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Neighborhood fast food availability and fast food consumption

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Abstract

Recent nutritional and public health research has focused on how the availability of various types of food in a person's immediate area or neighborhood influences his or her food choices and eating habits. It has been theorized that people living in areas with a wealth of unhealthy fast-food options may show higher levels of fast-food consumption, a factor that often coincides with being overweight or obese. However, measuring food availability in a particular area is difficult to achieve consistently: there may be differences in the strict physical locations of food options as compared to how individuals perceive their personal food availability, and various studies may use either one or both of these measures. The aim of this study was to evaluate the association between weekly fast-food consumption and both a person's perceived availability of fast-food and an objective measure of fast-food presence—Geographic Information Systems (GIS)—within that person's neighborhood. A randomly selected population-based sample of eight counties in South Carolina was used to conduct a cross-sectional telephone survey assessing self-report fast-food consumption and perceived availability of fast food. GIS was used to determine the actual number of fast-food outlets within each participant's neighborhood. Using multinomial logistic regression analyses, we found that neither perceived availability nor GIS-based presence of fast-food was significantly associated with weekly fast-food consumption. Our findings indicate that availability might not be the dominant factor influencing fast-food consumption. We recommend using subjective availability measures and considering individual characteristics that could influence both perceived availability of fast food and its impact on fast-food consumption. If replicated, our findings suggest that interventions aimed at reducing fast-food consumption by limiting neighborhood fast-food availability might not be completely effective.

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Declaration of Conflicting Interests

The authors declare that there is no conflict of interest.

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Keywords

Fast food; neighborhood; availability; presence; fast-food consumption

Introduction

Obesity is currently a major public health issue in the United States (Flegal, Carroll, Kit, & Ogden, 2012). Perhaps because of the limited success of individual-level weight-control interventions, policy-level strategies targeting environmental risk factor areas termed ‘obesogenic environments’ are on the rise (Ard, 2007; Caspi, Sorensen, Subramanian, & Kawachi, 2012; Fleischhacker, Evenson, Rodriguez, & Ammerman, 2011; Larson, Story, & Nelson, 2009; Story, Kaphingst, Robinson-O’Brien, & Glanz, 2008; Swinburn & Egger, 2004). Substantial research has focused on the lack of healthy factors in areas known as ‘food deserts’; such a lack is considered a factor in poor diet and increased obesity (Rose et al., 2009). Newer research has hypothesized that living in an area known as a ‘food swamp’, with increased availability of unhealthy food, may be a more important factor influencing dietary behavior (Dunn, Sharkey, & Horel, 2012; He et al., 2012; Jeffery, Baxter, McGuire, & Linde, 2006; Richardson, Boone-Heinonen, Popkin, & Gordon-Larsen, 2012). It is thus interesting to note that the obesity epidemic in the United States has coincided with exponential growth in the number of fast-food establishments and increased fast-food consumption (Powell, Chaloupka, & Bao, 2007).

Although fast-food consumption has been found to be a risk factor for obesity, the association between the availability of fast food and fast-food consumption is unclear, as there have been a limited number of studies performed on this subject. Additionally, although some studies support the hypothesis that higher fast-food availability is associated with poorer health behaviors or outcomes, others studies do not confirm this pattern (Caspi et al., 2012).

A key issue in the literature has been the characterization of fast-food availability in terms of a clear definition of places where fast food is consumed (e.g., restaurant vs. convenience store), a representative choice of locations determining availability (availability around one’s home vs. availability at one’s workplace vs. availability during the daily commute) and type of measurement (objective Geographic Information Systems (GIS) data vs. subjective perception data) (Larson et al., 2009; Sharkey, Johnson, Dean, & Horel, 2011; Thornton, Lamb, & Ball, 2013). In general, two methodological approaches have been used to measure availability: objective GIS-based data and subjective perception data (Charreire et al., 2010; Forsyth, Lytle, & Van Riper, 2010). Although the analysis of GIS data has been widely used in previous food environment research, its validity in measuring true exposure has been questioned, and the use of subjective measures such as an individual’s perceptions of his or her food environment has been recommended (Lucan & Mitra, 2012). However, to date, few studies have compared objective and subjective measures of this food-environment characteristic. A study that includes both objective and subjective measures offers an important contribution to the field because its findings may help clarify whether future intervention studies aimed at decreasing fast-food consumption should prioritize changes in

the built food environment (i.e., limiting the number of fast-food establishments), modifying individual perceptions or utilizing both approaches. Thus, we aimed to examine the association between neighborhood fast-food availability and weekly fast-food consumption, independent of sociodemographic and environmental characteristics, using both subjective and objective measures of the fast-food environment.

Materials and Methods

Study design and setting

This cross-sectional study was conducted in an eight-county study region in central South Carolina. The area was chosen because its entire food environment has been objectively assessed previously through on-the-ground verification of all commercial food outlets by teams of researchers (Liese et al., 2010, 2013).

Telephone survey data were collected by the University of South Carolina Survey Research Laboratory, and all interviews were conducted by trained staff between April and June of 2010. A simple random sample of residential phone numbers was selected from 64 eligible ZIP codes (covering the aforementioned eight-county study area), yielding a total of 2,477 residential listed landline telephone numbers. The study goal was to conduct phone interviews with about 15 respondents per ZIP code (i.e., ~960 total participants). All participants had to be at least 18 years old, the primary food shopper of the household and able to speak English. Ultimately, 968 individuals were recruited to a phone interview and were deemed eligible for participation; 337 successful contacts did not meet the inclusion criteria. Overall, applying the American Association for Public Opinion Research Response Rate Formula 4 (American Association for Public Opinion Research, 2009), we estimated a response rate of 47%, which is comparable to the 49% rate observed among landline households in a recent evaluation of the Behavioral Risk Factor Surveillance System (Hu, Balluz, Battaglia, & Frankel, 2011). The study was reviewed and approved by the institutional review board of the University of South Carolina.

Exposure

Perceived availability of neighborhood fast food was assessed using one question from an existing questionnaire designed for the Multi-Ethnic Study of Atherosclerosis (MESA) (Mujahid, Roux, Morenoff, & Raghunathan, 2007). A test-retest reliability survey showed good results (intra-class correlation 0.66, 95% confidence interval (CI): 0.54–0.76) for use in our study population (Ma et al., 2013). Participants were asked to think of their neighborhood as an area within a 20-minute walk, or about 1 mile, from their home. They then indicated the extent to which they agreed with the following statement on a five-point Likert scale: “there are many opportunities to purchase fast foods in my neighborhood such as McDonald’s, Taco Bell, KFC and take-out pizza places, etc.” Possible responses ranged from strongly agree (0) to strongly disagree (4). All answers were reverse coded so that 0 indicated the lowest perceived availability of fast food. For the statistical analysis, neutral replies (2) were excluded because of their low frequency (n=11). As no meaningful differences in fast-food consumption were found between the categories 0 and 1 and between the categories 3 and 4 and also because of sample-size considerations, this variable

was collapsed into a binary scale: lower (0,1) vs. higher (3,4) perceived availability of fast food.

The GIS-based presence of fast-food outlets (number of fast-food restaurants in a 1-mile buffer around the respondents home)—based on previously collected data of the food environment (Liese et al., 2010, 2013) and linked to participants via their geocoded address—was included in the analysis. Because a skewed distribution was observed and the majority of people (84.6%) had no fast-food outlet present in their neighborhood, this variable was collapsed into a binary scale (0 vs. 1 fast-food outlet present).

Outcome

A slightly altered question from MESA was used to assess weekly fast-food consumption (Moore, Roux, Nettleton, Jacobs, & Franco, 2009). Participants were asked “how often do you [typically] eat a meal from a fast-food place such as McDonalds’s, KFC, Taco Bell or take-out pizza places? By meal we mean breakfast, lunch or dinner, include eat in or takeout.” Participants could respond with “never” or a number of times per day, week, month or year. All responses were transformed to express a weekly consumption scale. Because the data were skewed, a categorization of the continuous variable was necessary, and thus a three-category variable was created (never or <1 time/week vs. 1 time/week vs. >1 time/week).

Covariates

Several demographic, socioeconomic and environmental characteristics were assessed during the telephone interview and were used to adjust for potential confounding factors. Age in years, sex, race/ethnicity according to the US Census approach, level of education (highest level of schooling completed), employment status and urbanity of living environment were included in the analysis.

Statistical analysis

Of the 968 participants, we sequentially excluded 106 persons with missing values on personal characteristics, 7 with no data on weekly fast-food consumption, 5 lacking perception data and 1 missing geospatial data. After excluding another 11 participants with neutral responses to the perceived fast-food availability question, 838 participants remained for analysis. Analyses were performed using the PROC LOGISTIC statement in SAS v9.2. (Cary, NC). To address our research question, unadjusted and adjusted multinomial logistic regression models were constructed to test the association between weekly fast-food consumption and both the perceived availability of fast food and the GIS-based presence of fast-food outlets within a person’s neighborhood.

Results

Table 1 presents the baseline characteristics of the participants. Our study sample was predominantly female, explained by the fact that women were the primary food shoppers in most of the households surveyed. The participants were on average 57.6 years old, and two-thirds reported being overweight or obese. The proportion of minority participants (33.4%)

was representative of the general South Carolina population. About half the participants had no college education, and around two-thirds were retired or unemployed. The perceived availability of fast food was equally distributed in the study sample, with roughly half the participants reporting lower perceived availability of fast food in their neighborhood. As determined by GIS, most of participants did not have any fast food present in their neighborhood. Around two-thirds of residents reported no weekly fast-food consumption, and the remaining one-third was split almost equally in terms of fast-food frequency per week (1 time/week or >1 time/week). Most of the individuals who had at least one fast-food restaurant present in their neighborhood were white (64.3%), had increased body mass index (BMI) (54.3% were overweight or obese), had a college education (62.0%) and resided in an urban neighborhood (58.9%) (data not shown).

Table 2 presents the baseline characteristics of participants by weekly fast-food consumption. There were only small differences in the amount of weekly fast-food consumption between participants with lower and higher perceived availability of fast food. Interestingly, based on GIS data, a higher proportion of participants with at least one fast-food restaurant in their neighborhood reported no fast-food consumption compared to participants with no fast-food restaurant in their neighborhood. In addition, eating fast food at least one time per week was more frequently reported among those with no fast-food restaurant in their neighborhood. Other notable differences were found between younger and older age, white and non-white race/ethnicity, different education levels and employed compared to unemployed or retired participants.

Table 3 presents the odds ratios (ORs) of weekly fast-food consumption as a function of the perceived availability or the GIS-based presence of fast food. For models 1 and 2, univariate logistic regression analyses of the two main exposure variables on fast-food consumption were performed. Residents who reported higher perceived availability of fast food were found to be at higher risk for fast-food consumption; however, the observed associations were not statistically significant. Interestingly, according to the GIS data, having one or more fast-food restaurants present in the neighborhood was significantly associated with lower odds of eating fast food on a weekly basis compared to not being exposed to any fast-food restaurants within the neighborhood. After adjusting for potential confounding factors, this association was no longer significant. When using a different GIS variable (distance to nearest fast-food outlet from a respondent's home), similar but weaker results for an inverse association between the GIS-based presence of fast food and fast-food consumption were observed (data not shown). The covariates younger age, white race/ethnicity and being employed (vs. unemployed or retired) significantly increased the odds of weekly fast-food consumption.

Discussion

Our study is one of the first to simultaneously assess the influence of both the perceived availability and the GIS-based presence of fast food on fast-food consumption. There was no evidence for an association between neighborhood fast-food availability (perceived or GIS-based) and weekly fast-food consumption in this study sample.

Using GIS data in studies examining the association between neighborhood fast-food presence and fast-food consumption, previous research reported conflicting findings (Boone-Heinonen et al., 2011; Dunn et al., 2012; Jeffery et al., 2006; Longacre et al., 2012; Moore, Roux, Nettleton, Jacobs, & Franco, 2009; Richardson et al., 2012; Thornton, Bentley, & Kavanagh, 2009; Turrell & Giskes, 2008). For example, using data derived from a cohort of young adults in the United States, Boone-Heinonen and colleagues (2011) reported that fast-food presence is associated with fast-food consumption among low-income respondents. Longacre et al. (2012) found that persons living in a non-metropolitan area with five or more fast-food outlets in their neighborhood are 30% more likely to eat fast food compared to persons with no such availability. In contrast, two other studies found no significant association between the presence of fast food and an individual's fast-food consumption (Jeffery et al., 2006; Thornton et al., 2009). The GIS-based results in our study partially confirm those of previous research in that they do not show a significant association between the number of fast-food outlets present in one's neighborhood and individual weekly fast-food consumption.

According to Lucan and Mitra (2012), GIS-based data are not able to capture all characteristics of the food environment, as it is determined not only by the presence of stores and restaurants but also factors such as street accessibility and produce sold. Additionally, fast-food restaurants might be geographically clustered around supermarkets, and GIS-based availability variables are not able to control for that fact (Lamichhane et al., 2013). Whereas most GIS-based data consider only traditional fast-food outlets as potential sources of fast food, there is evidence that convenience stores are also used to buy takeaway food (Sharkey et al., 2011). Another crucial determining factor not captured by GIS methodology is a person's individual perspective of his or her food environment. To overcome the abovementioned limitations of GIS-based data and in hopes of obtaining more consistent results, researchers now tend to use subjective methods that are based on an individual's perception and awareness measures of his or her food environment (Freedman & Bell, 2009; Lucan & Mitra, 2012; Moore, Roux, & Brines, 2008; Moore, Roux, & Franco, 2012; Moore, Roux, Nettleton, & Jacobs, 2008; Mujahid et al., 2007). Our research group has shown that self-reported information on food retail availabilities is quite accurate (Barnes, Freedman, Colabianchi, Bell, & Liese, in press). We have also shown that the built, GIS-based food environment does not explain a significant amount of variation in a person's perception of healthy or unhealthy neighborhood attributes (Barnes, Bell, Bethany A, et al., under review). To the best of our knowledge, only two previous studies used subjective availability measures, and both of these studies found significant associations between the perceived availability of fast food and fast-food consumption (Ho et al., 2010; Moore et al., 2009). Using self- and informant-reported measures of availability and a study design similar to that used in our study, Moore and colleagues (Moore et al., 2009) reported that higher perceived neighborhood fast-food availability increased the odds of eating fast food at least once a week by 61%. Another study conducted in Hong Kong (Ho et al., 2010) partially supports these findings by reporting a positive relationship between perceived fast-food availability and junk-food intake among boys and persons with low family affluence. Our point estimates here show an association in this same direction; however, no significant results were observed in our study. There are a number of methodological differences

between the study by Moore et al. and ours. Whereas Moore et al. (Moore et al., 2009) assessed binary fast-food consumption near a participant's home (yes/no), we asked for overall fast-food consumption and used a categorization that incorporated frequency per week. Additionally, whereas Moore et al. (Moore et al., 2009) collected data on persons living in urban areas, most of our participants resided in rural areas. On average, participants in our study had 0.5 fast-food restaurants present within a 1-mile buffer around their home compared to 2 fast-food restaurants in the study by Moore et al. (Moore et al., 2009). In terms of subjective measures of fast-food availability, our participants reported low perceived neighborhood fast-food availability (mean of 1.83 on a scale ranging from 0 to 4); Moore and colleagues (Moore et al., 2009) observed a much higher self-reported fast-food availability among their subjects (mean of 3.5 on a scale ranging from 0 to 4). Interestingly, even though fast-food availability was lower in our study population, the percentage of people who reported consuming fast food at least one time per week was much higher (40.6% in our study vs. 29.7% in Moore et al., 2009).

Some limitations of our study should be considered when interpreting our results. Because of the cross-sectional study design, causation cannot be inferred (i.e., availability might influence behavior, or food preferences might influence availability). Focusing on the study design, the true associations may be weaker than those reported here, as we did not ask about fast-food consumption near home specifically, and we had no data about fast-food availability for other relevant sites, such as a respondent's workplace (Thornton et al., 2013). In addition, the definition of fast food may vary among the participants, and thus the responses could be biased. Our study design is based on the assumption that people use the most proximate food outlet; however, this is not necessarily the case, as participants might travel longer distances for food consumption (Burgoiné & Monsivais, 2013; Krukowski, Sparks, DiCarlo, McSweeney, & West, 2013). Coulton and colleagues (Coulton, Jennings, & Chan, 2013; Coulton, Korbin, Chan, & Su, 2001) showed that there are individual differences in how a person defines his or her neighborhood. To address this issue, participants in our study were told to think about their neighborhood as an area within a 20-minute walk, or about 1 mile, from their home; however, bias in this measure is still possible. Furthermore, fast-food consumption might not be restricted to fast-food restaurants, as convenience stores and supermarkets increasingly offer takeout and prepared foods (Sharkey et al., 2011). As mentioned above, our sample was comprised primarily of women because our inclusion criteria required participants to be the primary food shopper of the household. It is reasonable to assume that a person responsible for a household's food shopping has more balanced knowledge and perception of their food environment and might be less influenced by the presence of fast-food outlets. Thus, generalizability of our findings might be limited.

The major strength of this study is the use of both perceived and verified, GIS-based data of neighborhood fast-food availability, thereby allowing for a comparison between objective and subjective measures. In addition, our sample comprised urban and non-urban neighborhoods and included participants of different socioeconomic characteristics, such as education, race/ethnicity and employment.

Our findings have two important implications. First, our results support the claim of previous studies that GIS-based and perceived data on fast-food availability might not measure the same construct and should be differentiated. Even though our results did not reach statistical significance, our point estimates clearly showed a positive relationship between fast-food availability and consumption when using perception data and an inverse relation when using GIS-based data. Incorporating the entire subjective impression of the environment, it is thus reasonable that subjective measures might better reflect the actual influence of fast-food presence. Second, in consideration of our results and the conflicting findings of previous research, we posit that a person's role as the primary food shopper of the household could be crucial for both that person's perception of fast-food availability and the impact of fast-food presence on his or her food shopping behavior. Persons responsible for food shopping for a household may have an increased awareness of neighborhood fast-food availability. This assumption is supported by the fact that 80% of participants in our study accurately perceived the presence of a fast-food restaurant within 1 mile of their home ($Kappa=0.5-0.61$) (Barnes et al., 2015 revision in review). It is intriguing to speculate that such people would also tend to buy more food for preparation at home and thus be less influenced by fast-food availability. This may be one explanation for the lack of association between perceived or GIS-based fast-food availability and fast-food consumption. Additional evidence for this line of reasoning comes from one other study that demonstrated a positive association between fast-food availability among men only, who are not typically the primary food shoppers of the household (Boone-Heinonen et al., 2011).

Our results highlight the need for more research on the influences of fast-food availability on fast-food consumption. Specifically, studies should consider individual differences in how the structural presence or perceived availability of fast food can influence fast-food consumption. Although this study cannot rule out previous inconsistencies in the data, our results indicate that neighborhood fast-food availability might not directly influence fast-food consumption. If our findings are replicated, they suggest that policy-level interventions that reduce neighborhood fast-food availability with the aim of reducing fast-food consumption might not be as effective as hoped.

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Highlights

- We investigated the influence of fast-food availability on fast-food consumption.
- Fast-food availability was measured using perception and GIS data.
- Fast-food availability was not associated with fast-food consumption.
- Individual differences influence availability perception and its effect.
- Limiting neighborhood fast-food availability might not be as effective as hoped.

Table 1

Description of baseline characteristics of participants. Values are presented as means (SD) or percent frequency.

Variables	N=838
Perceived neighborhood fast-food availability (lower vs. higher) ^a	
<i>lower</i>	56.0
<i>higher</i>	44.0
<i>mean^c</i>	1.8 (1.5)
Presence of fast-food outlets within 1 mile from home (0 vs. 1) ^b	
<i>0</i>	84.6
<i>1</i>	15.4
<i>mean^c</i>	0.5 (1.8)
Fast-food consumption	
<i>never or <1 time/week</i>	59.4
<i>1 time/week</i>	18.3
<i>>1 time/week</i>	22.3
<i>mean^c</i>	1.11 (1.76)
Demographics	
Gender	
<i>men</i>	20.9
<i>women</i>	79.1
Age	
<i>years</i>	57.6 (14.5)
BMI ^d	
<i>under or normal weight (<25)</i>	31.0
<i>overweight (25 to <30)</i>	36.0
<i>obese (≥ 30)</i>	33.0
Race	
<i>non-Hispanic white</i>	66.6
<i>minority^e</i>	33.4
Education	
<i>less than high school education</i>	11.6
<i>grade 12 or GED</i>	35.3
<i>any college</i>	53.1
Employment	
<i>retired</i>	35.2
<i>unemployed</i>	22.9
<i>employed</i>	41.9
Urbanity	
<i>urban</i>	20.8
<i>non-urban</i>	79.2

^a Lower availability was defined as having answered 0 or 1 to the perceived availability question. Higher availability was defined as having answered 3 or 4 to the same question.

^b Number of fast-food restaurants present within a 1-mile buffer around the respondent's home, categorized as 0 (no fast-food outlet present) or 1 (at least one fast-food outlet present).

^c Calculated using the original continuous variable before categorization.

^d Calculated using self-reported weight and height.

^e Minorities included were African American, Hispanic and other.

Table 2

Baseline characteristics of participants by weekly fast-food consumption. Values are presented as percent frequency. (N=838)

Variables	Weekly fast food consumption		
	never	1 time/week	more than 1 time/week
Overall	59.4	18.3	22.3
Perceived neighborhood fast-food availability (lower vs. higher) ^a			
<i>lower</i>	60.1	28.1	21.8
<i>higher</i>	58.5	18.4	23.1
Presence of fast-food outlets within 1 mile from home (0 vs. 1) ^b			
0	57.6	18.9	23.5
1	69.8	14.7	15.5
Demographics			
Gender			
<i>men</i>	53.7	20.6	25.7
<i>women</i>	60.9	17.7	21.4
Age			
<45	37.8	30.7	41.5
45 to <65	58.0	19.0	23.0
65	74.2	15.8	10.0
BMI ^c			
<i>under/normal weight (<25)</i>	63.0	15.2	21.6
<i>overweight (25 to <30)</i>	57.4	18.9	23.7
<i>obese (≥ 30)</i>	59.4	19.2	21.4
Race			
<i>non-Hispanic white</i>	55.4	19.9	24.7
<i>minority^d</i>	67.5	15.0	17.5
Education			
<i>less than high school education</i>	71.1	15.5	13.4
<i>grade 12 or GED</i>	60.8	17.6	21.6
<i>any college</i>	56.0	19.3	24.7
Employment			
<i>retired</i>	74.6	15.3	10.2
<i>unemployed</i>	66.2	15.5	19.3
<i>employed</i>	43.0	22.8	34.2
Urbanity			
<i>urban</i>	66.1	15.5	18.4
<i>non-urban</i>	57.7	19.0	23.3

^aLower availability was defined as having answered 0 or 1 to the perceived availability question. Higher availability was defined as having answered 3 or 4 to the same question.

^b Number of fast-food restaurants present within a 1-mile buffer around the respondent's home, categorized as 0 (no fast-food outlet present) or 1 (at least one fast-food outlet present).

^c Calculated using self-reported weight and height.

^d Minorities included were African American, Hispanic and other.

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Table 3

Multinomial logistic regression models testing the association between fast-food consumption and both perceived availability of fast food and GIS-based presence of fast-food outlets. (N=838)

	Exposure	Fast-food consumption 1 time/week vs. never	Fast-food consumption <1 time/week vs. never
		OR (95% CI)	OR (95% CI)
Model 1	Perceived availability of fast food ^a	1.044 (0.725–1.504)	1.088 (0.776–1.526)
Model 2	Presence of fast-food outlets ^b	0.643 (0.378–1.094)	0.543 (0.324–0.911)
Model 3	Perceived availability of fast food ^a	1.153 (0.789–1.684)	1.238 (0.871–1.758)
	Presence of fast-food outlets ^b	0.609 (0.351–1.057)	0.501 (0.293–0.854)
Model 4 ^c	Perceived availability of fast food ^a	1.195 (0.800–1.786)	1.300 (0.880–1.920)
Model 5 ^c	Presence of fast-food outlets ^b	0.720 (0.400–1.298)	0.623 (0.346–1.123)
Model 6 ^c	Perceived availability of fast food ^a	1.250 (0.832–1.876)	1.379 (0.929–2.046)
	Presence of fast-food outlets ^b	0.684 (0.376–1.242)	0.579 (0.319–1.052)

^aReference category: lower availability (defined as having answered 0 or 1 to the perceived availability question; higher availability was defined as having answered 3 or 4 to the same question)

^bReference category: having no fast-food outlet present within a 1-mile buffer around the respondent's home (vs. having at least one fast-food outlet present).

^cModel adjusted for: age, gender, race, education, employment and living environment.