Health & Place 23 (2013) 104–110

Contents lists available at SciVerse ScienceDirect

Health & Place

journal homepage: www.elsevier.com/locate/healthplace

More neighborhood retail associated with lower obesity among New York City public high school students

Michael D. M. Bader [a,*], Ofira Schwartz-Soicher [b], Darby Jack [c], Christopher C. Weiss [d], Catherine A. Richards [e], James W. Quinn [e], Gina S. Lovasi [e], Kathryn M. Neckerman [f], Andrew G. Rundle [e]

[a] Department of Sociology and Center on Health, Risk and Society, American University Washington, DC, USA
[b] School of Social Work, Columbia University, NY, USA
[c] Department of Environmental Health Sciences, Mailman School of Public Health, Columbia University, NY, USA
[d] Applied Quantitative Research Program, Department of Sociology, New York University, NY, USA
[e] Department of Epidemiology, Mailman School of Public Health, Columbia University, NY, USA
[f] Columbia Population Research Center, Columbia University, NY, USA

ARTICLE INFO

Article history:
Received 22 May 2012
Received in revised form
20 May 2013
Accepted 23 May 2013
Available online 13 June 2013

Keywords:
Adolescent obesity
New York City
Fast food
Retail ecology
Neighborhoods

ABSTRACT

Policies target fast food outlets to curb adolescent obesity. We argue that researchers should examine the entire retail ecology of neighborhoods, not just fast food outlets. We examine the association between the neighborhood retail environment and obesity using Fitnessgram data collected from 94,348 New York City public high school students. In generalized hierarchical linear models, the number of fast food restaurants predicted *lower* odds of obesity for adolescents (OR:0.972 per establishment; CI:0.957–0.988). In a “placebo test” we found that banks – a measure of neighborhood retail ecology – also predicted lower obesity (OR:0.979 per bank; CI:0.962–0.994). Retail disinvestment might be associated with greater obesity; accordingly, public health research should study the influence of general retail disinvestment not just food-specific investment.

1. Introduction

Stemming the rising prevalence of obesity among children and adolescents is a key priority for policy makers in the United States. To accomplish this goal, some jurisdictions have adopted policies banning fast food restaurants within specific geographic areas. For example, the Los Angeles city council embargoed new fast food retail in a disadvantaged area of the city and the New York City (NYC) Council considered a fast food ban surrounding schools (Los Angeles City Council, 2008; Sturm and Cohen, 2009; Buckley, 2009).

Given the poor nutritional quality of products served by fast food restaurants, this seems like a reasonable course of action. Yet, studies examining the association of childhood and adolescent weight-related outcomes find mixed evidence. Some studies find a statistically significant, though small, association between obesity and fast food restaurants surrounding adolescents homes and schools (Harrison et al., 2011; Currie et al., 2010; Davis and Carpenter, 2009); however, others find no relationship between fast food restaurants and obesity-related outcomes for children and adolescents (Sturm and Datar, 2005; Powell et al., 2007; Laska et al., 2010; An and Sturm, 2012; Lee, 2012). One study of Australian youth found an inverse relationship between obesity and both distance to and density of fast food restaurants (Crawford et al., 2008).

Although the energy-dense products sold by fast food restaurants make them an obvious target for policy action (Bowman et al., 2004; Gordon-Larsen et al., 2011), the locations of fast food restaurants also reflect broader patterns of retail investment in neighborhood environments that may have positive outcomes for residents. The density of retail firms may provide employment (Wilson, 1996), “eyes on the street” to mitigate crime (Jacobs, 1961; Klinenberg, 2003; Browning et al., 2010), and financial and political capital to help improve city services (LaVeist, 1992, 1993; Logan and Molotch, 1987; Deener, 2007). By focusing exclusively on the link between fast food restaurants and obesity risk, public health researchers and policy makers risk missing – and ultimately exacerbating – more fundamental causes (Link and Phelan, 1995) of socioeconomic, and particularly, racial disparities in obesity.

* Correspondence to: Department of Sociology, American University, Battelle-Thompkins T-15, 4400 Massachusetts Ave. NW, Washington, D.C. 20016-8072, USA. Tel.: +1 202 885 2433; fax: +1 202 885 2477.
E-mail addresses: bader@american.edu, michaeldmbader@gmail.com (M.D.M. Bader).

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http://dx.doi.org/10.1016/j.healthplace.2013.05.005

In this paper, we examine the relationship between fast food, retail density, and obesity among 94,348 high school students in the NYC public school system. We link retail investment data to the residential Census tract of NYC public school students in the 2007–08 NYC Fitnessgram student assessments, which provides objective measures of height and weight. We examine the relationship between individual student obesity and the count of fast food restaurants in a student's neighborhood. To explore whether retail investment, rather than fast food specific investment, can explain our results, we also develop a “placebo test” by modeling the relationship between banks – a retail establishment that we have no reason to suspect would directly influence obesity in general – and obesity of high school students.

2. Methods

2.1. Data

Anthropometric data on 135,322 non-special education high school students came from the New York City (NYC) public schools' Fitnessgram program during the 2007–2008 academic year. The NYC Departments of Education and Health and Mental Hygiene jointly administer Fitnessgram, a program developed by the Cooper Institute to measure and improve physical fitness and health. Physical education teachers administered the physical fitness tests, including collection of data on students' height and weight (Morrow Jr. et al., 2010). Researchers have used Fitnessgram to study the role of ecological contexts on BMI, overweight, and obesity in previous studies (Currie et al., 2010; Kim et al., 2005).

We excluded special education students because they are often taught in separate classrooms and have medical conditions that might influence BMI. We excluded 21,088 students that did not have height or weight measures and therefore lacked data to calculate BMI or had a BMI *z*-scores greater than 5 standard deviations from the median of our sample because such extreme values likely result from measurement error (e.g., data entry errors). We also excluded observations for students who identified as American Indian/Native American, multiracial, and “other” race ($N=1047$); if the students' nativity was unknown ($N=56$); or if the student was less than 13 years old ($N=8$). This left an analytic sample of 113,123 (83% of those for which we have any Fitnessgram data).

American University, Columbia University, and the NYC Departments of Education and Health approved human subjects protection protocols.

2.2. Dependent variable

High school physical education teachers measured students' height and weight. We used these measures, along with their sex and age, to calculate BMI *z*-scores using the Centers for Disease Control SAS macro (Centers for Disease Control and Prevention, 2011). Of students in our data, 69.6% were categorized as having normal weight (BMI < 85th percentile), 16.6% were categorized as overweight (BMI≥85th percentile and BMI < 95th percentile) and 13.8% were obese (BMI≥95th percentile). This paper focuses on the comparison of normal weight students to obese students ($n=94{,}348$).

2.3. Independent and control variables

Students' home addresses listed in NYCDOE records were used to geocode the students to their residential Census tracts. Census tracts were deemed sufficiently large to provide anonymity for students while being sufficiently small for analysis of neighborhood characteristics. Students in our study come from a total of 2121 census tracts that represent each of the five NYC boroughs. The primary independent variables included in the model were measures of the neighborhood food environment in the Census tract based on geocoded establishment data obtained from Dun & Bradstreet. We created counts of three types of establishments: fast food (including national chain, local chain, and non-chain fast food), non-chain pizza establishments, and bodegas based on classifications previously used by Rundle et al. (2009).

Aggregating students to Census tracts can induce aggregation biases for two reasons: exposure might vary over the geographic area of the tract and the number of school-aged residents might not be distributed equally. Since we wish to measure the exposure experienced by adolescents within the tract, we used a two-stage approach to measure establishment counts. For a Census tract made up of B city blocks, we first drew a 400-m buffer around the centroid of each city-block b within the tract and counted the number of establishments, N_b, within that block's buffer. In the second stage, we took the average of the counts within each blocks buffer weighted by the proportion, p_b, of the tract's high school aged residents (residents ages 15–18) that live on the block. That is, the measure of establishment counts for tract i, X_i, is calculated as:

$$X_i = \sum_{b=1}^{B} p_{ib} N_{ib}$$

This method accounts for both variation in exposure and the uneven distribution of high school aged children in the tract.

We included a number of covariates at both the neighborhood and individual level of analysis. At the neighborhood level, we included a neighborhood walkability index adapted from the well-known measure developed by Frank et al. (2006), which includes measures of population density, intersection and subway stops density, land use mix and the ratio of retail building floor area to retail area (Neckerman et al., 2009). From 2000 Census data, we included indicators of Black and Latino segregation (measured as more than 70% of residents being Black or Latino, respectively), the proportion of foreign-born residents, and the proportion of residents below the federal poverty line.

The individual characteristics included in the file provided by NYCDOE were: age in years at time of Fitnessgram administration, gender (ref.=female), race/ethnicity (Asian, Black, or Hispanic with White being the reference category), and foreign birth. We constructed indicators of students' socioeconomic status based on their receipt of free or reduced price lunch: (a) Human Resource Administration free lunch provided to students in families participating in either Temporary Aid for Needy Families or Supplemental Nutrition Assistance Program and attending school in an impoverished area; (b) form-based free lunch obtained by applying to the school and qualifying based on income; (c) form-based reduced price lunch through the same application process; and (d) full price lunch. We also included an indicator if school lunch status is missing for a student.

2.4. Analytic strategy

We examined multivariate relationships of our dependent variable (obesity) with individual and residential neighborhood-level covariates. We use generalized hierarchical linear models with a logit link function to account for the clustering of students by neighborhood (Raudenbush and Bryk, 2002). After we conducted analyses on the full sample, we conducted gender-stratified analyses to examine potential heterogeneity of associations by gender.