# Obesity and Supermarket Access: Proximity or Price?

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*Objectives.* We examined whether physical proximity to supermarkets or supermarket price was more strongly associated with obesity risk.

*Methods.* The Seattle Obesity Study (SOS) collected and geocoded data on home addresses and food shopping destinations for a representative sample of adult residents of King County, Washington. Supermarkets were stratified into 3 price levels based on average cost of the market basket. Sociodemographic and health data were obtained from a telephone survey. Modified Poisson regression was used to test the associations between obesity and supermarket variables.

*Results.* Only 1 in 7 respondents reported shopping at the nearest supermarket. The risk of obesity was not associated with street network distances between home and the nearest supermarket or the supermarket that SOS participants reported as their primary food source. The type of supermarket, by price, was found to be inversely and significantly associated with obesity rates, even after adjusting for individual-level sociodemographic and lifestyle variables, and proximity measures (adjusted relative risk = 0.34; 95% confidence interval = 0.19, 0.63)

*Conclusions.* Improving physical access to supermarkets may be one strategy to deal with the obesity epidemic; improving economic access to healthy foods is another. (*Am J Public Health.* 2012;102:e74–e80. doi:10.2105/AJPH.2012.300660)

Access to food sources within the built environment can exert a powerful influence on diet quality, body weight, and other health outcomes.[1–10] Inequitable access to healthful foods, in particular, is thought to be one root cause of the obesity epidemic.[11,12]

In many studies, people living in low-income or minority communities were reported to be at greater distance from full-service supermarkets and from grocery stores selling healthful foods.[13–22] Lower income census tracts had fewer supermarkets compared with wealthier areas.[20,23,24] African Americans were less likely to live in census tracts with a supermarket compared with Whites.[4,25] In other studies, closer proximity to full-service supermarkets was associated with healthier eating, lower body mass index values, and with lower rates of obesity and diabetes among adults.[1–5,7,26–30]

Studies on obesity and access to healthful foods were based, for the most part, on 2 underlying assumptions. The first assumption was that full-service supermarkets were most likely to offer healthful foods at affordable prices.[7,12] Consequently, full-service supermarkets were clearly distinguished from fast-food outlets and convenience stores.[3,4,7,10,16,18,31,32] It may also be helpful to differentiate supermarkets further by food quality or food price.[33–36]

The second assumption was that most people shopped for food either at the nearest food store or in their own neighborhood or census tract. Physical distance to the nearest supermarket became the principal measure of access to healthful foods. The density of supermarkets or other food stores in a given area was then linked with measures of diets and health in the same area.[7,11,27,31,36] Some studies employed more realistic street network distances to calculate the distance between the participant's home and the nearest supermarket.[37–41]

To our knowledge, a study from Newcastle, United Kingdom, was the only observational study that collected data on food retail access—distance to the food shops, food availability, and price—and examined these in relation to socioeconomic status (SES), diets, and health.[35,36] The present Seattle Obesity Study (SOS), was the first US-based study to collect data on supermarkets, SES, and health, advancing the field in 3 important ways. First, the geocoding of study participants' home addresses and the locations of their principal food sources, as obtained from a telephone survey, allowed for the calculation of network distances between the participants' homes, the nearest supermarket, and the supermarket that study respondents actually shopped at. Second, supermarket chains were stratified into 3 price levels based on the average cost of the market basket of 100 representative foods. The stratification of supermarkets by price allowed for the novel reconceptualization of access to healthy foods both in terms of physical proximity and economic access as determined by supermarket price. Third, the SOS was the first study to collect all data at the individual level, eliminating potential bias because of geographic aggregation.

The goal was to determine whether supermarket proximity or price would be more strongly associated with obesity rates, adjusting for individual level demographics, education, and income. In previous studies, obesity was linked to the consumption of low-cost, energy-dense foods.[42,43]

## METHODS

The SOS was a population-based study of social disparities, diet quality, and health. A stratified sampling scheme ensured adequate representation by income range and race/ethnicity. King County, Washington, zip codes with high percentages of households with incomes less than $35 000, African-Americans, or Hispanics were oversampled. Detailed methodology was previously published.[44,45] Following standard procedures, randomly generated telephone numbers were matched with residential addresses using commercial databases. A prenotification letter was mailed out to alert potential participants that their household was randomly selected for a study by the University of Washington (UW) School of Public Health. Telephone calls were placed in the afternoons and evenings by trained, computer-assisted interviewers with up to 13

follow-ups. Once the household was contacted, an adult member of the household was randomly selected to be the survey respondent. Exclusion criteria were age younger than 18 years, discordance between data obtained from the vendor and self-reported by the respondent, and cell phone numbers. The study protocols were approved by the UW institutional review board.

### Socioeconomic, Demographic, and Health Measures

A 20-minute telephone survey, administered to 2001 participants, yielded self-reported data on sociodemographic and health measures. The protocols were modeled on the Behavioral Risk Factors Surveillance System (BRFSS) surveys for Washington State. The SOS sample was demographically comparable to the BRFSS data, and was representative of King County.[44]

Demographic variables of interest were age, gender, race/ethnicity, and household size. Smoking and physical activity were used as lifestyle indicators. Smoking was characterized as current smokers versus nonsmokers. Physical activity was indicated by any physical activity outside work versus none. The 6 categories of education were recoded into 3 categories for analytic purposes: high school or less, some college, and college degree or higher. Income groups were also combined into 3 categories: less than $50 000, $50 000 to less than $100 000, and $100 000 or more. In addition, an index of SES was created by combining the income and education categories into a single measure. Based on distribution of the data obtained, 5 categories were created, starting from lower education and lower income (< college degree and income < $50 000), lower education and higher income (< college degree and income ≥ $50 000), higher education and lower income (≥ college degree and income < $50 000), higher education and higher income (≥ college degree and income $50 000 to < $100 000), and higher education and highest income (≥ college degree and income ≥ $100 000). The new SES index allowed us to capture the combined effects of both income and education, which could not be observed using income or education alone.[46,47]

Obesity was defined as body mass index (BMI; defined as weight in kilograms divided by the square of height in meters) greater than or equal to 30.

### Network Distance Measures

*Geocoding residential locations.* The home address of each respondent was geocoded to the centroid of the home parcel using the 2008 King County Assessor parcel data, using standard methods in ArcGIS 9.3.1 (ESRI, Redlands, CA). Addresses that failed the automatic geocoding (30%, using a match score of 100) were manually matched using a digital map environment with annotated layers from the reference data augmented by online resources such as GoogleMaps, QuestDEX, and Yelp. Each home point was checked for plausibility and accuracy.

*Geocoding supermarket locations.* Full-service supermarkets were identified from the 2008 food establishment permits provided by Public Health–Seattle & King County (PHSKC). Supermarkets were defined as stores run by nationally or regionally recognized chains that engaged in retailing a broad selection of foods, such as canned and frozen foods, fresh fruits and vegetables, and fresh and prepared meats.[48] The PHSKC data included 10 254 permit records, 926 of which belonged to 207 unique supermarket stores (most individual supermarkets had multiple permits). All permit addresses were geocoded by the Urban Form Lab, matched to King County parcel centroids, also using ArcGIS. Of the food permit addresses, 99.6% were geocoded.

*Street network distance measures.* Distance measures were computed from each respondent's home to the nearest supermarket (the conventional measure) and to the supermarket

**TABLE 1—Participant Characteristics (n = 1682): the Seattle Obesity Study, King County, WA, 2008–2009.**

| Characteristics | Total (n = 1682), No. | Obese (n = 336), No. (%) | Nonobese (n = 1238), No. (%) |
|---|---|---|---|
| Gender | | | |
| Men | 628 | 149 (44) | 460 (37) |
| Women | 1054 | 187 (56) | 778 (63) |
| Age, y | | | |
| 18–54 | 831 | 157 (47) | 622 (50) |
| 55–74 | 659 | 158 (47) | 460 (37) |
| ≥ 75 | 183 | 21 (6) | 154 (13) |
| Race/ethnicity | | | |
| Whites | 1392 | 286 (86) | 1024 (84) |
| Non-Whites | 268 | 47 (14) | 202 (16) |
| Annual household income, $ | | | |
| < 50 000 | 593 | 153 (51) | 418 (38) |
| 50 000 to < 100 000 | 495 | 96 (32) | 379 (34) |
| ≥ 100 000 | 380 | 50 (17) | 311 (28) |
| Education | | | |
| < high school | 322 | 86 (26) | 213 (17) |
| Some college | 432 | 92 (27) | 304 (25) |
| ≥ college degree | 921 | 156 (47) | 718 (58) |
| SES index[a] | | | |
| Category 1 | 374 | 100 (34) | 258 (23) |
| Category 2 | 269 | 56 (19) | 196 (18) |
| Category 3 | 217 | 52 (17) | 159 (14) |
| Category 4 | 304 | 54 (18) | 239 (22) |
| Category 5 | 302 | 36 (12) | 255 (23) |

*Note.* SES = socioeconomic status. Sum may not add up to 100% because of missing values.
[a]SES index defined in 5 categories: (1) low education and low income (< college degree and income < $50 000), (2) low education and higher income (< college degree and income ≥ $50 000), (3) high education and low income (≥ college degree and income < $50 000), (4) high education and higher income (≥ college degree and income $50 000 to < $100 000), (5) high education and highest income (≥ college degree and income ≥ $100 000).

that was reported to be the primary food source. Network distances were calculated in ArcGIS 9.3.1 using ESRI StreetMap Premium North America NAVETQ 2009 Release 1. Network distances (in miles) represented the fastest route participants would likely drive along the existing road network from home to the nearest or to the primary supermarket they used. Added distance was defined as the network distance traveled from home to the primary supermarket minus the distance to the nearest supermarket.

### Characterization of Supermarkets by Price

Of 2001 respondents, 1682 (84%) reported using supermarkets, which constituted the sample for analyses. Market basket data were collected in person from 8 stores identified as primary food sources by 88% of the sample (n = 1480 of 1682): Safeway, Fred Meyer, Quality Food Centers (QFC), Puget Consumer Co-op (PCC), Albertsons, Trader Joe's, Whole Foods, and Metropolitan Market (Appendix 1; data available as a supplement to the online version of this article at http://www.ajph.org). The SOS market basket, adapted from the Consumer Price Index and Thrifty Food Plan Market Baskets, contained 100 foods and beverages. These included a selection of healthful and less healthful foods. The market basket included foods that were part of the BRFSS nutrition module, notably salads (lettuce, spinach), fresh fruit (apples, oranges, bananas, grapes, and strawberries), fruit juice, potatoes, and carrots. Standardized criteria were developed to collect food prices. Prices were based on the medium size package available at most of the supermarkets. For each store, the lowest price available for each item in the market basket was used; most often this was the store brand price. If only brand names were available for a product, that price was recorded. Most of the available items were comparable across stores. If a particular item was not available at a given store, a substitution, matched as closely as possible for nutritional content and package size, was priced instead. For example, PCC carried only raw sugar as opposed to refined sugar, and all meats were organic. Whole Foods had fresh turkey breast rather than frozen, and had freshly baked cupcakes rather than packaged. Sale prices, specials, coupons, or membership discounts were excluded. Additional details were previously published for the collection of prices in a different database.[49] The total cost of the market basket was the sum of the prices of all 100 foods.

The lowest market basket cost was $224, with the highest being 60% more expensive. Cluster analyses were used to classify supermarkets into 3 price strata: low, medium, and high.

Another 12% of the SOS sample available for analyses reported 5 additional stores as their primary source for food shopping. To classify each of these stores into an appropriate price level, prices were either collected from the Web or through contact with the store managers. Assessments of the market basket cost also examined the availability of foods by store chain. Supermarkets in all 3 price levels stocked close to 100% of items in the market basket. For a few items that were found to be missing in selected stores, prices were imputed based on the average price of the same item from other supermarkets of the same price level.

### Statistical Analyses

Supermarket patrons were classified into the 3 supermarket groups: low, medium, and high depending on market basket cost at the supermarket that was their primary food store.

We used descriptive statistics to explore the relation between obesity and key sociodemographic characteristics, supermarket price, and the network distance. We used bivariate analysis to examine SES and demographic variables and obesity rates by supermarket type.

Modified Poisson regressions with robust error variance[50] were conducted to examine if the risk of obesity was associated with the supermarket type (by price) used or distance traveled to the supermarket, before and after taking SES, demographic, and lifestyle variables into account. The final analytical sample consisted of 1304 respondents, after taking missing values into account. Obesity (obese vs nonobese) was used as the primary outcome variable of interest. Main independent variables included 3 types of supermarkets as a categorical variable and 2 distance measures as continuous variables. Combined SES index was used as the measure of SES. Other covariates included age, gender, race/ethnicity, household size, smoking, and physical activity. An $\alpha$ level of 0.05 was used to test for statistical significance. All analyses were conducted using Stata 10.0 (StataCorp LP, College Station, TX).

## RESULTS

Participant characteristics are presented in Table 1. The sample was more likely to be female (63%), and 50% were younger than 54 years. The sample was mostly White (84%), with 7% African Americans and 7% Asians. Annual household income for 60% of the sample was greater than or equal to $50 000 (median for King County was $53 937 in year 2000). More than half the sample (55%) had graduated from college.

**TABLE 2—Mean and Median Network Distance Traveled by Obese vs Nonobese: the Seattle Obesity Study, King County, WA, 2008–2009.**

| Distance Variable (miles) | Total | | Obese | | Nonobese | |
|---|---|---|---|---|---|---|
| | Mean ±SD | Median (IQR) | Mean ±SD | Median (IQR) | Mean ±SD | Median (IQR) |
| Network distance to the primary supermarket used | 2.53 ±2.14 | 1.90 (1.02, 3.43) | 2.62 ±2.02 | 1.94 (1.23, 3.50) | 2.51 ±2.17 | 1.88 (1.00, 3.41) |
| Network distance to nearest supermarket | 1.18 ±0.81 | 0.99 (0.58, 1.65) | 1.19 ±0.80 | 1.03 (0.62, 1.67) | 1.17 ±0.79 | 0.98 (0.57, 1.62) |
| Added distance[a] | 1.22 ±1.63 | 0.51 (0.001, 1.85) | 1.35 ±1.69 | 0.69 (0.001, 1.94) | 1.18 ±1.60 | 0.47 (0.001, 1.81) |

*Note.* IQR = interquartile range.
[a]Defined as the network distance traveled from home to the primary supermarket minus the network distance from home to the nearest supermarket.

The obesity rate was 21%, compared with the countywide estimate of 20.2% for King County in the 2007 BRFSS. Obese individuals were more likely to be male, with an annual household income of less than $50 000 and lower education levels than nonobese individuals. The SES gradient for obesity was even sharper using the combined index of education and income. Obese persons were more likely to be from lower income and lower education groups compared with nonobese persons.

The proximity to full-service supermarkets, the conventional measure of food access, is summarized in Table 2. Only 1 in 7 (14%) of the study participants reported shopping at the nearest supermarket. In general, SOS participants shopped for food farther from home than necessary; on average, the nearest full-service supermarket was a mean of 1.18 miles from the respondents' home (median [interquartile range] (IQR) = 0.99 [0.58–1.65] miles), and the supermarket identified as the primary food source was a mean of 2.53 miles away (median [IQR] = 1.90 [1.02, 3.43]). For obese and nonobese respondents, there were no significant differences in the mean and median network distances between the residential address and the location of the nearest supermarket. The street network distance between the residential address and the supermarket listed as the principal food source was unrelated to obesity rates.

By contrast, obesity rates by supermarket type were significantly different (Table 3). Obesity prevalence among shoppers in high price supermarkets was 9%, whereas obesity prevalence among shoppers in lower price supermarkets was 27%, a 3-fold difference.

The sociodemographic profiles of supermarket shoppers are summarized in Table 3. Although shoppers at high-price supermarkets were more likely to have higher education and incomes, shoppers at lower price supermarkets were more likely to have lower education and incomes. Shoppers at low- and medium-price supermarkets were more likely to be both older and male, whereas shoppers at high-price supermarkets were more likely to be younger and female.

The combined SES index highlighted these social disparities. High price supermarkets drew a significantly higher proportion of patrons from higher income and education groups. An exact opposite trend was observed for lower price supermarkets, whose patrons were more likely to be drawn from groups of lower education and incomes. These trends are also illustrated in Figure 1, which shows how supermarket choice differed as a function of education and income. As SES increased, the proportion of shoppers in high-price supermarkets also increased.

Table 4 shows the results from the modified Poisson regression analysis that examined the relative impact of supermarket proximity or price on obesity risk, taking SES, demographics, and lifestyle variables into account. The combined SES index served as the primary indicator of SES.

Model 1 confirmed the inverse association between obesity and supermarket type after taking demographic and lifestyle factors into account. Compared with low-price shoppers, obesity risk among medium-price shoppers was lower by 23%, and among high-price shoppers it was lower by 62%, after adjusting

**TABLE 3—Participant Characteristics by Supermarket Type: the Seattle Obesity Study, King County, WA, 2008–2009.**

| Characteristic | Supermarket Category | | |
|---|---|---|---|
| | Low Price, No. (%) | Medium Price, No. (%) | High Price, No. (%) |
| Total | 500 (30) | 999 (59) | 183 (11) |
| Gender | | | |
| Men | 188 (38) | 385 (39) | 55 (30) |
| Women | 312 (62) | 614 (61) | 128 (70) |
| Age, y | | | |
| 18–54 | 234 (47) | 500 (50) | 97 (54) |
| 55–74 | 203 (41) | 381 (38) | 75 (41) |
| ≥ 75 | 63 (12) | 111 (12) | 9 (5) |
| Race/ethnicity | | | |
| Whites | 416 (85) | 822 (83) | 154 (85) |
| Non-Whites | 76 (15) | 164 (17) | 28 (15) |
| Annual household income, $ | | | |
| < 50 000 | 208 (47) | 343 (40) | 42 (26) |
| 50 000 to < 100 000 | 146 (33) | 284 (33) | 65 (40) |
| ≥ 100 000 | 93 (20) | 230 (27) | 57 (34) |
| Education | | | |
| ≤ high school | 132 (26) | 185 (19) | 5 (3) |
| Some college | 155 (31) | 253 (25) | 24 (13) |
| ≥ college degree | 212 (43) | 557 (56) | 152 (84) |
| SES index[a] | | | |
| Category 1 | 148 (33) | 217 (25) | 9 (6) |
| Category 2 | 102 (23) | 151 (17) | 16 (10) |
| Category 3 | 60 (13) | 125 (15) | 32 (19) |
| Category 4 | 76 (17) | 176 (21) | 52 (32) |
| Category 5 | 61 (14) | 187 (22) | 54 (33) |
| Health variable | | | |
| Obese | 126 (27) | 194 (21) | 16 (9) |
| Nonobese | 342 (73) | 739 (79) | 157 (91) |

*Note.* SES = socioeconomic status.
[a]SES index defined in 5 categories: (1) low education and low income (< college degree and income < $50 000), (2) low education and higher income (< college degree and income ≥ $50 000), (3) high education and low income (≥ college degree and income < $50 000), (4) high education and higher income (≥ college degree and income $50 000 to < $100 000), (5) high education and highest income (≥ college degree and income ≥ $100 000).

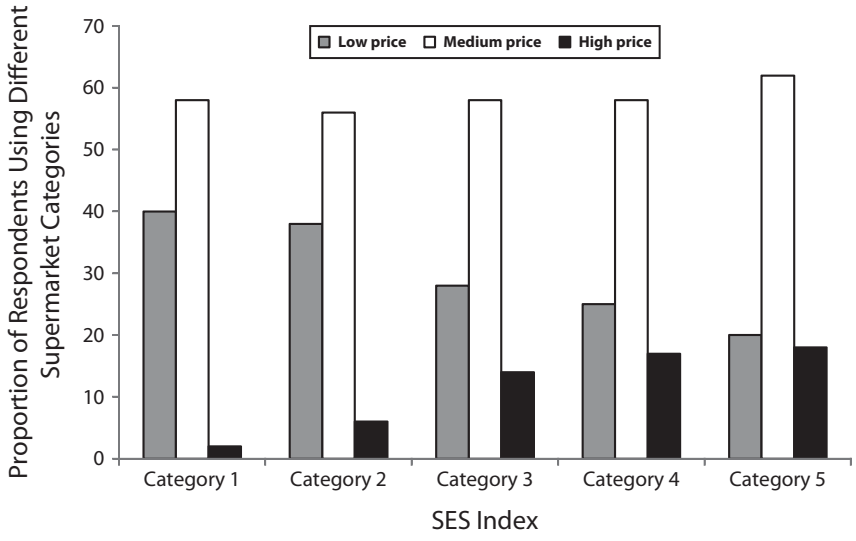


**FIGURE 1—Supermarket choice as a function of socioeconomic status index: the Seattle Obesity Study, King County, WA, 2008–2009.**

for demographic and lifestyle factors. No significant associations were observed between obesity and any of the physical distance variables.

In model 2, the inverse association between obesity and supermarket type remained unchanged even after taking individual level SES variables into account. The supermarket effect remained robust even after the inclusion of the 2 distance variables (models 3 and 4). The risk of obesity among high-price shoppers remained significantly lower (adjusted relative risk [RR] = 0.34; 95% confidence interval [CI] = 0.19, 0.63) compared with low-price shoppers, after taking distance traveled, SES, and demographic and lifestyle variables into account (model 3).

By contrast, every 1 additional mile of distance to the primary supermarket (adjusted RR = 1.01; 95% CI = 0.96, 1.05) or every 1 mile of added distance (adjusted RR = 1.04; 95% CI = 0.98, 1.10) were not significantly associated with higher obesity risk. Sensitivity analyses were also conducted by including quadratic terms for each of the distance measures in models 3 and 4, respectively, and the inverse association between obesity and supermarket category used remained unchanged (results not shown).

## DISCUSSION

To our knowledge, this is the first US-based study to collect individual-level data on food shopping destinations. The participants' home addresses and locations of the nearest supermarket and the supermarket they reported as their primary food source were obtained and geocoded. This allowed for the first calculation of network distances between the home and the primary supermarket as opposed to the nearest supermarket. Access to supermarkets was further examined in terms of physical proximity versus food prices.

One major finding was that only 1 in 7 study respondents reported shopping at the nearest supermarket. Although proximity to a supermarket can be an important variable in some urban locations, it may be of less importance in Seattle's King County, where most people shop by car. This finding is consistent with the Newcastle study, where respondents who shopped by car were not limited by the physical distance to the store.[35,36] In the present study, proximity to the nearest supermarket had no impact on obesity rates. Proximity to the supermarket identified as a primary food source by study respondents had no impact on obesity rates, either. These findings ran counter to previous research consensus that physical proximity to supermarkets had a major influence on diets and health.[3,7,8,11,31]

However, the study did show that the type of supermarket was closely linked to obesity rates. Patrons of high-price supermarkets had obesity rates (9%) that were one third of those of patrons of low-price supermarkets (27%). The inverse association observed between supermarket type and obesity rates held even after adjusting for the standard individual-level SES variables, education, and income. It is well established that obesity rates are inversely related to indexes of SES. One interpretation of the present results was that the choice of the primary food source was driven by price. Supermarket choice may be an understudied aspect of social class or other unmeasured cultural factors.

Measures of the physical food environment and its association with obesity until now focused on 2 parameters: the type of food sources and their geographic distribution.[11,13] Studies used the presence or absence of supermarkets in a given area as a predictor of diet quality and body weight.[3,4,51] Studies on the retail food environment and health contrasted supermarket density or counts per capita with those of fast food outlets or convenience stores.[5,7,10,27,31,52] Characterizing supermarkets by price provided additional insights into mechanisms behind food purchases, diet quality, and body weight.

In previous research, measures of geographic distribution were either based on administrative units, such as counties or census tracts, or on a buffer zone around an individual's residence.[3,23,27,52–54] These features of the built environment were then linked with individual survey data on diets and health. The overwhelming research consensus was that physical proximity to supermarkets had a major influence on diets and health. The present study showed that people generally did not shop in the immediate neighborhood and pointed to the critical importance of obtaining data on food shopping behaviors. Mere physical proximity to a store might not be an accurate index of exposure. These findings might hold true for other areas in United States where people shop by car and have similar geographic distribution of supermarkets.

However, the present study had limitations. First, as seen in the BRFSS sample for King County, the SOS sample was older and had a higher proportion of females. This can be attributed to the use of landline telephone surveys. Second, most respondents traveled to their supermarket by car. Hence, the data might not be generalizable to other areas of the

**TABLE 4—Association Between Obesity and Supermarket Proximity and Price: the Seattle Obesity Study, King County, WA, 2008–2009.**

| | Model 1 Bivariate[a] | | Model 2 Multivariate[b] | | Model 3 Multivariate[c] | | Model 4 Multivariate[c] | |
|---|---|---|---|---|---|---|---|---|
| | RR (95% CI) | *P* | RR (95% CI) | *P* | RR (95% CI) | *P* | RR (95% CI) | *P* |
| Supermarket Category | | | | | | | | |
| Low price (Ref) | 1.00 | | 1.00 | | 1.00 | | 1.00 | |
| Medium price | 0.77 (0.63, 0.93) | .008 | 0.80 (0.65, 0.98) | .035 | 0.79 (0.64, 0.98) | .035 | 0.80 (0.64, 1.00) | .054 |
| High price | 0.38 (0.23, 0.62) | < .001 | 0.38 (0.22, 0.66) | .001 | 0.34 (0.19, 0.63) | .001 | 0.36 (0.20, 0.67) | .001 |
| Distance | | | | | | | | |
| 1 mile to primary supermarket | 1.01 (0.97, 1.05) | .442 | | | 1.01 (0.96, 1.05) | .615 | | |
| 1 mile of added distance[d] | 1.05 (1.00, 1.11) | .05 | | | | | 1.04 (0.98, 1.10) | .163 |
| SES index | | | | | | | | |
| Category 1 | 1.00 | | 1.00 | | 1.00 | | 1.00 | |
| Category 2 | 0.76 (0.57, 1.02) | .07 | 0.78 (0.58, 1.04) | .094 | 0.80 (0.60, 1.08) | .153 | 0.81 (0.60, 1.09) | .18 |
| Category 3 | 0.92 (0.69, 1.23) | .597 | 0.98 (0.73, 1.32) | .946 | 0.95 (0.71, 1.29) | .788 | 0.97 (0.72, 1.31) | .87 |
| Category 4 | 0.66 (0.49, 0.91) | .011 | 0.73 (0.53, 0.99) | .048 | 0.71 (0.51, 0.97) | .037 | 0.72 (0.52, 1.00) | .052 |
| Category 5 | 0.46 (0.32, 0.67) | < .001 | 0.52 (0.36, 0.76) | .001 | 0.55 (0.38, 0.81) | .002 | 0.56 (0.38, 0.82) | .003 |

*Note.* CI = confidence interval; RR = relative risk; SES = socioeconomic status.
[a]Model 1: Adjusted for age + gender + race/ethnicity + household size + physical activity.
[b]Model 2: Single model with supermarket category + SES index. Additionally adjusted for age + gender + race/ethnicity + household size + smoking + physical activity.
[c]Models 3 and 4: model 2 + distance variables.
[d]Indicates every 1 mile of added distance, which is defined as street network distance traveled from home to the primary supermarket minus the distance to the nearest supermarket.

United States with different geographic configurations. Third, 5 supermarket chains used by the respondents were classified into appropriate price strata based on prices obtained from company Web sites. However, this might not be a major concern because these 5 stores were used by only 12% of the sample available for analysis. Fourth, the obesity variable was defined based on self-reported data on weight and height, which might have some known bias. Fifth, the present findings were based on cross-sectional data, which limited the ability to draw causality between the associations observed. Nonetheless, the present results underscored the importance of obtaining data on food destinations. Knowing who shops for food, where, how often, and why can provide new insights into the food environment and the obesity epidemic.

Building new supermarkets in low-income neighborhoods is one commonly suggested approach to reducing obesity rates and improving population health.[55] Reducing economic disparities in access to healthy foods should be another. Communities may be vulnerable to obesity and chronic disease, not because the nearest supermarket is more than a mile away, but because healthy choice is not always the most affordable choice. Systematic efforts to improve diet quality will need to take economic inequalities into account. Ensuring access to affordable healthy foods, with the emphasis on affordability, may be key. ■

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## Contributors

All authors were involved in planning and implementation of the study. A. Drewnowski led the study, assisted in data analysis, and led the article writing. A. Aggarwal supervised data collection, performed data analysis, and assisted in article writing. P. Monsivais was responsible for the market basket tool and reviewed the article. P. M. Hurvitz was responsible for developing the distance variables and reviewed the article. A. V. Moudon conceptualized and led the development of distance data, and contributed to writing the article.

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## Human Participant Protection

All study instruments and protocols were approved by institutional review board at the University of Washington.

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