For Low-Income Americans, Living ≤1 Mile (≤1.6 km) from the Nearest Supermarket Is Not Associated with Self-Reported Household Food Security

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Abstract

Background: Motivated by concern over lack of access to nutritious food in low-income neighborhoods, healthy food financing initiatives have encouraged the introduction of new supermarkets. Extensive research on the association between the food retail environment and nutrition outcomes has shown mixed results. There has been less research specifically on food security outcomes.

Objective: We assessed the association between multiple food environment measures and food security for low-income US households.

Methods: By using the USDA’s nationally representative 2012–2013 Food Acquisition and Purchase Survey (FoodAPS; n = 4826 households), which provides unique information about neighborhood- and household-level food retailer access, we quantified cross-sectional associations between food environment characteristics and household-level outcomes, with and without regression controls. Logistic regression analysis was used for binary household food security outcomes.

Results: Most households bypassed the nearest retailer to select a primary retailer farther from home. For low-income households, distance to the nearest supermarket and to the primary retailer was not associated with food security. In comparison to shopping with households’ own automobile, the odds of being food secure were lower for households that used another automobile (OR: 0.59; 95% CI: 0.38, 0.90) or other transportation (OR: 0.32; 95% CI: 0.17, 0.61) to reach the primary retailer.

Conclusions: Having a closest supermarket ≤1 mile from home was not associated with household food security. In contrast, the mode of transportation used to access the primary retailer was associated with household food security. In future research, it may be valuable to not only focus on the distance to the nearest supermarket but to investigate the qualities of the food retail environment at distances ≥1 mile that are most strongly associated with food security outcomes. Curr Dev Nutr 2017;1:e001446.

Introduction

An extensive research literature has investigated how local food retail access conditions in low-income US neighborhoods affect diet quality, diet-related health, and to a lesser extent, food insecurity (1–12). These concerns have risen to the level of policy makers, as federal, state, and local-level programs have been enacted to improve access to sources of healthful foods (13–15).

Much of the research and policy interest have focused on the lack of retailers selling healthful foods in low-income neighborhoods identified as “supermarket deserts.” Research and policy efforts have typically measured access by the presence or absence of supermarkets at very close distances, such as 0.8 km (0.5 miles) or 1.6 km (1 mile) from home (2, 4–7, 11, 12), especially in more-dense, urban areas. Sometimes greater distance
benchmarks are used in less-dense rural areas and to account for greater access to automobiles (16). Other studies used density of
stores within similar specific distances (3, 10). A few studies have
also emphasized automobile access and their use for traveling to su-
permarkets regardless of proximity (6, 11, 17). Less healthful food se-
lections have been associated with supercenter retail formats (18)
and with higher monthly shopping frequency (19). Finally, a few
studies focused on the importance of prices of food, in addition to
proximity, as determinants of where households shop and what
they purchase (20, 21). In sum, the existing studies have made di-
fferent implicit assumptions about which features of the food retail en-
vonment matter, and they have reached different conclusions about
the direction of likely effects.

This article sought to identify what qualities of the food retail
environment are associated with household food security for low-
income consumers. Rather than make assumptions about what
distances are adequate or which retailers should be preferred,
we took an empirical approach to identifying the qualities of the
food retail environment that predict low-income consumers’
choice of primary food retailer, their opinion about this primary
retailer, and their experience of household food security.

The article used data from the USDA’s National Household Food
Acquisition and Purchase Survey (FoodAPS), fielded in 2012–2013.
FoodAPS was the first household survey to collect data on foods
purchased or acquired during a survey week for a sample who is
representative of Supplemental Nutrition Assistance Program
(SNAP) participant households, low-income nonparticipating
households, and all US households. The survey collected informa-
tion related to food consumption and diet, including food shopping
behavior and household food security. FoodAPS provided informa-
tion not just about distance to the nearest supermarket but also
about the distance to the primary food retailer where respondents
actually shop. The USDA’s first report that used these survey data
found that, for SNAP households, the mean distance to the nearest
supermarket was 3.2 km (2.0 miles), but the mean distance to the
primary retailer actually used for food shopping was considerably
greater, 5.5 km (3.4 miles) (21).

In our conceptual framework shown in Figure 1, the left side
shows that our basic explanatory variables were the distance to
the nearest supermarket and household resources, including
SNAP benefits, cash income, and access to an automobile. The
right side shows that our main outcome variable was household
food security based on survey responses. For intermediate vari-
ables, we focused on consumers’ choice of primary food retailer, in-
cluding the mode of transportation used to reach the retailer and
the consumers’ stated reasons for choosing the retailer. The dis-
tance to nearest supermarket at the top left is a characteristic of
a household’s geographical location, whereas the intermediate
variables in the center depend simultaneously on geographic loca-
tion and on the household’s own choice about where to shop.

Methods

FoodAPS included nationally representative samples of SNAP par-
ticipants plus 3 income strata of nonparticipants. For brevity, we
called these the 4 “household resource strata.” The sample design
had 50 primary sampling units, which were counties or groups of
contiguous counties. Each primary sampling unit contained 8 sec-
ondary sampling units, which were census block groups or groups
of contiguous block groups. The sample size was 4826 households
for FoodAPS overall and 2015 households for the 2 lowest-income
strata (SNAP participants and the lowest-income nonparticipants).

Basic variables

SNAP participation status was determined on the basis of adminis-
trative records and on self-report from the survey questionnaire. If
the administrative records indicated participation, but the self-
report did not, the administrative record was accepted as correct.
For 122 households that did not consent to have their records
matched, SNAP participation status was determined by self-reported
participation. The household income category was determined on
the basis of household respondent answers to detailed questions
about income sources. Supermarkets and supercenters were design-
nated on the basis of their classification in SNAP’s Store Tracking
and Redemption System (STARS). The supermarket category is com-
posed of supermarkets, food stores, grocery stores, and warehouses
that typically have >10 checkout lanes with registers, bar code scan-
ers, and conveyor belts. The supercenter category is composed of
very large supermarkets, “big box” stores, superstores, and food
warehouses that sell a wide variety of grocery and other store mer-
chandise. Linear distance was calculated from each household home
address to the nearest SNAP-authorized supermarket or superstore
(henceforth “supermarkets” for brevity). We defined 4 distance cat-
egories to the nearest supermarket: ≤0.8, >0.8 and ≤1.6, >1.6 and
≤16.1, and >16.1 km (≤0.5, >0.5 to 1, >1 to 10, and >10 miles,
respectively). For ease of comparison with the US literature, we re-
ferred to these distance boundaries in miles.

Intermediate variables

Respondents were asked, “Where [do you/does your household] do
most of your food shopping?” Major food retail outlets near each
secondary sampling unit were identified in advance of the survey,
and this list was available to interviewers administering the household questionnaires. If the household reported a primary food retailer that was not identified in advance, the interviewer recorded the name and approximate address, and the location was determined later. Linear distance from the home address to the primary retailer was also calculated. For a question about the mode of transportation to the primary retailer, we categorized responses as the respondent’s own automobile, somebody else’s automobile, and other (including bus, walking, and cycling). The respondent was asked the reason for choosing the primary retailer, and on the basis of the 2 most frequently given responses, we defined 4 response categories (because it is close to home, because of low prices, both reasons, and neither reason).

Just over two-thirds of low-income households (69%) leased or owned an automobile; of these, one would expect, a large fraction (88%) used their own automobile as their transportation mode to the primary retailer (Supplemental Table 1). The remaining low-income households (31%) did not own or lease an automobile; of these, nonetheless, 20% reported using their “own” automobile as the mode of transportation to the primary retailer. Respondents may experience a range of access rights to automobiles (e.g., automobiles owned by relatives or close friends in the same household or neighborhood). We used the direct question about transportation mode to the primary retailer as the clearest statement of the respondents’ perceived access to transportation for grocery shopping.

Control variables
We included an indicator for residence in a metropolitan statistical area, sex of respondent, completion of high school and college or beyond, and race and ethnicity of the respondent (white non-Hispanic, black non-Hispanic, other non-Hispanic, or Hispanic). Due to an insufficient sample size for some races, the other non-Hispanic category included respondents identifying with American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, >1 race, or other race.

Outcome variable
Household food security was defined by using the 10 adult-referenced items in the USDA’s household food security survey module, with a reference period of the previous month. Households that gave ≤2 affirmative responses were classified as food secure.

Statistical analyses
Cross-tabulations showed the association between the basic explanatory variables and intermediate variables, and also between the distance to the primary retailer (an intermediate variable) and the household food security outcome. In the main multivariate analysis, logistic regression models expressed the binary food security outcome variable as a function of the food retail environment, household resources, and decisions about the chosen primary retailer simultaneously. Recognizing that none of the explanatory variables was randomly assigned, the cross-sectional associations were not interpreted as causal. Because the households’ choice of primary retailer in particular was endogenous to their own preferences and decisions, alternative specifications available in Supplemental Table 2 expressed the outcome variables as a function of just the basic explanatory variables. All of the logistic regression analyses included separate specifications for the full sample and for just the 2 lowest-income strata.

All of the analyses were weighted to represent the national US population with the use of survey weights provided by the USDA on the FoodAPS household data set. SEs and hypothesis tests were corrected for the survey design by using the Taylor Series expansion method, as implemented in the “svy” procedures of Stata 12.0 (StataCorp). Estimated associations were deemed significant based on an α of 0.05. The Tufts University Institutional Review Board granted exemption from review under category 4, for analysis of secondary data.

Results

Descriptive statistics
For the full sample, the nearest supermarket was located ≤0.5 miles from home for 26% of households, and another 29% had a nearest supermarket between 0.5 and 1 mile from home (Table 1). Access to a nearby supermarket was better for the 2 lowest-income resource strata. For SNAP participants, 33% had a nearest supermarket within 0.5 miles from home, and another 35% had a nearest supermarket between 0.5 and 1 mile from home.

In all 4 resource strata, households commonly traveled farther than the closest supermarket (Table 1), usually accessing the primary retailer by automobile. Depending on the resource stratum, 81–97% of households used an automobile as their mode of transportation. For the highest-income stratum of non-SNAP households, 95% used their own automobile. For SNAP participants, by contrast, 66% used their own automobile and another 21% used somebody else’s automobile.

The frequency of citing “low prices” as a reason for choosing the primary retailer ranged from 50% in the highest-income non-SNAP stratum to 60% in the SNAP stratum (Table 1; summing the response frequencies for “low prices” and “both” reasons). The frequency of citing proximity as a reason had the opposite correlation with income. It ranged from 56% for the highest-income non-SNAP stratum to 40% for the lowest non-SNAP stratum (Table 1; summing the response frequencies for “close” and “both” reasons).

Even for the 2 lowest-income resource strata, many households bypassed the nearest retailer to use a primary food retailer at a greater distance (Table 2). For example, among households that had a nearest supermarket within 0.5 miles from home, 19% chose a primary retailer between 0.5 and 1 mile from home, and fully 44% chose a primary food retailer at a distance >1 mile from home. Conversely, among low-income households whose nearest supermarket was >1 mile from home, few simply made do with a nearby retailer: 1.3% of these households chose a primary retailer (a non-supermarket) that was ≤1 mile from home.

For low-income households whose nearest supermarket was >1 mile from home, only 1.7% used a transportation mode other than an automobile to reach their primary food retailer (Table 2). For low-income households that had a nearest supermarket at closer distances, the relative frequency of using a non-automobile mode to the primary retailer (because it is close to home, because of low prices, both reasons, and neither reason).
mode of transportation was much higher. Yet, even for low-income households with nearby supermarkets ≤0.5 miles from home, fully 71% used an automobile to reach their primary food retailer.

Approximately half of low-income households that had access to a nearby supermarket at a distance of ≤0.5 miles said they chose their primary retailer because it was “close” (Table 2; summing the response frequencies for “close” and “both” reasons). In places where the nearest supermarket was >1 mile away, only 41% of households gave “close” as a reason for choosing the primary retailer.

The distance to the primary food retailer was strongly associated with the mode of transportation, in the direction one would expect (Table 3). Of low-income households that traveled between 1 and 10 miles to the primary food retailer, 6.8% used a transportation mode other than automobile. By contrast, of low-income households that traveled ≤0.5 miles to the primary food retailer, almost 40% used a transportation mode other than automobile (although this still leaves more than half of these households using an automobile). In addition, traveling longer distances to the primary retailer was associated with a higher probability of citing “low prices” as a reason and a lower probability of citing “close” proximity as a reason for choosing the primary retailer (Table 3).

With regard to the main outcome variable, 55.5% of low-income households were food secure, which left 44.5% with reported food insecurity in the previous month (Table 3). Low-income households that traveled a longer distance to the primary food retailer were not more likely to be food insecure. The null hypothesis of no association between proximity and food security could not be rejected \( (P = 0.22) \).

### Logistic regression analysis

The logistic regression analysis allowed us to measure the associations between the several intermediate and basic explanatory variables and the household food security outcome. We first report results for the 2 lowest-income resource strata (Table 4, left column) and then report results for the full sample with all 4 strata (Table 4, right column).

For the 2 lowest-income resource strata, compared with the omitted category of using one’s own automobile, the use of somebody else’s automobile and the use of some other transportation mode to reach the primary food retailer were associated with lower odds of being food secure (Table 4, left column). Reporting low prices as the reason for choosing the primary retailer was associated with lower odds of being food secure.

For the full sample of all 4 resource strata, compared with using one’s own automobile, the use of a non-automobile transportation mode was again associated with lower odds of a household being food secure (Table 4, right column). For the full sample, as with the low-income sample, no distance variable showed any significant association with food security. By contrast, having higher income was associated with greatly increased odds of a household being food secure (OR: 5.7; 95% CI: 3.75, 8.73). Having a college education was associated with greatly increased odds of a household being food secure.

As a robustness check, we also conducted the logistic regression analysis by using only the basic explanatory variables that describe household resources and distance to the nearest supermarket, and then again by using only the intermediate variables (Supplemental Tables 2 and 3). Most of the results of these 2
separate analyses mirrored the results of the full model. One exception is that automobile ownership had a significant and positive association with food security in the model with the use of only the basic explanatory variables (Supplemental Table 3), whereas the corresponding coefficient had been insignificant in our full model (Table 4). Automobile ownership was nonsignificant in models that also included mode of transportation to the primary retailer.

**Discussion**

First, we found that the distance to the nearest supermarket had surprisingly little association with some household decisions about the primary food retailer. Most low-income respondents were not trapped into using a very close retailer at walking or bus distances of 0.5 or 1 mile. Instead, low-income households most commonly used automobiles to reach primary food retailers at distances of 1–10 miles. Even among low-income households whose nearest supermarket was close to home, 64% bypassed their closest supermarket to choose a primary food retailer at a greater distance, and 70% reached their primary food retailer by automobile. For SNAP participants and for nonparticipants in all 3 income strata, a common reason for choosing the primary food retailer was "low prices." For SNAP participants and low-income nonparticipants, it was less common to choose the primary food retailer because it was "close."

Second, we found that distance variables had surprisingly small associations with food security outcomes. In the descriptive analyses, the distance to the primary retailer had no significant association with household food security. In the logistic regression

**TABLE 2**  Factors related to supermarket choice for low-income FoodAPS households in the United States, by distance to nearest supermarket

<table>
<thead>
<tr>
<th>Food environment indicators</th>
<th>Total, %</th>
<th>≤0.5 miles</th>
<th>&gt;0.5 to 1 miles</th>
<th>&gt;1 mile</th>
<th>F-statistic</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>33.3</td>
<td>33.8</td>
<td>32.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to primary retailer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤0.5</td>
<td>13.5</td>
<td>37.5</td>
<td>—</td>
<td></td>
<td>51.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;0.5 to 1</td>
<td>19.0</td>
<td>18.6</td>
<td>39.7</td>
<td>1.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;1 to 10</td>
<td>53.0</td>
<td>33.6</td>
<td>52.4</td>
<td>73.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;10</td>
<td>14.5</td>
<td>10.4</td>
<td>7.9</td>
<td>25.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation mode to retailer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Own auto</td>
<td>64.8</td>
<td>53.7</td>
<td>61.9</td>
<td>79.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Another auto</td>
<td>20.6</td>
<td>17.4</td>
<td>25.1</td>
<td>19.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other mode</td>
<td>14.6</td>
<td>28.9</td>
<td>13.0</td>
<td>1.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason for choosing primary retailer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.4</td>
<td>0.25</td>
</tr>
<tr>
<td>Neither</td>
<td>15.7</td>
<td>17.2</td>
<td>17.6</td>
<td>12.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low prices</td>
<td>39.2</td>
<td>34.1</td>
<td>37.0</td>
<td>46.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close</td>
<td>24.7</td>
<td>26.7</td>
<td>24.3</td>
<td>23.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>20.4</td>
<td>22.0</td>
<td>21.1</td>
<td>18.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Values are population-weighted proportions unless otherwise indicated; n = 2014 households. FoodAPS, Food Acquisition and Purchasing Survey.
2The 1 to ≤10- and >10-mile distance categories were combined for disclosure purposes.
3Values are row percentages.
4The ≤0.5- and 0.5 to ≤1-mile estimates were combined for nondisclosure purposes.

**TABLE 3**  Factors related to supermarket choice and both food security and diet quality for low-income FoodAPS households in the United States, by distance to primary supermarket

<table>
<thead>
<tr>
<th>Food environment indicators</th>
<th>Total, %</th>
<th>≤0.5 miles</th>
<th>&gt;0.5 to 1 miles</th>
<th>&gt;1 to 10 miles</th>
<th>&gt;10 miles</th>
<th>F-statistic</th>
<th>P</th>
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</thead>
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<tr>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td>13.5</td>
<td>19.0</td>
<td>53.0</td>
<td>14.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation mode to retailer</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Own auto</td>
<td>64.8</td>
<td>48.0</td>
<td>57.6</td>
<td>70.2</td>
<td>70.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Another auto</td>
<td>20.6</td>
<td>12.1</td>
<td>19.3</td>
<td>23.0</td>
<td>21.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other mode</td>
<td>14.6</td>
<td>39.9</td>
<td>23.1</td>
<td>6.8</td>
<td>8.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason for choosing primary retailer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neither</td>
<td>15.7</td>
<td>11.2</td>
<td>14.4</td>
<td>17.4</td>
<td>15.6</td>
<td></td>
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<tr>
<td>Low prices</td>
<td>39.2</td>
<td>20.6</td>
<td>25.3</td>
<td>46.5</td>
<td>48.1</td>
<td></td>
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<tr>
<td>Close</td>
<td>24.7</td>
<td>45.7</td>
<td>33.8</td>
<td>17.3</td>
<td>20.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>20.4</td>
<td>22.5</td>
<td>26.5</td>
<td>18.8</td>
<td>15.9</td>
<td></td>
<td></td>
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<tr>
<td>Household food security</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Not food secure</td>
<td>44.5</td>
<td>44.5</td>
<td>50.9</td>
<td>42.7</td>
<td>42.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food secure</td>
<td>55.5</td>
<td>55.6</td>
<td>49.1</td>
<td>57.3</td>
<td>57.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Values are population-weighted proportions unless otherwise indicated; n = 2014 households. FoodAPS, Food Acquisition and Purchasing Survey.
2Values are row percentages.
analysis, although higher income and education were associated as expected with much greater odds of a household being food secure, the distance to the nearest supermarket had no significant association with food security, in any specification, for either the low-income or the full sample. This seems like an important null result: favorable food security outcomes were associated with many economic and transportation constraints, but they were not associated with the distance to the nearest supermarket.

Third, mode of transportation was associated with household food security. In the logistic regression analysis, for the low-income sample, households that used their own automobile to reach the primary food retailer had the highest odds of being food secure. By comparison to this "own automobile group," significantly lower odds of being food secure were observed for low-income households that used other people's automobiles or no automobile. As noted in Methods, we cannot necessarily conclude that owning an automobile caused the positive food security outcome. It may be that owning an automobile was beneficial or it may just be that having an automobile was associated with unobserved financial assets, economic resources, human capital, or budgeting practices, which also could affect household food security directly. One possible interpretation is that favorable outcomes were linked to being able to break out of the most immediate food retail environment to reach a primary food retailer whose low prices and other qualities are most important for household food security.

Most low-income shoppers had access to automobiles and to supermarkets within short driving distances, but it is still worthwhile to consider the populations who face greater food retail access challenges. First, we found that 3.7% of all households lacked a nearest supermarket located ≥10 miles, a distance beyond which food retail access may be impaired even for households that travel by automobile. Second, a small share of households that were located far from the nearest retailer may have faced considerable hardship because they lacked convenient access to an automobile. Of the low-income households with a nearest supermarket between 1 and 10 miles away (30% of all low-income households), 18% used somebody else's automobile and 2% used no automobile at all. We noted earlier that the distance to the nearest supermarket had no association with our main food security outcomes, but that the lack of association may be attributable to the effort—perhaps burdensome effort—that low-income households may exert to gain access to an automobile for grocery shopping.

### Table 4

Logistic regression of food environment factors associated with food security for FoodAPS households in the United States

<table>
<thead>
<tr>
<th>Food environment indicators</th>
<th>Low-income groups (n = 1918)</th>
<th>All income groups (n = 4809)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distance to nearest retailer, miles</strong></td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>≤0.5</td>
<td>0.86 (0.66, 1.11)</td>
<td>0.91 (0.67, 1.23)</td>
</tr>
<tr>
<td>&gt;0.5 to 1</td>
<td>0.83 (0.54, 1.27)</td>
<td>1.08 (0.79, 1.50)</td>
</tr>
<tr>
<td>&gt;1 to 10</td>
<td>1.39 (0.43, 4.49)</td>
<td>0.72 (0.33, 1.53)</td>
</tr>
<tr>
<td>&gt;10</td>
<td>1.06 (0.75, 1.50)</td>
<td>0.96 (0.68, 1.34)</td>
</tr>
<tr>
<td><strong>Car ownership</strong></td>
<td>0.82 (0.57, 1.17)</td>
<td>0.85 (0.59, 1.21)</td>
</tr>
<tr>
<td><strong>SNAP/income group</strong></td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Non-SNAP</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>&lt;100% FPL</td>
<td>—</td>
<td>1.74* (1.19, 2.53)</td>
</tr>
<tr>
<td>100 to &lt;185% FPL</td>
<td>—</td>
<td>5.72* (3.75, 8.73)</td>
</tr>
<tr>
<td>≥185% FPL</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>SNAP</td>
<td>0.82 (0.57, 1.17)</td>
<td>0.85 (0.59, 1.21)</td>
</tr>
<tr>
<td><strong>Distance to primary retailer, miles</strong></td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>≤0.5</td>
<td>0.73 (0.46, 1.17)</td>
<td>0.93 (0.62, 1.39)</td>
</tr>
<tr>
<td>&gt;0.5 to 1</td>
<td>0.97 (0.60, 1.58)</td>
<td>1.25 (0.75, 2.07)</td>
</tr>
<tr>
<td>&gt;1 to 10</td>
<td>0.89 (0.39, 2.06)</td>
<td>1.75 (0.89, 3.43)</td>
</tr>
<tr>
<td>&gt;10</td>
<td>1.04 (0.64, 1.67)</td>
<td>0.97 (0.64, 1.47)</td>
</tr>
<tr>
<td><strong>Transportation mode to primary retailer</strong></td>
<td>0.90 (0.52, 1.58)</td>
<td>0.94 (0.64, 1.37)</td>
</tr>
<tr>
<td>Own auto</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Another auto</td>
<td>0.59* (0.38, 0.90)</td>
<td>0.56* (0.40, 0.80)</td>
</tr>
<tr>
<td>Other mode</td>
<td>0.32* (0.17, 0.61)</td>
<td>0.47* (0.32, 0.69)</td>
</tr>
<tr>
<td><strong>Reason for choosing primary retailer</strong></td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>Low prices</td>
<td>0.62* (0.41, 0.93)</td>
<td>0.72 (0.50, 1.04)</td>
</tr>
<tr>
<td>Close</td>
<td>1.04 (0.64, 1.67)</td>
<td>0.97 (0.64, 1.47)</td>
</tr>
<tr>
<td>Both</td>
<td>0.90 (0.52, 1.58)</td>
<td>0.94 (0.64, 1.37)</td>
</tr>
<tr>
<td>Neither</td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td><strong>Race/ethnicity</strong></td>
<td>Reference</td>
<td>Reference</td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>1.19 (0.85, 1.66)</td>
<td>0.77 (0.55, 1.06)</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>1.05 (0.55, 2.02)</td>
<td>0.61* (0.61, 0.92)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1.07 (0.80, 1.43)</td>
<td>0.68* (0.49, 0.94)</td>
</tr>
<tr>
<td>Metropolis</td>
<td>1.06 (0.84, 1.33)</td>
<td>1.00 (0.76, 1.31)</td>
</tr>
<tr>
<td>Female sex</td>
<td>0.86 (0.62, 1.19)</td>
<td>1.04 (0.81, 1.34)</td>
</tr>
<tr>
<td>High school graduate</td>
<td>1.40 (0.94, 2.08)</td>
<td>1.44* (1.11, 1.86)</td>
</tr>
<tr>
<td>College graduate</td>
<td>1.70 (0.92, 3.15)</td>
<td>2.82* (1.77, 4.50)</td>
</tr>
</tbody>
</table>

1 Values are ORs (95% CIs). *P < 0.05. FoodAPS, Food Acquisition and Purchasing Survey; FPL, federal poverty level; SNAP, Supplemental Nutrition Assistance Program.
Our results may be surprising, because much of the literature has focused on the absence of supermarkets or long distance to the nearest supermarket in some neighborhoods. But some research, including both older (22) and more recent (17, 23) research, has also found that distance to the nearest supermarket is not the most important determinant of where households shop for food. Other recent research suggests that the opening of a new supermarket in a neighborhood that was previously without one may not necessarily change store choice (5, 6).

This research has several limitations. Because the design was cross-sectional, the model may exhibit reverse causality or have omitted confounding variables. This may be especially true for intermediate variables describing the households’ own decisions about the primary food retailer. Our main results merely identified associations. It remains for future work to measure the impact of decisions about the primary food retailer with the use of instrumental variables approaches or other research designs capable of identifying cause and effect.

This article sought to identify the features of the food retail environment that are most strongly associated with low-income households’ own experiences of food security. In particular, we moved beyond distance to the nearest supermarket and focused instead on access to an automobile and being able to choose a primary retailer whose low prices and other qualities were important for consumer shopping choices.

It will be valuable in future research to develop more robust information about the range of competitive prices and other retail characteristics available in the food retail environment faced by low-income Americans to measure the impacts on food-spending outcomes beyond the broad measure of self-reported food security studied here. Healthy food financing initiatives have identified neighborhoods to target for investments, on the basis of distance to nearest supermarket and poverty status. This study contributes to a body of research that suggests that such initiatives could reduce emphasis on distance to the nearest supermarket and consider several additional factors, including the distance to the primary retailer, reasons for choosing the primary retailer, mode of transportation to the primary retailer, frequency of lack of access to an automobile, and self-reported satisfaction with the food retail environment. With this approach, it is possible that somewhat fewer neighborhoods would be identified as supermarket deserts and that healthy food financing efforts can be targeted to the particular food retail characteristics that are most salient to residents’ self-reported experience.

Acknowledgments
The authors’ responsibilities were as follows—PW and MVP: designed the research strategy; PW and AS: analyzed the survey data; and all authors: wrote the manuscript and read and approved the final manuscript.

References
5. Cummins S, Flint E, Matthews SA. New neighborhood store increased awareness of food access but did not alter dietary habits or obesity. Health Aff (Millwood) 2014;33:283–91.