-level factors. In this sample, there was on average 1 person per census tract (range of 1–5 people per tract), and thus our modeling strategy was a fixed effects model rather than treating individuals nested within neighborhoods in a hierarchical or multilevel model. In the unadjusted models, neighborhood proportion of black was the only factor associated with weight change based on an a priori p-value of <0.05. As a result, subsequent analyses focused on this association. Before conducting a generalized linear model, we examined neighborhood values for neighborhood proportion of black that could be considered outliers or implausible. There were no outliers for this exposure of interest. Based on the unadjusted association between the individual-level factors and percentage weight change, the final models were adjusted for sex, race, and years of formal education. We did not adjust for any other neighborhood variables since they were not associated with the outcome of interest. We conducted a sub-analysis of the racial differences in percentage weight change among participants living in neighborhoods with the lowest proportion black. We did not include potential mediators since there was no association between each of the specific mediators and percentage weight change among this population.

3. Results

The EMPOWER analytic sample (N = 127) is 91% female, 81% white, a mean (SD) of 16.6 (±2.8) years of formal education (72% with

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