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Perceptions of a healthier neighborhood food environment linked to greater fruit and vegetable purchases at small and non-traditional food stores

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Abstract

The aim of this study was to examine associations between perceived neighborhood food environments and food purchasing at small and non-traditional food stores. Intercept interviews of 661 customers were conducted in 105 small and non-traditional food stores. We captured (1) customer perceptions of the neighborhood food environment, (2) associations between customer perceptions and store-level characteristics, and (3) customers' perceptions and shopping behaviors. Findings suggest that customers with more favorable perceptions of the neighborhood food environment were more likely to purchase fruits and vegetables, despite no significant association between perceptions of the neighborhood and objectively measured store characteristics.

Keywords

Food Environment; Perceptions; Purchasing; Shopping Behaviors; Fruit; Vegetables; Small Food Stores; Non-Traditional Stores

Introduction

Fruits and vegetables (F&V) are essential components of a healthy diet. A diet rich in F&V has been associated with lower blood pressure,^{1,2} reduced heart disease,^{3–6} and cancer risk.⁷ Access to supermarkets and large grocers has been linked to greater consumption of F&V as

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Conflict of Interest

The authors do not declare any conflicts of interest.

well as overall healthier diets.^{8–13} However, small food retailers (e.g., corner stores) are also a common food source for many people in the U.S., especially those persons living in urban and low-income neighborhoods.^{14–17} Research on the use of small food stores has increased in recent years with customers reporting visits to these stores as often as every day or multiple times per week.^{18–24} Likewise, non-traditional food retailers, such as gas-marts, pharmacies, and dollar stores, have also been recognized as a common food sources in the urban food environment.^{25–27} In particular, pharmacies and dollar stores have increased in the market share of food retailers,^{28,29} and in many geographic regions of the US, these stores can be located in low-income neighborhoods or food deserts.³⁰ Although, the inclusion of these non-traditional stores in food environment research is limited, recent research efforts in Minneapolis-St. Paul have demonstrated that nearly 85% of pharmacies and 92% of dollar stores sell some type of fruit and vegetables, and 23% of pharmacies sell fresh fruits and vegetables.²⁷

Unfortunately, food purchases at small and non-traditional food stores have been associated with energy-dense and poor quality food choices,^{23,31–33} and purchasing food from small stores has been linked to increased obesity risk and other poor health outcomes.^{34–36} Less healthy products, such as sugar-sweetened beverages and snacks, are typically featured in these stores via advertisements, favorable product placement, and price promotions.^{37–40} However, many efforts are now underway to improve small food store purchases across the U.S. through policies and programs addressing both the kind of food that is stocked and how it is marketed.^{16,26,41,42} Evaluations of such efforts have demonstrated successful improvement in various features of the store environment, including availability, visibility, affordability, and promotion of healthy foods.⁴³

Beyond store features and marketing, a number of studies have demonstrated that residents' with favorable perceptions of the neighborhood retail food environment may have healthier diets.^{8,44–48} For example, those who report more healthful food quality, selection, and affordability in their own neighborhood report higher F&V intake.^{9,49,50} Indeed, residents' perceptions of the food environment may be even more relevant to dietary behaviors than objective food environment features because they account for constraints in access and other cognitive processes relevant to behavior.⁸ In a recent study of a new supermarket opening in a food desert, Dubowitz and colleagues found significant improvements in overall dietary quality among residents who lived near the new store; however, the mechanisms of this impact appeared not to be related to use of the new supermarket per se, but instead may be linked to improved perceptions of the neighborhood food environment and neighborhood satisfaction.⁵¹

Research on food environment perceptions generally has been limited to the neighborhood in which the resident lives; little is known about whether the food environment around a particular store is related to the healthfulness of customers' purchasing behavior. The neighborhood around a given food store, or simply an individual's perception of that neighborhood, might encourage more or less healthful purchases. For instance, some food shoppers travel to neighborhoods outside their own in order to do their grocery shopping based on factors such as convenience, price, and perceived quality of the store.^{52,53} Additionally, many studies have argued that food shopping is complex and it cannot be

assumed that any one single factor determines where people shop.⁵⁴ Based on these facts, it is reasonable to hypothesize that if a store's environment is perceived as healthful, it may draw people who intend to purchase F&Vs. As yet, perceptions of the environment around the food store where people shop have not been fully explored.

The purpose of this paper was to examine customers' perceptions of the neighborhood food environment surrounding small and non-traditional food stores and their food purchasing behaviors. Figure 1 presents a conceptual model of the hypothesized relationships between these constructs. We proposed that customers' perceptions of the store's neighborhood environment can be influenced by the overall neighborhood environment surrounding the store, a customer's preferences and predisposition, as well as the characteristics of the retail store itself. Additionally, a customer's shopping behavior may be influenced by their perception of the store's neighborhood food environment, their own personal preferences and predisposition, as well as the store's characteristics. In this study, we examined two of these relationships.

First, we tested the association between store-level characteristics (e.g., healthy and less healthy food advertisements and product placement) and customer perceptions of the neighborhood environment. We hypothesized that customers' perception of the neighborhood food environment around the store would be healthier (e.g., higher agreement of availability, affordability, quality and/or ease of obtaining F&V in that neighborhood) if the store marketing features were healthier. Secondly, we examined the associations between customer perceptions and their shopping behaviors (e.g., shopping frequency and purchases of F&V). We hypothesized that customers who perceived the neighborhood food environment around the store to be healthier would shop more frequently at the store and purchase more F&Vs, while customers who perceived the neighborhood food environment to be less healthy around the store would shop less frequently at the store and purchase fewer F&Vs. Understanding the role of customer perceptions could provide insight into how future interventions and initiatives could be tailored to improve food purchases at small food stores.

Methods

This study was based on baseline (pre-policy) data collected through a larger research effort to evaluate the Minneapolis Staple Foods Ordinance,⁵⁵ a local policy requiring licensed grocery stores to stock minimum amounts and varieties of specific foods, including F&V, whole grains, and low-fat dairy. The evaluation included stores in Minneapolis, Minnesota and St. Paul, Minnesota as comparable controls. Data were collected between July and November 2014 (pre-policy), recruiting participants as they exited food stores. All eligible stores were determined from a list of licensed grocers provided by the Minneapolis Health Department and the Minnesota Department of Agriculture. The Institutional Review Board of the University of Minnesota approved this study.

Stores were excluded if the licensing address was invalid and/or it was not expected to stock a wide variety of foods, including those consisting of 100ft² of retail space and those located in the downtown commercial districts. In addition, stores participating in the Special

Supplemental Nutrition Program for Women, Infants, and Children (WIC), which includes specific program requirements regarding stocking healthy, staple foods were also excluded from our sample. Further details on store eligibility are published elsewhere.³³

Out of 255 eligible stores, 180 were randomly selected to participate. Customers exiting these stores were successfully recruited to participate in intercept interviews at 106 of these stores (63 in Minneapolis and 43 in St. Paul). Of the 74 stores where customer intercept interviews were not completed, 20 were identified as ineligible upon visiting the store (e.g., due to new participation in WIC), 32 refused to participate, and in the remaining 22 stores, no participants were successfully recruited. Data on each store, including store type, were collected during a separate visit to assess a range of store characteristics. All stores could be categorized as a corner store, gas-mart, pharmacy, dollar store, or general retailer based on store characteristics via in-person store audits. For instance, a store was classified as a pharmacy if prescriptions could be filled at the retailer. Large retail pharmacy vendors included “Walgreens” and “CVS.” Dollar stores were defined as any retailer providing discount home and food goods, but were not primarily a food retailer or gas-mart. Examples of dollar stores were “Dollar Tree” and “Family Dollar.” Gas-marts were distinguished from corner stores, by the present of gas pumps. In analyses, we excluded the one large general retailer based on its size and lack of similarity to the other store types; our final sample of stores where customer intercepts were conducted was 105. For a subset of our analyses that also utilized observational store-level data, our analytic sample including 99 stores where both customer intercept surveys and store assessment data were collected.

Measures

Customer Intercepts

In teams of two, data collectors visited stores and obtained permission from an employee to recruit customers exiting the store. Data collectors attempted recruitment for 30 minutes; if at least one survey was completed, they stayed an additional 15-30 minutes. Eligible participants were English-speakers who were 18 years old and who made a food or beverage purchase at the store. Data collectors recorded participants' food and beverage purchases (quantity, size, product name, and price paid) and administered a brief survey. In total, 661 participants were recruited. The process detailing recruitment is further described elsewhere.⁵⁶ The participation rate was 35%. Many stores in this sample were used for more than food shopping, so not every customer made a food/beverage purchase; recruitment data suggest that 41% of customers exiting the store made no food or beverage purchases.⁵⁶

Customer Characteristics and Shopping Behavior

Data on participant demographics (age, gender, race/ethnicity, education, employment), were obtained from the intercept survey. Shopping behavior was characterized as the frequency with which each participant shopped at the store (e.g., at least once a day, 1-6 times a week, and once a week or less).

Perceived Neighborhood Food Environment

Perceived F&V availability within the neighborhood of the store was measured using three questions. Participants were asked the extent to which they agree with the following: (1) “The fresh fruits and/or vegetables in this neighborhood are of high quality,” (2) “A large selection of fresh fruit and/or vegetables is available in this neighborhood,” and (3) “Fruits and vegetables are affordable at the stores in this neighborhood.” Survey responses were: “strongly disagree” (1), “disagree” (2), “neither agree nor disagree (neutral)” (3), “agree” (4), and “strongly agree” (5); (“don’t know” was a response option coded to missing). For analysis purposes, responses were scaled to range from 0 to 4, with a score 0 indicating the lowest perception and a score of 4 indicating the highest. For ease of interpretation, each question was dichotomized into “Do not agree” (2) and ‘Agree’ (3) categories.⁵⁷ A summary score for overall fruit and vegetable perceptions was also created by adding the three perception variables.^{48,58,59} Summary scores ranged from 0 to 12, with 0 indicating strong disagreement that F&V were high quality, available, and affordable in the neighborhood. This score was also dichotomized into ‘high agreement’ (9) (where individuals ‘agreed’ or ‘strongly agreed’ with all three survey items) versus ‘low agreement’ (8).

To assess overall perception of healthy food in the neighborhood, participants were also asked if they agreed with the following: “It is easy to find healthy foods in this neighborhood.” These questions used the same 5-point Likert scale, as described above.

Fruit and Vegetable Purchases

Using the intercept survey, each participant was queried on whether they “have ever bought fresh fruits and vegetables at the current store?” (Yes/no). In addition, data on food/beverage purchases at the time of the interview were entered by trained study staff into Nutrition Data System for Research (NDSR), a nutrient analysis program. To characterize food/beverage purchases, the categories available in NDSR were collapsed into 24 mutually exclusive categories (17 food categories, 7 beverage categories). A comprehensive description of these categories has been described elsewhere.³³ Only the F&V categories were utilized in this paper. For each participant purchase, the total number of servings of each fruit/vegetable category was calculated. If the total servings for all F&V combined was ≥ 1 (e.g., $\frac{1}{2}$ cup), the participant was categorized as having purchased a serving or more of F&V.

Store Characteristics

Store assessments were also conducted for each store. We measured the amount (in pounds) and number of varieties of F&V in each store. Amount was a continuous measure of the total pounds of fresh and/or plain frozen (with no sugar added) F&V. Due to a skewed distribution we created a 4-level categorical measure for analysis (none, 1-18, 19-50, and >50). We also measured the total varieties of fresh, frozen and canned F&V. This measure only included canned fruit packed in 100% juice, and plain canned vegetables with nothing added except salt. This was also a skewed measure which we categorized into three levels (0-5, 6-12, and >12).

In addition, the presence of advertisements for healthy and less healthy foods and beverages were recorded. Data were collected based on a retail scoring system, which has demonstrated good inter-rater and test-retest reliability.⁵⁶ Our study team modified the tool focusing on the presence (1) of exterior and interior healthy and unhealthy food advertisements and product placement within stores.³⁸ Healthy foods included F&V, whole grains, beans, nuts and seeds, non-fat/low fat milk products, lean meat, poultry, fish, and black coffee. These include minimal or no added fat, sugars, or sweeteners. Less healthy food included high calorie, low nutrient foods and beverages including alcoholic beverages, soft drinks and other sweetened beverages including diet drinks, sweet desserts and highly sugared cereals, chips and other salty snacks, most solid fats, fried foods, and other foods with high amounts of sugar, fat, and/or sodium. To assess product placement (e.g., impulse buys), research staff recorded: 1) if fresh produce (fruits and vegetables) could be seen from the front entrance; 2) the presence of less healthy food items within reach of the cash register including gumball machines, candy, soda, chips, and other food/beverage items (e.g., energy drinks, beef jerky, cookies, donuts, ice cream, and pastries); and 3) the presence of healthy food items within reach of the cash register including trail mix/granola (no added sugar), bagged nuts/seeds (no added sugar), fresh fruit, bottled water, 100% fruit juice, and other food/beverage items (as specified).

Finally, a neighborhood socioeconomic status variable was measured as the percent of families in each store's census tract living on <185% of the federal poverty level (FPL). Specifically, each store's address was geocoded within ArcGIS 10.3 (Esri, Redlands, CA), and the corresponding percent of households meeting the poverty criteria was assigned using 2013 American Community Survey (ACS) data.⁶⁰ In addition, the reported cross streets of each customer's home and the store's address were used to determine how far away customers lived from the store.

Statistical Analysis

The primary unit of analysis was the customer purchase and intercept event. Of the 661 eligible customers, descriptive statistics, percentages or mean (SD), for all measures including customers' demographic characteristics, shopping behaviors, and perceptions of the neighborhood food environment were performed. Store-level characteristics including F&V availability and the presence of healthy and unhealthy ads and products are also described. For all measures, we calculated descriptive statistics across the full sample and by each of the store types where customers made purchases. For comparisons by store type, either Chi-square tests (for categorical variables where all cells had expected frequency ≥ 5), Fisher exact tests (for categorical variables if some cells had expected frequency < 5), or analyses of variance, ANOVA (for means), were performed.

Neighborhood food environment perception measures were analyzed relative to store-level characteristics using generalized linear models. For these models, data was restricted to the 99 stores and 594 customer intercepts where data was collected on both customer perceptions (from customer intercepts) and store characteristics (from store assessments). All models were adjusted for age, sex, race/ethnicity, education, employment, and store type and neighborhood-level poverty as fixed effects and store ID as random effect due to nesting

of individuals within stores. The adjusted least square means (lsmeans) were compared to account for any within group differences.

Logistic regression was used to assess the bivariate and multivariate associations between all three dependent shopping behavior variables (shopping frequency, ever purchasing F&V, and the purchase of at least one serving of F&V at the time of intercept) and the independent perceptions variables, including perceived quality, availability, and affordability of F&V (three individual variables and one summary variable) and perceived ease of finding healthy foods. Models included age, sex, race/ethnicity, education, employment, and store type and neighborhood-level poverty as fixed effects and store ID as random effect due to nesting of individuals within stores. For all analyses, a p-value <0.05 was considered as statistically significant and all analyses were conducted using SAS software version 9.4 (SAS Institute, Inc., Cary, NC).

Results

Participant characteristics including demographics and shopping behaviors are presented in Table 1 for the overall sample and by store type. On average, participants were 40 years of age and majority were male (57%) across all store types. Forty-seven percent of participants were non-Hispanic White, 36% non-Hispanic Black; small percentages of shoppers were Hispanic, non-Hispanic Native American/Alaska Native, Asian, multi-racial, or other (3-4% each). Nearly two-thirds of participants (63%) had at least some college education. Using geographic methods, we determined that 50% of participants lived within less than a mile away from the store. The overall mean distance was 3.3 miles for all stores.

Twenty-nine percent of participants reported shopping at the store of intercept at least once per day for any reason (ranging from 11% at pharmacies to 38% at corner stores). An additional 44% reported shopping there at least once per week (ranging from 38% in corner stores to 50% at pharmacies). Thirty-three percent of participants reported ever purchasing a fruit or vegetable at the store across all store types. A greater proportion of participants from corner/small grocery stores (43%) and food/gas marts (41%) reported ever purchasing a fruit or vegetable at that store compared to those from dollar stores (12%) and pharmacies (13%). However, there were no significant differences in the proportion of participants across store types that purchased at least one serving of fruit or vegetables at the time of the intercept survey. Only 8% of participants purchased at least one serving of fruits/vegetables at the time of the intercept.

Many participants reported favorable perceptions of the food environment, specifically agreeing that (1) the fresh F&V in the neighborhood of the store were of high quality (69%), (2) a large selection of fresh F&V was available in the neighborhood (64%), and (3) F&V were affordable at the stores in the neighborhood (67%). In addition, 70% of participants perceived that it was easy to find healthy foods in the neighborhood across all store types. There were no statistically significant differences by store type for any of the items individually or summed.

Store-level characteristics are also presented in Table 1. Across all stores, 28% did not have any fresh or frozen fruit or vegetables. Only 3% of food/gas-marts had no fresh or frozen fruit or vegetables, versus 63% of dollar stores and 86% of pharmacies. Most stores had some variety in fresh, frozen, or canned fruits and vegetables with 72% of stores possessing 6 or more varieties. Almost half (46%) of stores had unhealthy exterior food advertising and promotion, with 39% having healthy exterior advertisements. A higher percent of food-gas marts had both healthy and less healthy advertisements compared to other store types. The proportion of dollar stores and pharmacies with fruits and vegetables visible from the entrance was lower than that of corner stores or gas-marts.

Table 2 shows the adjusted associations between store-level characteristics and perceptions of the neighborhood environment. Only the presence of unhealthy interior food and beverage advertisements was significantly associated with perceptions of the neighborhood fruit and vegetable environment (p-value = 0.003). Thus, in stores where unhealthy interior advertisements were located, customers were less likely to broadly perceive the neighborhood as being healthy (i.e., in terms of quality, availability, and affordability of F&V). There were no other significant associations observed.

Finally, the relationship between customers' perceptions of the neighborhood food environment and shopping behaviors are presented in Table 3. When adjusting for covariates, participants who agreed that F&V were high quality, available, and affordable in the store's neighborhood were more likely to report ever purchasing F&V there (OR = 1.7, 95% CI 1.2 – 2.6) and had twice the odds of having purchased at least one serving of F&V at the time of intercept (OR = 2.2, 95% CI 1.1 – 4.1) compared to participants who did not agree that F&V in the neighborhood were high in quality, availability, and affordability (i.e., "low agreement"). Compared to participants who reported it hard to find healthy foods in the neighborhood, participants who perceived it easy to find healthy foods were also more likely to report ever purchasing fruit and/or vegetables at the store (OR = 1.6, 95% CI 1.0 - 2.4).

Discussion

Our findings support previous findings that customer perceptions of the food environment are associated with food purchasing behaviors.⁶¹ Specifically, we found that participants who agreed that fruits and vegetables were available, of high quality, and affordable in the neighborhood where they shopped were also more likely to have purchased a fruit and vegetable from a small or non-traditional food store in that neighborhood. However surprising, healthy store features were, by and large, unrelated to a person's perceptions of the food environment around the store. Previous research examining perceptions of the food environment have predominantly centered on customer perceptions of their own neighborhood and consumption of fruits and vegetables,⁸ rather than perceptions of the neighborhood where the store is located. In this study, we were able to examine this relationship as it relates to small and non-traditional food stores and fruit and vegetable purchases.

Our findings address how customer perceptions potentially influence shopping behaviors. For example, if a customer does not have a positive perception of a neighborhood in which a

given store is located, then that customer may not seek out healthy food there. This unwillingness to purchase healthy food may be reflected in poor demand, which has been cited as barrier in food environment interventions.^{62–64} A sustainable supply-demand loop depends on customers having a positive perception of the food environment they encounter.⁶² In addition, recent findings by Dubowitz et al. have demonstrated that the introduction of a supermarket alone in a community did not improve use of that store and food purchasing behavior; however participants' perceptions and neighborhood satisfaction may have encouraged changes in shopping behavior.⁶⁵ Additionally, Cummins et al. examined the impact of a new grocery store observing a positive impact on perceptions of food availability; however it did not lead to increased fruit and vegetable intake.⁶⁶ These findings support the need to examine the relationship between food environments, customer perceptions, and health behaviors more closely.⁶⁷

As mentioned earlier, we found no significant relationship between store features (advertisements and product placement) and customer's perceptions of the neighborhood. This is contrary to our initial hypothesis and counterintuitive to the notion that customer's perceptions of the neighborhood food environment would be significantly associated with retailer advertising and other store features. However, our results are in line with other published findings that have found that objective aspects of the food environment are often unrelated to consumer perceptions of their food environment^{44,49} and consistent with another study from the same sample of small and non-traditional food stores, in which store marketing features were largely unrelated to the healthfulness of customer purchases.⁶⁸ These finding points to the idea that shopping behaviors are complex and a lot of different factors can drive individuals' shopping decisions and not all factors are related or created equal. Other factors such as neighborhood cleanliness, traffic volume, or safety, all could have influenced a person's perception of the food environment rather than the store's actual features.⁶⁹ In addition, a person's own bias e.g. preferences and predisposition could also influence how they ultimately perceive their environment.

The lack of relevance of store marketing features to customer psychosocial and behavioral outcomes could be due to several factors. The abundance of food advertising and marketing (much of it for unhealthy products) may result in saturation among customers, so that healthy marketing is overwhelmed by less healthy marketing. Alternatively, it is possible that these small and non-traditional stores -- which tend to be limited in the healthfulness of their offerings, as well as their advertising and promotions -- simply may not be representative of the neighborhoods in which they are located. Customers may expect these stores to be unhealthy, even when they have a favorable perception of the neighborhood in which they are located. Within a more healthful neighborhood food environment, customers were more likely to buy fruits and vegetables at the small store. Our results indicate that there may be some discordance between small and non-traditional food store features and the surrounding food environment. More work is needed to examine this effect in future corner store interventions.

Limitations and Methodological Considerations

Our findings should be considered within the context of the study's limitations. First, data collection was limited to small and non-traditional food stores, excluding large grocery stores and WIC retailers. Secondly, although most participants reported frequently shopping at the store where they were intercepted (at least once per week or more) and 50% lived less than one mile away from the store, they may not have been completely familiar with the surrounding neighborhood they were asked to rate. Third, we did not capture the purpose of each customer's shopping trip. However, in previous analyses of our sample, it was reported that 75% of customer's shopped at the store because it was close to their destination.⁷⁰ Fourth, our customer response rate was 35%. It is possible that participants who consented to participate may have had different kinds of purchases than those who did not consent to participate (and/or different perceptions of the neighborhood environment), but it is difficult to hypothesize the directionality of this potential bias. Also, our analysis does not include perception of the individual store, only perception of the overall food environment. It is possible that customers could have perceived the store differently than the surrounding neighborhood. Lastly, our analysis does not account for customers' food preferences, predispositions, or awareness/knowledge of the benefits of consuming F&Vs, which could be an unmeasured confounder, affecting both perceptions and behavior.

Strengths of our study include a large sample of objectively assessed F&V purchases, directly observed by trained data collectors at the time of the customer intercept. In addition, data were collected from a wide range of small and non-traditional stores, which have not been included in many studies in the past. We also collected data on perceptions of the neighborhood environment around these stores (rather than the participants' homes, which has been the focus of previous work in this area).

Implications on Research

Researchers studying food environments have acknowledged that we need a deeper understanding of how people access food, moving beyond basic measures of availability or proximity to supermarkets and/or specific food items. Aspects of the environment including the type of food venue visited, food marketing, and how people perceive their environment can influence food shopping behaviors and interactions within the environment. Moreover, food environments are dynamic and multidimensional spaces that mean different things to different people. And when considering a social-ecological approach, which characterizes the relationship between people and their environments, there are many forces that can shape human behavior.⁵⁴ In the area of food shopping, the physical environment has received a lot of attention, however, other factors including a person's perceptions, preferences, and social constructs can play a role and warrant consideration. In this study, we have examined how customers' perceptions were related to their purchasing of fruits and vegetables. In future research, it may be important to consider customers' awareness and perceptions of the food environment if the objective of an intervention, for instance, is to improve fruit and vegetable purchasing in a designated community. Hence, perceptions of the surrounding community food environment might contribute to a store's success in selling healthy food. These perceptions may also be independent of the store's features, which were not

associated with customers' perceptions of the neighborhood food environment in our study. Despite less healthful marketing features at a store, customers' environmental cues may be derived from other factors, such as neighborhood aesthetics, perceived safety, and/or socio-economic status of residents.

Conclusions

Findings suggest there may be an association between how individuals perceive the availability of F&V in the environment and their F&V purchasing behaviors at small and non-traditional food stores like corner stores, gas-marts, dollar stores, and pharmacies. Findings also support previous studies indicating that certain neighborhoods draw people who seek out healthy food based on perceived access to fruits and vegetables. Future small store interventions might need to take into account the surrounding features of the food environment, because customers' perceptions of the neighborhood may be a primer of whether or not they purchase healthy food there.

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Figure 1.
Conceptual Model

Table 1.

Customer-, store- and neighborhood-level characteristics for customer intercepts at all stores and at each of four store type: mean (sd) or percentage

	All stores	Corner/small grocery stores	Food/Gas marts	Dollar stores	Pharmacies	<i>I</i> <i>p</i>
Customer-level Characteristics	n=661	n=194	n=268	n=67	n=132	
<i>Demographics</i>						
Age	40 (15)	38 (13)	40 (15)	44 (15)	42 (17)	.01
BMI	28 (6)	28 (6)	28 (7)	28 (7)	28 (7)	.65
Gender: male	57	55	64	48	48	.009
Race/ethnicity						<.0001
Hispanic	3	4	4	3	2	
Non-Hispanic						
White alone	47	37	51	27	63	
Black alone	36	44	30	50	29	
American Indian or Alaskan Native alone	4	2	5	9	1	
Asian alone	3	7	1	3	2	
Other race alone	4	2	5	5	3	
Multi-racial	3	4	4	3	1	
Education						<.0001
High school diploma or less	38	41	39	52	21	
Some college	37	32	34	37	49	
Bachelor's degree or higher	26	27	27	10	30	
Employment						.002
Employed	64	60	71	51	60	
Unemployed/disability	26	33	19	31	25	
Other (student, retired)	11	7	10	18	15	
Distance from home to store (miles)	3.3 (6.2)	1.9 (4.5)	4.2 (5.8)	3.2 (10.3)	3.4 (6.2)	.003
<i>Shopping Behaviors</i>						
Shopping frequency						<.0001
At least once a day	29	39	30	33	11	
1-6 times a week	44	37	45	47	50	
Less than once a week	27	24	26	20	39	
Ever purchased fruit and vegetables at store	33	44	41	12	13	<.0001
Purchased at least one serving of fruit and/or vegetables at time of intercept	8	9	7	10	8	.66
<i>Perceptions of Neighborhood Food Environment</i>						
Fresh fruit and vegetables						
...are of high quality						
Agree, 3-4	69	72	69	64	68	.67
...large selection						
Agree, 3-4	64	63	62	62	69	.52
...are affordable						

	All stores	Corner/small grocery stores	Food/Gas marts	Dollar stores	Pharmacies	<i>I</i> p
Customer-level Characteristics	n=661	n=194	n=268	n=67	n=132	
Agree, 3-4	67	69	69	61	62	.33
Fresh fruit/vegetables summary						
High Agreement (9-12)	38	35	36	41	43	.45
Easy to find healthy food						
Agree, 3-4	70	67	71	68	72	.70
Store- and Neighborhood-level Characteristics	n=99	n=39	n=31	n=8	n=21	
<i>Fruit and Vegetable Availability in Store</i>						
Pounds (fresh and frozen)						<.0001
0	28	10	3	63	86	
1-18	23	26	39	13	0	
19-50	22	15	52	0	0	
>50	26	49	6	25	14	
Varieties (fresh, frozen and canned)						<.0001
0-5	27	13	39	0	48	
6-12	35	18	52	50	38	
>12	37	69	10	50	14	
<i>Ads and Product Placement in Store</i>						
Healthy ads on exterior	39	21	61	38	43	.005
Healthy ads on interior	22	18	40	0	14	.04
Unhealthy ads on exterior	46	31	94	25	14	<.0001
Unhealthy ads on interior	63	49	87	88	48	.002
Fruits/vegetables visible from entrance	35	49	48	0	5	.0004
Healthy impulse items at checkout	63	67	61	38	67	.46
Unhealthy impulse items at checkout	97	95	97	100	100	.84
<i>Percent of Households in Neighborhood: 185% Below Poverty</i>	35 (22)	36 (21)	34 (23)	39 (20)	35 (24)	.97

^I Comparisons of differences across stores types: ANOVA test for means; Chi square test for percentages except Fishers exact test for some due to some cells having expected frequencies <5; (bold if p .05)

BMI=body mass index

Table 2.

Associations between perceptions of neighborhood food environment and store characteristics (n=594)

	High agreement that fruits and vegetables are high quality, availability, and affordable	Agreement that it is easy to find healthy food
	Means (adjusted) ^I	Means (adjusted) ^I
Fruit and vegetable availability		
Pounds (fresh and frozen)	p=.08 (3df)	p=.42 (3df)
0	.31	.67
1-18	.36	.69
19-50	.33	.71
>50	.48	.79
Varieties (fresh, frozen and canned)	p=.24 (2df)	p=.54 (2df)
0-5	.37	.72
6-12	.32	.68
>12	.42	.75
Ads and product placement		
Healthy ads on exterior	p=.46	p=.95
Yes	.35	.72
No	.39	.72
Healthy ads on interior	p=.68	p=.38
Yes	.35	.76
No	.38	.71
Unhealthy ads on exterior	p=.47	p=.97
Yes	.35	.72
No	.39	.72
Unhealthy ads on interior	p=.003	p=.72
Yes	.32	.71
No	.46	.73
Fruits/vegetables visible from entrance	p=.90	p=.65
Yes	.37	.70
No	.37	.73
Healthy impulse items at checkout	p=.86	p=.65
Yes	.37	.73
No	.36	.70
Unhealthy impulse items at checkout	p=.17	p=.94
Yes	.36	.72
No	.58	.70

^IRegression models adjusted for age, sex, race, education, employment, store type and neighborhood-level poverty as fixed effects and store ID as random effect due to nesting of individuals within stores (bold if p .05)

df=degrees of freedom

Table 3.Relationship between perceptions of neighborhood food environment and shopping behaviors¹

	Shopping frequency		Ever purchased fruit/ vegetables at store	Purchased at least one serving of fruit/ vegetables
	1-6/wk vs. <1/wk	1/day vs. <1/wk	Yes vs. No	Yes vs. No
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Agreement that fruits and vegetables are high quality, availability, and affordable (score 0-12)				
Low Agreement, 0-8	ref	ref	ref	ref
High Agreement, 9-12	1.5 (1.0, 2.4)	1.5 (0.9, 2.4)	1.7 (1.2, 2.6)	2.2 (1.1, 4.1)
Fresh fruit/vegetables are of high quality (0-4)				
Do not agree, 0-2	ref	ref	ref	ref
Agree, 3-4	0.8 (0.5, 1.3)	0.7 (0.4, 1.3)	1.6 (1.0, 2.6)	2.0 (0.9, 4.9)
Large selection of fresh fruit/vegetables (0-4)				
Do not agree, 0-2	ref	ref	ref	ref
Agree, 3-4	1.0 (0.6, 1.6)	0.9 (0.6, 1.6)	0.8 (0.6, 1.2)	1.2 (0.6, 2.4)
Fruit/vegetables are affordable (0-4)				
Do not agree, 0-2	ref	ref	ref	ref
Agree, 3-4	1.2 (0.8, 2.0)	0.8 (0.5, 1.4)	1.8 (1.1, 2.7)	2.6 (1.2, 5.8)
Easy to find healthy food				
Do not agree, 0-2	ref	ref	ref	Ref
Agree, 3-4	1.5 (0.9, 2.3)	1.1 (0.6, 1.8)	1.6 (1.0, 2.4)	0.7 (0.4, 1.4)

¹Regression models adjusted for age, sex, race, education, employment, store type and neighborhood-level poverty (bold if p .05)

OR= odds ratio; CI= confidence interval