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Urban sprawl and body mass index among displaced Hurricane Katrina survivors

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ABSTRACT

Objective: Existing research suggests that walkable environments are protective against weight gain, while sprawling neighborhoods may pose health risks. Using prospective data on displaced Hurricane Katrina survivors, we provide the first natural experimental data on sprawl and body mass index (BMI).

Methods: The analysis uses prospectively collected pre- (2003–2005) and post-hurricane (2006–2007) data from the Resilience in Survivors of Katrina (RISK) project on 280 displaced Hurricane Katrina survivors who had little control over their neighborhood placement immediately after the disaster. The county sprawl index, a standardized measure of built environment, was used to predict BMI at follow-up, adjusted for baseline BMI and sprawl; hurricane-related trauma; and demographic and economic characteristics.

Results: Respondents from 8 New Orleans-area counties were dispersed to 76 counties post-Katrina. Sprawl increased by an average of 1.5 standard deviations (30 points) on the county sprawl index. Each one point increase in sprawl was associated with approximately .05 kg/m^2 higher BMI in unadjusted models (95%CI: .01–.08), and the relationship was not attenuated after covariate adjustment.

Conclusions: We find a robust association between residence in a sprawling county and higher BMI unlikely to be caused by self-selection into neighborhoods, suggesting that the built environment may foster changes in weight.

Introduction

Existing research suggests that the built environment matters for weight gain and its antecedents. With few exceptions (Durand et al., 2011), current studies show that residential density and street connectivity are associated with transit use, active transport, and less driving (de Nazelle et al., 2011; Sallis et al., 2012) and with lower odds of overweight and obesity (Ewing et al., 2003, 2006; James et al., 2013; Lee et al., 2009; Li et al., 2009; Mujahid et al., 2008; Plantinga and Bernell, 2007; Sallis et al., 2009). However, most studies examining the effects of the neighborhood built environment are cross-sectional, and virtually all are observational (O. Ferdinand et al., 2012). As a result, existing studies have been unable to reject endogeneity as an explanation for observed associations, with the possibility of leaner subjects electing to live in more walkable communities, or pressuring their current communities to become more walkable. The threats of confounding by residential self-selection and reverse causation underscore the need for quasi-experimental data to rigorously explore built environment effects on body mass index (BMI) (Eid et al., 2007; Frank et al., 2007; Handy et al., 2006). In fact, despite the publication of nearly 50 studies on the built environment and BMI or obesity (O. Ferdinand et al., 2012), researchers are still unable to draw conclusions about whether observed relationships are causal (Casazza et al., 2013).

Notwithstanding the Moving to Opportunity experiment (Katz et al., 2001; Leventhal and Brooks-Gunn, 2003; Leventhal and Dupere, 2011), random or nearly random assignment to neighborhoods is uncommon. To date, there have been no experimental or quasi-experimental studies published on the effect of sprawl on weight gain. This analysis uses multilevel statistical analysis to explore county-level sprawl as a predictor of BMI in a longitudinal study of low-income, displaced Hurricane Katrina survivors who had little to no control over their neighborhood placement immediately after the disaster, providing the first natural experimental data on urban sprawl and BMI.

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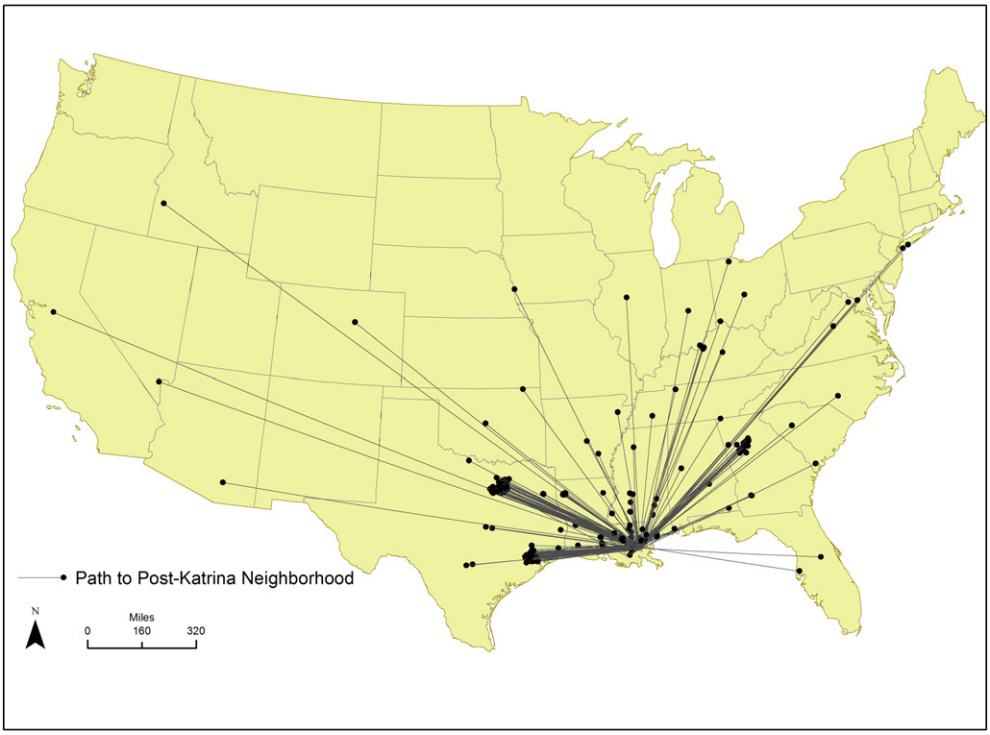

Fig. 1. Study participant paths from pre-Katrina (2003–2005) New Orleans-area neighborhoods to post-Katrina (2006–2007) neighborhoods.

Methods

Data source

The Resilience in Survivors of Katrina (RISK) project is a longitudinal study of Hurricane Katrina survivors that offers prospectively collected pre- and post-hurricane data on 1019 young, poor, predominantly African American parents from New Orleans. Pre-Katrina data were collected as part of MDRC's Opening Doors Evaluation, a randomized-design program aimed to increase academic persistence in community colleges that included a National Institutes of Health-funded health module. Participants were sought from three community colleges in New Orleans in 2003–2005. Eligible respondents had to be 18–34 years old; the parent of at least one dependent child under 19; have a household income under 200% of the federal poverty level; and have a high school diploma or equivalent. Data collection for the 12-month follow-up survey was interrupted when Hurricane Katrina struck on August 29, 2005, and the Opening Doors study was redesigned to become the RISK Project, which followed subjects to their new neighborhoods after the disaster. A qualitative data collection component, consisting of in-depth interviews with a sample of subjects, was also added to help elucidate experiences of trauma, displacement, and related processes. The study was approved by the Harvard and Princeton Institutional Review Boards.

At baseline (November 2003–February 2005), all 1019 subjects lived in New Orleans or a surrounding metropolitan area parish. We were able to locate and survey 711 of the original respondents 7 to 19 months after Katrina struck (March 2006–March 2007), 693 of whom provided information about where they were living (Fig. 1).

Roughly 47% were living in the New Orleans metropolitan region, while 53% of subjects ($n = 369$) were displaced from the area at follow-up. To isolate the causal effects of neighborhood sprawl on BMI, we excluded those who remained in the New Orleans area, as this residential location had been self-selected prior to the hurricane. The analysis focused exclusively on subjects who were living outside the New Orleans region at follow-up. The factors that led displaced participants to their post-Katrina neighborhoods have been discussed extensively elsewhere (Fussell, 2012), with illustrative examples gleaned from qualitative in-depth interviews including: seeking out nearby relatives, evacuating to Georgia because east-bound evacuation traffic seemed lightest, and a Dallas-bound bus being turned away in Dallas, Houston, and Mesquite due to full shelters before finally stopping in Wylie, TX. Though our qualitative data suggest that displaced subjects did not select into neighborhoods systematically with regard to sprawl, we test for this possibility empirically.

Of the 369 displaced subjects, 280 had complete baseline and follow-up information on BMI and county of residence, and serve as our study population. At follow-up, the 280 participants (Fig. 2) were dispersed across 76 counties in 24 states, including within Louisiana.

Outcome

Our outcome of interest was BMI, calculated from self-reported height and weight at each wave. While self-reported BMI is known to be downwardly biased, we have no reason to expect the extent of this bias to vary according to displacement experiences. Previous research has demonstrated that self-reported BMI is valid when compared to clinical measurement, including a study by Willett et al. (1983) showing that self-reported weights were highly correlated with measured weights ($r = 0.96$).

Exposure

To characterize the built environment, we used a standardized measure of urban sprawl called the *county sprawl index*, which has been previously associated with physical activity and BMI (Ewing et al., 2003, 2006; James et al., 2013). The county sprawl index was developed by Smart Growth America (2002) and calculated for all 448 metropolitan counties or statistically equivalent entities in the US. More than 183 million Americans, nearly two thirds of the United States population, lived in these 448 counties in 2000. Six county-level US Census 2000 variables were used to describe two characteristics of sprawl: 1) low residential density, which was a function of gross population; percentage of county population living at low suburban densities; percentage of county population living at moderate-to-high urban densities; and net density in urban areas, and 2) poor street accessibility, captured by average block size, and the percentage of blocks smaller than .01 square miles in area (the typical urban block is bounded by sides roughly .09 miles long).

Sprawling areas are generally less walkable or bikable than compact places. Through principal component analysis, the six census variables were combined to form one factor that explained 63.4% of the total variance among the input variables. This factor was then transformed to a county sprawl index variable