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Neighborhood Food Environments and Body Mass Index The Importance of In-Store Contents

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Abstract

Background—Most public health studies on the neighborhood food environment have focused on types of stores and their geographic placement, yet marketing research has long documented the influence of in-store shelf-space on consumer behavior.

Purpose—This paper combines these two strands of research to test whether the aggregate availability of specific foods in a neighborhood is associated with the BMIs of its residents.

Methods—Fielded from October 2004 to August 2005, this study combines mapping of retail food outlets, in-store surveys, and telephone interviews of residents from 103 randomly sampled urban census tracts in southeastern Louisiana. Linear shelf-space of fruits, vegetables, and energy-dense snack foods was measured in 307 food stores in the study tracts. Residential addresses, demographic information, and heights and weights were obtained from 1243 respondents through telephone interviews. Cumulative shelf-space of foods within defined distances of each respondent was calculated using observations from the in-store survey and probability-based assignments of shelf-space to all unobserved stores in the area.

Results—After controlling for sociodemographic variables, income, and car ownership, regression analysis, conducted in 2008, showed that cumulative shelf-space availability of energy-dense snack foods was positively, although modestly, associated with BMI. A 100-meter increase in shelf-space of these foods within 1 kilometer of a respondent's household was associated with an additional 0.1 BMI points. Fruit and vegetable shelf-space was not significantly related to BMI.

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Conclusions—Interventions that seek to improve the neighborhood food environment may need to focus on more than just increasing access to healthy foods, because the results suggest that the availability of energy-dense snack foods plays a role in weight status.

Introduction

Obesity is the most pressing nutritional problem in the U.S. A number of researchers have studied the relationship between neighborhood food environments and the consumption of foods that might affect weight status.[1–5] Researchers have also explored the direct relationship between retail outlets and weight status. A Massachusetts study found that the presence of a supermarket in a ZIP code area was associated with a reduced risk of obesity among area residents.[6] Using census-tract data from four states, it was found[7] that the presence of a supermarket was associated with a lower prevalence of obesity or overweight status. Another study[8] found that the ZIP code–level concentration of chain supermarkets was associated with reduced BMI and overweight among a national sample of U.S. adolescents.

Although these studies have advanced the field of neighborhood analysis, more work is needed to understand the nuances of context. The marketing literature has long realized the importance of shelf-space in affecting consumer behavior,[9–12] yet this aspect has rarely been considered in public health studies on the neighborhood food environment. For example, it has been found[10] that doubling the shelf-life of fruits and vegetables resulted in sales increases of about 40%; other studies[9,12] have also documented increased sales resulting from shelf-space manipulations for a wide variety of foods. A second gap in the public health literature is that most of it has focused on supermarkets, but in urban neighborhoods, stores other than supermarkets might play an important role in consumption. A third issue is that geographic scale has not been well explored in these studies. The census tract may be too small an area, because many residents are likely to shop outside the tracts in which they live. ZIP codes or counties may be too broad, particularly for urban residents.

This paper seeks to develop our understanding of the link between weight status and the neighborhood food environment. Environments are characterized at various distances around an individual's residence by summing the shelf-space of specific foods—fruits and vegetables and energy-dense snack foods—in all area stores. BMI is hypothesized to be inversely associated with the availability of fruits and vegetables and positively associated with the availability of energy-dense snack foods.

Methods

Study Sample

This study is part of a larger project on neighborhood alcohol and food environments and their relationship to consumption and health outcomes.[13] The sample frame consisted of all urban census tracts within a 26-parish (county) area of southeastern Louisiana, and it included the cities of New Orleans, Baton Rouge, and Lafayette. Urban tracts were defined as those that had a population density of ≥ 2000 people per square mile. Of the 379 urban tracts in this area, 114 were randomly selected for this study. Begun in October 2004, the study ended abruptly in August 2005, because of Hurricane Katrina. Thus, only 103 of the initial 114 sampled tracts were observed. These are referred to as study tracts. The research consisted of three components: a mapping of all retail outlets that sold food in the study tracts and in neighboring areas, in-store surveys of stores in the study tracts, and a telephone survey of residents in study tracts. Phone and store surveys were sequenced throughout the year in a coordinated fashion, and systematic ordering assured a balanced representation across the three major cities, despite the abrupt ending.

Mapping of Retail Outlets

A list of retail outlets that sold alcohol was obtained from the Louisiana Department of Alcohol and Tobacco Control. The list was categorized by census tract in order to observe all stores in the study tracts. A team of two observers drove down every street in these tracts to verify that stores on the list were still open and to record addresses of stores not on the original list. In all, 307 stores were observed and geocoded using ArcGIS 9.2. Although most full-time food stores in Louisiana sell alcohol, some general merchandise and drugstores do not. To capture all outlets that sold food, and because residents might make purchases at stores in tracts adjacent to where they lived, address and store-type information was obtained from the Louisiana Office of Public Health for all stores permitted to sell food in the broader area from which tracts were sampled.

The final geocoded store list included the 307 stores in the study tracts described above, as well as 2614 stores in this broader area. These stores were first grouped into either full-time groceries (grocery sales ≥ 60% of total gross sales) or other store types (grocery sales <60% of gross sales). Full-time groceries were subsequently classified into three types: (1) small food stores (sales of <$1 million/year); (2) medium food stores (sales of $1–$5 million/year); and (3) supermarkets (sales of >$5 million/year). Other store types were subsequently classified into gas/convenience/drugstores, general merchandise stores, and liquor stores. These classifications were based on store names, including descriptors of chains and other key words. (Complete categorization criteria for store type is available from the authors.)

In-Store Survey

All outlets enumerated in the study tracts were included in the in-store survey. In each outlet, observers recorded the type of store and its total floor space. The length of shelf-space allotted to groups of foods was measured using a tape measure. Separate measures were taken for fresh fruits and vegetables versus canned and frozen versions of these foods. The length of shelf-space allotted to four categories of snack foods was also assessed. These included: candies, such as chocolates, hard candy, and gum; salty snacks, such as potato chips, salted nuts, and pretzels; cookies and pastries, including doughnuts, fruit pies, and crackers; and carbonated beverages, including diet sodas. The two observers were trained together in actual stores in a nonsampled tract. Inter-rater reliability measures were >0.95 for shelf-length measures for fruits and vegetables.[14]

Telephone Survey

The telephone survey was conducted in parallel with the mapping and in-store surveys and employed a two-stage sampling process. Study tracts were selected in the first stage (see the Study Sample section). In the second stage, a systematic random selection was made from households with landlines listed in public directories. The original target was to sample ten from each tract, with up to 12 call attempts on five different occasions for each household number. The overall cooperation rate (completes/known eligibles) was 0.80 and the overall response rate (completes/total imputed eligibles) was 0.38.[15] A “complete” refers to a completed phone interview. Private residences with working phones and an individual aged 18–65 years were eligible for the study. Within sampled households, interviewers randomly selected an interviewee within this age range. Interviews were conducted by professional interviewers at Clearwater Research Inc. using a computer-assisted telephone interview system. The questionnaire collected information on the household’s address; basic demographics on the respondent, including car ownership; and height and weight of the respondent. The final sample (N=1243) contains all individuals with nonmissing key variables, described below.

Key Variables

Respondents reported their weight in pounds and their height in feet and inches, which were converted into BMI. Household-specific addresses and street-network distances to all stores in the sample were used to characterize the neighborhood food environment within 100, 500, 1000, 2000, and 5000 meters of each household. The shelf-space of a specific food group in all of the stores within a given distance from a household was summed to get a cumulative availability measure—the total amount of shelf-space of fruits, for example, within 500 meters of a household. Cumulative availability measures were based on specific food groups (e.g., fruits, vegetables, salty snacks, candies, cookies, carbonated beverages) and on aggregated food groups (e.g., fruits and vegetables, snack foods). Although the in-store surveys measured shelf-space in outlets in the sampled tracts, residents might shop outside their tract. To account for this possibility, a probability-based technique, known as hot-decking, was used to randomly assign shelf-space from the observed stores to similar types of stores in these neighboring tracts.

Statistical Analyses

All analyses were performed in 2008 using Stata, version 10. Multivariable regression analysis was based on the ordinary least-squares procedure, and it controlled for demographics including gender, age, race/ethnicity, education, household income, and car ownership. Correction for clustering used the cluster procedure in Stata; clusters were defined by census tracts.

Results

Two thirds of respondents were women and >60% were aged ≤ 50 years (Table 1). About half of respondents were white, 42% were African-American, and 5% were Latino. The rate of car ownership in the sample was 88%. Table 1 also presents overall means of BMI. African Americans have a higher mean BMI than whites. Respondents who were aged >50 years had higher BMIs than respondents aged ≤ 30 years.

The most frequently observed stores in the in-store survey were the gas/convenience/drugstores (n=133), followed by small food stores (n=119). Supermarkets (n=38) contained an average of 114 meters of fruits and vegetables and 247 meters of energy-dense snack foods with an average of 4052 square meters of total floor space (not shown). The same averages for convenience stores were 0.66 meters, 40 meters, and 193 square meters, respectively. One quarter of households in the sample had a supermarket within 1 kilometer of their residence, whereas 76% had a gas/convenience/drugstore within that distance (not shown). Only about 5% of households had any store within 100 meters of their residence, whereas almost all households had some type of store within 2 kilometers.

Table 2 presents the amount of shelf-space of various food items within specified distances of each household. On average, households had 18 meters of fruit shelf-space, and 34 meters of vegetable shelf-space within 1 kilometer of their residences. The amounts of various snack food items at this distance far outweigh those of these healthy food items. For example, an average of 72 meters of candy was found within 1 kilometer of residences, which is about twice the amount of vegetables and four times the amount of fruits.

Neighborhood availability of fruits and vegetables was not significantly related to BMI in regression models (Table 3). A positive and significant, yet modest, association was found between the neighborhood availability of energy-dense snack foods and BMI. An additional 100 meters of shelf-space of these foods within 1 kilometer of an individual’s residence was positively associated with 0.1 units of BMI. African Americans, older individuals, and men also had higher BMIs. Controlling for other variables, the mean BMI for African Americans was about 2.3 units higher than that for the reference group.

Because of uncertainty regarding the relevant size of the neighborhood food environment, models were run with the availability of different foods at 500 meters, 1 kilometer, and 2 kilometers from each household. At 1 kilometer, not only was the aggregate availability of energy-dense snack foods positively associated with BMI, but so too was the availability of specific groups of snack foods—salty snacks, candies, and sodas (Table 4). Availability of fruits and/or vegetables was not significantly related to BMI at 500 meters, 1 kilometer, or at 2 kilometers, nor was availability of most of the snack food groups at 500 meters or at 2 kilometers. Exceptions were the availability of carbonated beverages at 500 meters and of candies at 2 kilometers.

Discussion

The neighborhood availability of energy-dense snack foods within 1 kilometer of an individual's residence was positively associated with BMI, after controlling for individual- and household-level characteristics. An additional 100 meters of shelf-space for snack foods was associated with an increase in 0.1 BMI units. At this rate, an increase equivalent to 1 SD in the neighborhood shelf-space of energy-dense snack foods would translate to about two extra pounds for a person who is 5′5″. Positive associations were also found when availability was disaggregated into specific types of snack foods, that is, when salty snacks, candies, and carbonated beverages were analyzed separately. There were no significant associations of BMI with the availability of fruits and vegetables.

Other public health research has reported associations between the food environment and weight status among area residents, with inverse associations between supermarket availability and BMI or obesity,[6–8] and positive associations between convenience store availability and overweight status.[7,8] The premise of this store-based literature is that the presence of a supermarket increases access to healthy food, allowing residents to achieve a better weight status from improved dietary consumption. The corollary is that convenience stores provide an excess of unhealthy foods, making it more difficult for residents to control their weight status. This research tests the availability dimension directly by assessing the total amount of shelf-space of fruits and vegetables and energy-dense snack foods. Although there is no other literature with which to compare the associations between food availability and BMI, the results are consistent with the premise and findings from previous store-based research.

This approach allows for an assessment of the cumulative contributions to food availability from various store types. Small and medium grocers often have positive amounts of fruits and vegetables, and their easy accessibility might allow for fill-in shopping in urban areas with a distant supermarket.[16] Moreover, the marketing literature has long shown that shelf-space is the relevant concept for driving consumer purchase decisions. Although area residents might not shop in all stores within a given radius of their house, greater shelf-space availability in this area implies more options about when and where to shop for specific foods, such as on the way home from work or on the way to visiting a neighbor's house.

Why then do the current results not show an inverse association between availability of fruits and vegetables and BMI? Unlike snack foods, the purchase of fruits and particularly vegetables is more likely to be planned than impulsive, because they typically require cooking or preparation. It has been argued[17] that salience, or seeing a food, can stimulate unplanned consumption. Energy-dense snack foods were much more available at 1 kilometer than fruits and vegetables, and snack foods are more frequently placed at cash registers. These cues could have led to more impulse purchases and greater consumption of energy-dense foods.

Second, consistent with this argument, the results do show negative, although not significant, coefficients on the fruit and vegetable availability measures at 2 kilometers (Table 4). Perhaps residents did mostly planned purchases of fruits and vegetables at supermarkets, so the wider radius was more relevant for this food group. About three times as many respondents had a supermarket within 2 kilometers of their house than within 1 kilometer. Finally, price may be more important for planned purchases than impulsive buys. Supermarkets not only have a greater availability of fruits and vegetables, but their prices for these foods are often lower than those in small groceries.[18] The lack of information on price data from these stores is certainly one limitation to this study.

Another limitation is that the study is cross-sectional. Thus, associations seen between access and BMI cannot be attributed to causality. Individuals were not randomly assigned to housing locations. Rather than the environment affecting food choices, individuals with given food preferences could have chosen to move to specific food environments. Although this argument could certainly be raised as a limitation to this study, mobility in Louisiana, prior to Hurricane Katrina (when this study was conducted), was relatively low. Census data from 2000 show that 79% of people living in Louisiana were born there, the highest rate in the country.[19]

Outcome measures were also based on self-report. Women are known to understate their weight, and men to overstate their height.[20,21] Both errors result in a lower BMI than the true value, and mean BMIs in this dataset are lower than national averages. However, there is no reason to believe that these biases would be systematically associated with geographic variables, such as distance to specific store types.

The results presented here come from a phone survey based on a sample of listed landlines. Compared to residents in the overall population from which this sample was drawn, the sample consists of those who are slightly older, with more women, fewer African Americans, and a higher average household income. However, regression models have controlled for these variables, so a sampling bias is not likely to affect the overall conclusions. Of more potential concern are unobserved differences caused by the unavoidable exclusion of households without landlines. Although recent research[22] suggests that binge drinking and smoking behaviors are more prevalent among “cell phone only” adults, it is unknown if these individuals react differently to food environments than others, and if they do, whether such differences would strengthen or weaken conclusions presented here.

A number of studies have shown associations between access to specific retail outlets and BMI/obesity. This study indicates an association of BMI and obesity, albeit modest, with specific types of foods. This type of finding, if supported by additional research, might be more easily amenable to policy action. It is not a simple matter to increase the number of supermarkets in underserved areas. Supermarkets operate at very narrow margins, so profitability limits entry into some areas. There may, however, be potential to change the shelf-space configurations of successful small stores currently operating in low-income neighborhoods. Various initiatives have been suggested[23,24] to achieve such change, from taxation of snack foods to incentives to increase healthy food offerings. If successful, these policy changes could improve the neighborhood food environment and offer better conditions for those seeking to address energy imbalance.

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References

1. Morland K, Wing S, Roux AVD. The contextual effect of the local food environment on residents' diets: the Atherosclerosis Risk in Communities Study. Am J Public Health 2002;92(11):1761–8. [PubMed: 12406805]
2. Laraia BA, Siega-Riz AM, Kaufman JS, Jones SJ. Proximity of supermarkets is positively associated with diet quality index for pregnancy. Prev Med 2004;39(5):869–75. [PubMed: 15475018]
3. Rose D, Richards R. Food store access and household fruit and vegetable use among participants in the U.S. Food Stamp Program. Public Health Nutr 2004;7(8):1081–8. [PubMed: 15548347]
4. Jago R, Baranowski T, Baranowski J, Cullen K, Thompson D. Distance to food stores & adolescent male fruit and vegetable consumption: mediation effects. Int J Behav Nutr Phys Act 2007;4(1):35. [PubMed: 17850673]
5. Moore LV, Roux AVD, Nettleton JA, Jacobs DR Jr. Associations of the local food environment with diet quality—a comparison of assessments based on surveys and geographic information systems: the Multi-Ethnic Study of Atherosclerosis. Am J Epidemiol 2008;167(8):917–24. [PubMed: 18304960]
6. Lopez RP. Neighborhood risk factors for obesity. Obesity (Silver Spring) 2007;15(8):2111–9. [PubMed: 17712130]
7. Morland K, Roux AVD, Wing S. Supermarkets, other food stores, and obesity: the Atherosclerosis Risk in Communities Study. Am J Prev Med 2006;30(4):333–9. [PubMed: 16530621]
8. Powell LM, Auld MC, Chaloupka FJ, O'Malley PM, Johnston LD. Associations between access to food stores and adolescent body mass index. Am J Prev Med 2007;33(4S1):S301–S307. [PubMed: 17884578]
9. Curhan RC. The relationship between shelf space and unit sales in supermarkets. J Market Res 1972;9:406–12.
10. Curhan RC. The effects of merchandising and temporary promotional activities on the sales of fresh fruits and vegetables in supermarkets. J Market Res 1974;11:586–294.
11. Inman JJ, Winer RS. Where the rubber meets the road: a model of in-store consumer decision making. Marketing Science Institute 1998;98–122:1–34.
12. Wilkinson JB, Mason JB, Paksoy CH. Assessing the impact of short-term supermarket strategy variables. J Market Res 1982;19(1):72–86.
13. Bluthenthal RN, Cohen DA, Farley TA, et al. Alcohol availability and neighborhood characteristics in Los Angeles, California and southern Louisiana. J Urban Health 2008;85(2):191–205. [PubMed: 18228148]
14. Cohen DA, Schoeff D, Farley TA, Bluthenthal R, Scribner R, Overton A. Reliability of a store observation tool in measuring availability of alcohol and selected foods. J Urban Health 2007;84(6): 807–13. [PubMed: 17763963]
15. Clearwater Research, Inc. Technical Report. Boise: Clearwater Research, Inc; 2005. Rand Alcohol Phone Survey of Los Angeles County and Louisiana State.
16. Bodor JN, Rose D, Farley TA, Swalm C, Scott SK. Neighbourhood fruit and vegetable availability and consumption: the role of small food stores in an urban environment. Public Health Nutr 2007;11 (4):413–20. [PubMed: 17617930]
17. Wansink B. Environmental factors that increase the food intake and consumption volume of unknowing consumers. Annu Rev Nutr 2004;24:455–79. [PubMed: 15189128]
18. Chung C, Myers SL. Do the poor pay more for food? An analysis of grocery store availability and food price disparities. J Consum Aff 1999;33(2):276–96.
19. Singer, A.; Donato, KM. In Katrina's wake, who will return?. 2005. www.brookings.edu/opinions/2005/0927demographics_singer.aspx
20. Rowland ML. Self-reported weight and height. Am J Clin Nutr 1990;52(6):1125–33. [PubMed: 2239790]
21. Kuczmarski MF, Kuczmarski RJ, Najjar M. Effects of age on validity of self-reported height, weight, and body mass index: findings from the Third National Health and Nutrition Examination Survey, 1988–1994. J Am Diet Assoc 2001;101(1):28–34. [PubMed: 11209581]
22. Blumberg SJ, Luke JV. Coverage bias in traditional telephone surveys of low-income and young adults. Public Opin Q 2007;71(5):734–49.

23. Glanz K, Yaroch AL. Strategies for increasing fruit and vegetable intake in grocery stores and communities: policy, pricing, and environmental change. Prev Med 2004;39(S2):75–80.

24. Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating healthy food and eating environments: policy and environmental approaches. Annu Rev Public Health 2008;29(1):253–72. [PubMed: 18031223]

Table 1

Demographic characteristics and mean BMI of sampled respondents

Variable	*n* (%)	BMI (M [SD])
Gender		
Female	822 (66.1)	27.2 (6.7)
Male	421 (33.9)	27.8 (5.2)
Age (years)		
18–30	246 (19.8)	26.1 (6.0)
31–49	532 (42.8)	27.4 (6.3)**
≥50	465 (37.4)	28.2 (6.2)**
Race		
White	626 (50.4)	26.4 (6.0)
African-American	522 (42.0)	28.8 (6.3)**
Latino	57 (4.6)	27.7 (6.1)
Other	38 (3.1)	25.1 (4.6)
Education		
<High school	112 (9.0)	28.3 (6.4)
High school	355 (28.6)	28.1 (6.2)
Some college	310 (24.9)	27.4 (6.0)
College	466 (37.5)	26.7 (6.4)*
Household income($)		
<10,000	192 (15.5)	28.4 (6.9)
10,000–25,000	306 (24.6)	28.1 (6.3)
25,000–50,000	304 (24.5)	27.2 (5.8)*
>50,000	441 (35.5)	26.7 (6.1)**
Owns a car		
Yes	1088 (87.5)	29.2 (7.2)
No	155 (12.5)	27.2 (6.0)**
Total	1243 (100.0)	27.4 (6.2)

* $p<0.05$

** $p<0.01$

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Table 2

Mean (SD) shelf-space of various food items within specified distances of households

Food group	100 m	500 m	1 km	2 km	5 km
Fruits	0.2 (2.0)	4.1 (11.5)	18.4 (27.3)	87.6 (69.1)	506.7 (254.8)
Vegetables	0.4 (3.3)	8.0 (19.2)	34.4 (46.8)	158.2 (124.9)	946.2 (542.7)
Fruits and vegetables	0.5 (5.3)	12.1 (30.5)	52.8 (73.3)	245.9 (192.5)	1452.9 (794.2)
Candy	0.4 (3.1)	14.8 (27.0)	72.4 (75.2)	314.8 (193.4)	1859.0 (892.5)
Salty snacks	0.6 (3.4)	16.9 (25.5)	79.4 (73.1)	341.0 (207.1)	2034.0 (1092.8)
Cookies	0.6 (4.4)	15.7 (28.8)	73.3 (78.0)	317.9 (211.6)	1901.3 (1022.0)
Soda	0.8 (4.0)	21.0 (28.6)	91.2 (81.9)	380.9 (260. 4)	2283.3 (1432.9)
All snacks	2.4 (13.9)	68.4 (104.1)	316.4 (294.6)	1354.6 (842.8)	8077.6 (4400.4)

Table 3

Regressions of BMI on neighborhood shelf-space

	Coefficient (SE)	
Variable	**Model 1**	**Model 2**
Shelf-space within 1 km of home		
Fruits and vegetables	0.000 (0.002)	
Energy-dense snacks		0.001 (0.001)*
Age (years; ref: ≤30)		
31–50	1.569 (0.460)**	1.591 (0.462)**
≥50	2.491 (0.395)**	2.502 (0.397)**
Gender (female)	−0.809 (0.344)*	−0.783 (0.342)*
Race (ref: white + other)		
African-American	2.259 (0.431)**	2.298 (0.428)**
Latino	1.279 (0.863)	1.276 (0.867)
Education (ref: high school or less)		
Some college	−0.111 (0.449)	−0.059 (0.452)
College graduate	−0.255 (0.478)	−0.194 (0.484)
Income ($K; ref: $0K–$25K)		
25–50	−0.145 (0.466)	−0.093 (0.466)
>50	−0.293 (0.498)	−0.202 (0.494)
Household owns car	−0.846 (0.674)	−0.735 (0.669)
Intercept	26.347 (0.809)**	25.789 (0.836)**

* $p<0.05$

** $p<0.01$

Table 4

Associations of neighborhood shelf-space of foods with BMI, by size of neighborhood around household[a]

	Coefficient (SE)		
Shelf-space of each food	**500 m**	**1 km**	**2 km**
Fruits	0.010 (0.010)	0.001 (0.005)	−0.001 (0.002)
Vegetables	0.004 (0.006)	0.001 (0.003)	−0.000 (0.001)
Fruits and vegetables	0.003 (0.004)	0.000 (0.002)	−0.000 (0.001)
Candy	0.008 (0.005)	0.005 (0.002)*	0.002 (0.001)*
Salty snacks	0.009 (0.006)	0.005 (0.002)*	0.001 (0.001)
Cookies	0.005 (0.005)	0.003 (0.002)	0.000 (0.001)
Soda	0.012 (0.006)**	0.004 (0.002)*	0.001 (0.001)
All snack foods	0.002 (0.001)	0.001 (0.001)*	0.000 (0.000)

[a] Each food shelf-space–neighborhood size coefficient is based on a separate, ordinary least-squares model, as displayed in Table 3, in which BMI is the dependent variable, and independent control variables include age, gender, race/ethnicity, education, income, and car ownership.

* $p<0.05$

** $p<0.01$