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The Relationship between Neighborhood Food Environment and Food Store Choice on Purchasing Habits among SNAP and Lower Income Households, USDA FoodAPS Data

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Abstract

The objective of the study was to determine relationship between neighborhood food store availability, store choice and food purchasing habits among Supplemental Nutrition Assistance Program (SNAP) participating households. The study sample consisted of SNAP households (n=1581) and low income households participating in the USDA's National Household Food Acquisition and Purchase Survey (FoodAPS) a nationally representative cross-sectional survey of American households with household food purchases and acquisitions data. Main Outcomes: 1) Food purchasing choices (sugar-sweetened beverages, fruits and vegetables, snacks, water, and milk) obtained from store receipts over a one-week period; 2) food shopping activities was obtained from a log book of where food was purchased over a one-week period. Key findings indicated those SNAP households within 1 mile of a supermarket had higher odds of shopping at a supermarket (2.05 OR [95% CI 1.34, 3.15]) compared to those without a supermarket. Shopping at a supermarket was associated with greater odds of purchasing water and low-calorie beverages (OR 1.69 [95% CI 1.12, 2.54]) and fruits and vegetables (OR 2.50 (95% CI 1.52, 4.11]) compared to not shopping at supermarket among SNAP households. Additionally, a fractional multinomial logit analysis (n=4,664) similarly found that close proximity to superstores or supermarkets increases the share of weekly food purchases made there, and that car access increases purchases made at restaurants while decreasing purchases made at other food shopping venues. Findings suggest that policies aiming to improve food purchasing habits among SNAP need to consider how to situate stores where SNAP households will choose to shop.

Executive summary

Over the past several years, research has begun to examine various factors that may influence rates of obesity and dietary intake, especially among lower income households and those households participating in the Supplemental Nutrition Assistance Program (SNAP), formerly food stamps. Research has established key constructs related to dietary intake such as access to food stores, transportation, and socio-economic status, among many others. However, there have been mixed reviews with regard to neighborhood environmental factors with a direct correlation to dietary intake. It is not surprising the mix of results given that the construct of neighborhood environment may be a complex factor with several related variables. To these ends this project examined the construct of food store choice as a key factor in food purchases and amount spent at various food venues among SNAP households.

In Chapter 1 of this report, the project focused on the analyzing the relationship between SNAP households, food store choices, and food purchasing habits. The findings indicate that neighborhood availability of stores influences the type of stores where SNAP households choose to shop. The store choice has a subsequent effect on the types of food purchased among SNAP households. Those who live in neighborhoods with close proximity (1 mile) to supercenters or supermarkets tend to shop at those stores. Shopping at these types of stores influences what is purchased. At supermarkets SNAP households tend to purchase lower calorie beverages and fruits and vegetables. Whereas at supercenters SNAP households purchase healthier food items but at the same they purchase sugar-sweetened beverages, snacks, and higher calorie items. The findings suggest that policies aiming to improve the purchasing habits among SNAP households may consider the types of stores that are in close proximity to SNAP households.

In Chapter 2 of this report, the project aimed to identify and measure the relevance of

consumer determinants of food venue choice using a fractional multinomial logit model. Using the nationally representative cross-sectional data from the USDA's National Household Food Acquisition and Purchase Survey (FoodAPS), we examined neighborhood food environment, household characteristics, and SNAP participation affected the shares of household weekly food expenditures made at different types of food venues—superstores, supermarkets, other FAH food venues, and all FAFH food venues. Using the fractional multinomial logit model enabled the analysis to consider shares of all food venue choices simultaneously and compare their relative importance for food acquisition via purchase shares.

Average marginal effects calculated from the fractional multinomial logit results estimated that close proximity to a superstore or supermarket increased the share of food purchases made at that store type. Car access increases the share of food purchases made at food-away-from-home (FAFH) venues and decreased the share of purchases made at food-at-home (FAH) venues other than a superstore or supermarket. SNAP participation also played a role, increasing the share of purchases at superstores and decreasing the share spent at FAFH venues, on average. Notably, neither income nor household size significantly impact purchase shares between the food venue categories. These findings suggest that both the neighborhood food environment, including transportation access, play a role in determining food venue choice for enough consumers for it to matter. While several localized studies have also found this to be true, this evidence is based on a nationally representative sample. In addition, SNAP participation affects food venue choice as well, though more research is needed to study the relationship between SNAP, food venue choice, food purchasing decisions and health; it may be that while SNAP participation leads to fewer purchases at FAFH venues, it may also negatively affect food purchasing decisions at FAH venues, and it is unclear whether this trade-off results in better or

worse health outcomes relative to SNAP-eligible-not-receiving households.

CHAPTER 1: Logistic Analysis Relating Neighborhood Food Availability to Food Store and Purchasing Choices

Introduction

In recent years the role of the food environment has been suggested to be a key determinant in diet and obesity rates [1]. Distal determinants (upstream causes) particularly the availability of food venues (grocery stores, farmers' markets) surrounding a home [2-6] are thought to play a key role in dietary intake and obesity rates. In part due to the complexity of measuring the neighborhood food environment, studies reveal mixed results regarding the relationship between availability of food venues and diet and obesity status among various sub-populations [7-14]. One limiting factor of studies exploring availability is the lack of attention to the potentially mediating variable of store choice [15-17]. Research has suggested that the type and number of stores in a neighborhood may influence the type of stores residents choose to shop in, which in turn influence what is purchased and consumed [16,18]. In a recent study, qualitative findings point to individuals adapting their personal shopping choices to meet financial needs. Shoppers in this urban setting choose stores to avoid violence and crime, while also choosing stores based on convenience [17,19] and not necessarily closest to home [17]. Additional work has demonstrated that individuals typically choose stores which reflect their racial and economic profile [19]. While these studies provide insight into distinct urban populations, there remains limited understanding of how low income residents across the United States make food shopping choices and food purchases based on their neighborhood.

A sub population most affected by neighborhood access is lower income households are those participating in the Supplemental Nutrition Assistance Program (SNAP, formerly Food

Stamps). Households participating in SNAP may be disproportionally impacted by both the neighborhood food environment and factors affecting individual store choice [20]. Several studies have reported that low-income households and those participating in SNAP have less access to grocery stores and stores selling healthier food items [20-22]. For example, households participating in SNAP often are living in neighborhoods with limited access to stores selling high quality and low priced healthy food items. SNAP households of differing racial and rural composition report residing in areas with limited access to stores accepting SNAP benefits[23]. SNAP households may live in food deserts and those that do have access to grocery stores may still choose to shop in neighborhood other than their own.

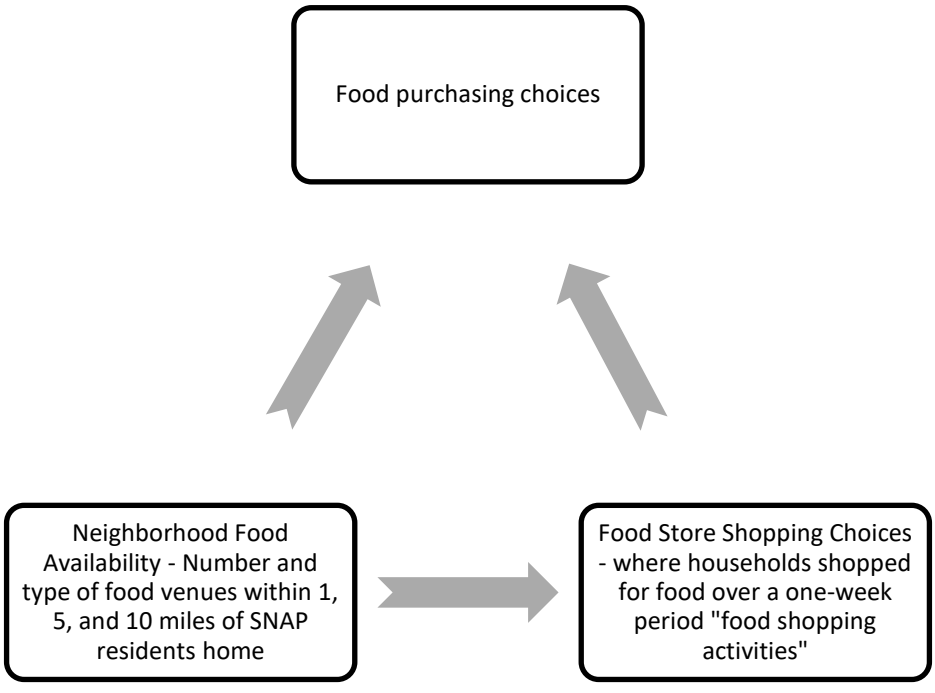
Additionally, many SNAP households are faced with challenges such as transportation and traveling to stores which accept EBT cards, posing limitations on store choice and thus purchasing habits. A recent study has pointed to SNAP households in lower income neighborhoods spending a large proportion of their benefits in medium size grocery stores [24], but several studies have also suggested that SNAP households shop outside their neighborhood for food a majority of the time [20,24,25]. The type of food venue SNAP households choose to shop in may be a reflection of their neighborhood but also the unique role that the actual SNAP benefits influences on the overall comfort that SNAP household members feel at stores [26] and acceptance of electronic benefit transfer (EBT) [27].

Existing research is limited by focusing only on food venue availability within a neighborhood and not expanding on how availability may influence store choice and purchasing habits. This study takes advantage of a unique data set, the FoodAPS data from United States Department of Agriculture(USDA), to examine multiple environmental influences of diet and obesity among SNAP participating households. The aims of the study are to determine the

association between 1) neighborhood food store availability and the outcome of primary food store choice; 2) neighborhood food store availability and the outcome of types of food purchased; and 3) primary food store choice and the outcome of types of food purchase. For each of these comparisons, we examine SNAP Participating households.

Conceptual model

The figure depicts the relationship between neighborhood food availability, food store shopping choices, and food purchasing choices. Neighborhood food availability both proximally and distally (via food store shopping choices) affects food purchasing choices. The study aims to examine the relationships depicted here as a way to better understand food purchasing choices.



Data

Dataset - USDA's National Household Food Acquisition and Purchase Survey (FoodAPS) is the first nationally representative survey of American households to collect detailed and comprehensive data about household food purchases and acquisitions. Detailed information was collected about foods purchased or otherwise acquired for consumption at home and away from home. The survey includes nationally representative data from 4,826 households, including Supplemental Nutrition Assistance Program (SNAP) households, low-income households not participating in SNAP, and higher income households.

Survey - The primary respondent (PR) was identified as the primary food shopper for the household. The PR completed 2 in-person interviews and 3 brief telephone interviews. All household members were also asked to track and report food acquisitions during a 1-week period; scan barcodes on food products; save their store receipts; and write information in a food book. For a detailed description of the methods see http://www.ers.usda.gov/data-products/foodaps-national-household-food-acquisition-and-purchase-survey/documentation.aspx.

Sample - From the survey question asking "Has anyone in your household received SNAP in the past year" the SNAP variable was created with verification of date last received with state-level enrollment files for March through November 2012 (n= 1581). There may be endogeniety of those selecting into SNAP being different compared to other eligible households that select to not participate in SNAP which could influence store choice. Therefore, we tested several instrumental variables such as county level poverty index or median household income at the county level and did not find that an IV approach worked for modeling endogeneity. Thus we included covariates that conceptually would be related to selecting into SNAP and be associated with store choice.

Methods

Independent variables

Neighborhood Availability of Food Venues - The first independent variable was availability of food venues within 1 , 2, and 10 miles of the home. These distances were chosen based on the average miles from home SNAP households live from various food venues (see Table 1). This variable was categorized as a binary variable, indicated whether each type of food store was present in the neighborhood surrounding each SNAP household for each mile buffer. The binary variable for each store type was coded as either the household did not have this store type within a 1, 2, and 10-mile radius of their homes (coded as "0") or they did have this store type within a 1,2, or 10-mile radius of their homse (coded as "1"). The following types of food venues were used: 1) supermarkets (greater than 50 employees but sells primarily food); 2) supercenters (greater than 50 employees and sells food plus a significant amount of other items such as clothes, automotive, household, furniture); 3) convenience stores; 4) combination grocery stores (i.e. food is sold as well as prepared food items and household goods); and 5) medium and large grocery stores (less than 50 employees). This information about the presence of each type of store within the geographic radius was derived from several steps, described below. First, each household was geocoded based on the latitude and longitude of FoodAPS households provided by Mathematica Policy Research. Then the USDA Economic Research Service (ERS) created point locations for the households. Block group, tract, county, and state FIPS code identifiers for both the 2000 and 2010 census geographies for the household points were obtained by using point-in-polygon geospatial analysis to identify in which 2000 and 2010 TIGER block group polygons each household was located. Data from the FoodAPS Geography component are based on 2010 census geographies. Second, the categorization of the food stores

used the STARS dataset. The STARS system classifies stores into types. The types of stores are categorized based on industry standards. Place names were standardized through matching to the STARS database and then through a manual review and then a final place category and place type were assigned based on information from STARS, InfoUSA, Google, and keywords in the place names.

Dependent variables

Our first set of models examined the odds of shopping at a particular food venue during the week of data collection "food shopping activity". The second set of models assessed the relationship between neighborhood availability and store choice on foods purchased. These variables are described in detail below.

The variable "Food shopping activity" was derived from participants keeping a log of all the locations they purchased food for the home in one week. The following categories were used for the type of food venues the PR had their food shopping events at during the 1-week period: 1) supermarkets; 2) supercenters; 3) medium/large grocery stores; 4) combination grocery (grocery store plus retail such as clothing); and 5) dollar stores/convenience/gas stations labeled "convenience". These "food shopping activities" were categorized based on the type of food venue the PR purchased food from. There are 5 separate models for each type of food shopping activity. A binary variable was created to indicate if the PR shopped at this type of store (coded as "0" for not shopping at this store type and "1" for shopping at this type of store) over the one-week recorded period.

Our second set of models examines food purchases as the primary outcome. Food purchases were grouped in to the following categories 1) sugar-sweetened beverages (full calorie

soda; sports drinks); 2) milk (including whole, skim, flavored); 3) low-calorie beverages and water; 4) juice including 100% fruit juice; 5) produce (fresh and frozen fruits and vegetables); 6) snacks (chocolate, candy, chips, pretzels). Cereal and breads were omitted since they could not be separated for sugar or fiber content, meats were omitted since they could not be separated for fat content. For each food category a binary variable was created if the household purchased the food category or if they did not purchase the food category during the one-week period (coded as "0" for not purchasing the food category and "1" if they did purchase the food category). These groups are not mutually exclusive, such that a household can purchase snacks and milk in the same one-week period. There are 5 different models assessing the odds of purchasing these food categories. These food purchases for home (FAH) were collected using three methods: 1) survey booklets complemented with telephone calls, 2) hand-held scanners, and 3) post-survey processing of saved receipts. Respondents were asked to record all acquisitions on the Daily List in the Primary Respondent's Book. PRs were asked to fill out a corresponding detailed page for each acquisition on pages which asked for details such as location, date, and payment types. PRs were asked to scan items purchased using the hand-held scanner and record details about items that could not be scanned. They also were asked to attach the receipt. On days 2, 5, and 7 of the reporting week, PRs were asked to report all acquisitions that had been written on the Daily List. For FAH purchases, the telephone interviews collected information on the Daily List as well as supplementary information about any problems respondents had in using the hand-held scanner. At this time, respondents were reminded to save their receipts.

To capture each FAH purchase at the item level there was coalescing of information from the Food Books, telephone interviews, scanners, and receipts by USDA. There was matching to phone reported events through a double entry process, where a second data entry person resolved

any inconsistencies. Items that were scanned or written were matched to receipts, and prices were assigned using the receipts information. In addition, item descriptions were updated using receipt information if the description from the scanned barcode or written information was limited or incomplete. Lastly, the categorization of the food purchases was matched to the isle.

Co-variates

Several key variables were collected to examine food shopping and neighborhood food venue availability. These include car ownership, primary reasons for choosing their primary store (prices of food, quality of food, location to home, good produce), household size, family size (the number of individuals who met the criteria for qualifying as being a legal relationship to the primary respondent), and household income (derived from asking the PR the household income including all assets). Additionally, distance from the respondent's home to each type of food store type (supercenter; supermarket; combination grocery; convenience; medium/large grocery) was used. Distance measures were obtained using Google Maps and the household's and place's geocoded addresses where the respondent acquired food. Lastly, to understand the differences between rural and urban counties interaction terms were tested to see if there was an effect. The interaction term was not significant but was retained in the model as cofounder, labeled as rural for census tract being in a rural area. All these covariates were included in the models below.

Analyses

To examine the association between neighborhood availability and food shopping activities a logistic model was used, controlling for car ownership, household size, distance to store type that corresponded to neighborhood availability of that store (i.e. distance to supercenter in the model examining neighborhood availability of supercenter), rural county designation, and household income. In all other analyses logistic regression was used while

controlling for the same covariates in the logistic model. All models used survey commands to account for clustering of households at the neighborhood level using primary sampling units. Taylor estimation was used for robust standard errors. All analyses was done using Stata 14.0 [28].

Results

The demographic characteristics of the SNAP sample are presented in Table 1. SNAP households reported 90% as English being the primary language, 60% owning a car, and 25% living in a rural census tract. SNAP households lived on average 3.2 miles away from a supercenter and 2.65 miles away from a supermarket, with an average travel time of 11.36 minutes to their primary food store. The distribution of stores visited during the week "food shopping activity" by SNAP participants indicates that a high percentage shop at supercenters (37%) followed by supermarkets (32%). Lastly, in regard to purchasing choices among SNAP households during a one-week period 62% bought sugar-sweetened, while 85% purchased fruits and vegetables.

Associations between food shopping events and food purchases (Table 4)

Supercenter Food Shopping - shopping at a supercenter was associated with greater odds of purchasing all food categories from any food venue over a one-week period.

Supermarket Food Shopping - shopping at a supermarket was associated with greater odds of purchasing water and low-calorie beverages (OR 1.69 [95% CI 1.12, 2.54]) and fruits and vegetables (OR 2.50 (95% CI 1.52, 4.11]). There is a similar relationship with medium/large grocery store shopping as well.

Convenience Store Food Shopping - shopping at a convenience store was associated with lower odds of purchasing any fruits and vegetables (.31 OR [95% CI .17-1.76) and water or low

calorie beverage (.30 OR [95% CI .11, 1.76]) from any store type over a one-week period compared to those never shopping at a convenience store.

Discussion

This study is one of the first to utilize a comprehensive dataset examining purchasing habits at the individual level, which helps elucidate the relationship between neighborhood food availability, shopping activity, and purchasing habits. The relationships described here are meant to be descriptive only, and do not suggest that SNAP itself is driving these store choice and purchasing decisions. But rather, there are distinct behavioral choices that SNAP households make which may to a greater or lesser degree be influenced by the neighborhoods they reside in.

First, neighborhood availability of stores was associated with the type of stores that SNAP household members choose to shop in over a one-week period. These data demonstrate that neighborhood availability of food stores with a supercenter have higher odds of shopping at a supercenter compared to those without a supercenter within 1 mile of their home and this food store choice is associated with higher odds of purchasing all food types. Although we find that healthy foods are being purchased at these venues, the result suggests that less healthy foods are being purchased at the same time. These results are situated within a growing body of research finding that neighborhoods with high access to supercenters is associated with higher body mass index (BMI) [29,30]. There is some suggestion that the behavior of shopping at supercenters is related to shopping once a month among SNAP household and buying foods in bulk that will last [25,31]. This type of shopping behavior and choice may lead to lower odds of purchasing healthier items such as milk and instead purchasing more shelf-stable items such as high calorie snack items [32]. The ability to make these links elucidates how neighborhood influences choice and thus

what is purchased based on the type of food venue. These results are not suggesting that supercenters cause poor food purchases or obesity, but rather this result is one example of many complicated pathways which helps to explore the role of the food environment among low income and SNAP households.

A second key insight is found in the unique role that supermarket availability and shopping activity at this venue has among SNAP households. Among SNAP households, proximity to a supermarket (living within 1 mile) was associated with choosing to shop at this venue. While, living farther away from a supermarket was associated with choosing to shop at a convenience store or medium/large grocery store. Previous literature has suggested that access to supermarkets may be a piece in improving healthful diet [33] and lower odds of obesity [5,14,34]. Given, that although supermarkets carry a variety of unhealthy items they also stock a variety of healthy items at fair prices [35]. Conversely, others have found that the food available in SNAP authorized convenience store retailers carry a low variety of healthy food options [36]. Our results suggest that those choosing to shop at a supermarket or medium/large grocery store purchased fruits and vegetables and water. Since our analyses did adjust for living in a rural community the findings can suggest that regardless of rural or urban neighborhoods living farther away from stores may influence the type of store SNAP households choose to shop in and thus the types of food purchased. We are not suggesting the proximity is the only factor in store choice but rather that when policies are addressing improving food access for vulnerable populations addressing restructuring of the environment (such as moving stores where SNAP residents reside) or providing tax incentives such as transportation vouchers for those living farther away from stores [37], may be an effective strategy for improving diets [38].

Lastly, the lack of a strong direct association between neighborhood availability with

food purchases among many of the food categories is similar to findings from previous studies [39,40]. This finding is not surprising given the many determinants (social, economic, physiological) along the pathway between neighborhood food store availability and purchasing habits. The lack of findings reinforces previous findings indicating the need for precise and accurate measures of the food environment, such as store choice [41,42].

There are several important limitations of this study that need to be addressed. Although the USDA FoodAPS data is the most extensive collection of food purchasing acquisitions to date, the data collection period was only over a one-week time period. While this one-week period may not reflect all the food purchases in a given month, the highly detailed data provided compensates somewhat for the limited time period covered. Extensive efforts were taken with collection of receipts however it is always possible that some food was not recorded in the food book or through the scanners. As with any self-report survey there can be over or under reporting. The neighborhood boundaries do not necessarily reflect each household's true operational neighborhood and thus these are investigator defined boundaries. While the 1, 5 and 10-mile radius was used, it does not account for ease of transport such as traffic patterns, barriers to walking, and other traffic pattern measures.

The implications of these finding points to the importance of not simply measuring the neighborhood food environment but taking a more nuanced approach to understanding the intricacies between neighborhood availability, store choice, and purchasing habits. Additionally, among lower income households those participating in SNAP may have unobserved characteristics that influence their food shopping and purchasing characteristics. Future studies among SNAP households may want to consider the in store contents of where SNAP households shop as just as vital as improving availability within neighborhoods. Lastly, policies are needed

which address improving access to different food store types for SNAP households, which may help to improve health outcomes through the role of improved food purchases.

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Conclusion

The implications of these finding points to the importance of not simply measuring the neighborhood food environment but taking a more nuanced approach to understanding the intricacies between neighborhood availability, store choice, and purchasing habits. Additionally, among lower income households those participating in SNAP may have unobserved characteristics that influence their food shopping and purchasing characteristics. Future studies among SNAP households may want to consider the in store contents of where SNAP households shop as just as vital as improving availability within neighborhoods.

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Table 1. Descriptives of neighborhood, food store choice, and purchasing habits among SNAP households, USDA FoodAps 2012 SNAP (n=1581)

	mean (SE)/percentage
Family Size	2.78 (.09)
Household Size	3.10 (.09)
English as primary language	90%
Household Receiving USDA food from local program	90%
Car Ownership	60%
Residing in rural census tract	25%
Perception of Household Diet	
Excellent	5%
Very Good	18%
Good	44%
Fair	20%
Poor	4%
Reasons for Not Buying Healthy Food (% Agree)	
Costs too much	47%
Too busy to prepare food	19%
Household doesn't think healthy food tastes good	26%
Family is eating enough healthy food	37%
Primary shopper reports eating right amount of F/V	
Eat right amount	23%
Eat More	77%
Eat Less	<1%
Reads the Nutrition Facts Panel	
Always	12%
Most of the time	15%
Sometimes	30%
Rarely	13%
Never	28%
Never seen panel	1%

Distance to Food Venues in Neighborhood (miles)	
Super Center	3.20 (.61)
Super Market	2.65 (.67)
Convenience Store	1.14 (.17)
Grocery Store	3.89 (.68)
Shopping Characteristics	
Travel Time to primary store self-report (minutes)	11.36 minutes
Travel Cost to store (self-report)	$2.79
Neighborhood Characteristics	
No SNAP retailers in .25 miles	53%
No SNAP retailers in .50 miles	30%
No SNAP retailers in 1 mile	16%
No Super Center in .5 miles	80%
No Super Center in 1 mile	55%
No Super Market in .5 mile	79%
No Super Market in 1 mile	49%
Primary Store (Self-Report)	
Super Center	49%
Super Market	48%
Reasons for Primary Store	
Low Prices	61%
Good Produce	12%
Good Quality	16%
Close to where I live	47%
Shopping Choices 1-week period	
Super Center	37%
Super Market	32%
Convenience	8%
Grocery	4%
Farmers Market	3%
Other (Dollar, Club)	1%

Distance to Shopping Choices (1-week period)	
Place distance	5.25 (.61)
Location accepted SNAP/EBT	87%

Food Buying Choices (1-week period)	
Sugar-sweetened beverages	62%
Milk	54%
Water/Low-Calorie Beverages	21%
Juice	23%
Fruits and Vegetable	85%
Snacks and Candy	73%

Associations between neighborhood food store availability and food shopping activities (Table 2)

Supermarket Availability - if a supermarket was within 1 mile of the home there was lower odds of shopping at supercenter (.36 OR [95% CI .22, .60]) compared to not having a supermarket within 1 mile. Those living within 1 mile of a supermarket had higher odds of shopping at a supermarket (2.05 OR [95% CI 1.34, 3.15]) compared to those without a supermarket within 1 mile. Of note, is that as supermarkets are farther away from a SNAP households the odds of shopping at a convenience store or combination grocery store increase. Such that, those with a supermarket 10 miles away report higher odds of shopping at a convenience store during the week (OR 3.57 [95% CI 2.24, 5.25]) and a combination store (OR 1.19 [95% CI 1.82, 2.79]).

Supercenter Availability - if a supercenter was within 1 mile there was higher odds of shopping at this venue (2.61 OR [95% CI 1.41, 4.79]) and less likely to shop at a supermarket (.44 OR [95% CI .26, .72])compared to those without a supercenter within 1 mile of the home. These relationships are not seen as stores are farther away from the SNAP household.

Medium/Large grocery store Availability - if a grocery store is within 5 miles or 10 miles there was higher odds of shopping at this venue (OR 3.97 [95% CI 1.81, 8.67]) and (OR 3.47 [95% CI 1.38, 8.74]). This result highlights the possible link between proximity of stores in a neighborhood and store choice.

Table 2. Odds Ratio of food shopping activities over one-week in relation to the type of food stores within a 1, 5, and 10 mile buffer of the household among SNAP households, USDA FoodAps 2012

	Food Shopping Activities over a one-week period			
Food Venues (1 mile buffer)	Supercenter	Supermarket	Grocery	Convenience
Supermarkets	**.36 (.22, .60)***	**2.05 (1.34, 3.15)***	.77 (.50, 1.19)	1.45 (.74, 2.84)
Super Centers	**2.61 (1.41, 4.79)***	**.44 (.26, .72)***	1.53 (.81, 2.91)	.85 (.55, 1.31)
Grocery Stores	1.14 (.75, 1.75)	.64 (.42, 1.00)	1.83 (.85, 3.98)	.76 (.41, 1.43)
Convenience Stores	1.05 (.65, 1.75	.86 (.52, 1.43)	.45 (.20, 1.01)	1.33 (.54, 3.28)
Combination Grocery	.82 (.50, 1.36)	1.05 (.60, 1.87)	1.54 (.64, 3.72)	.93 (.38, 2.26)
Food Venues (5 mile buffer)				
Supermarkets	.67 (.36, 1.26)	1.97 (.96, 4.05)	.86 (.37, 1.98)	.82 (.35, 1.91)
Super Centers	1.25 (.79, 1.92)	1.56 (.81, 2.98)	.90 (.43, 1.87)	.99 (.44, 2.21)
Grocery Stores	1.17 (.76, 1.81)	1.16 (.71, 1.92)	**3.97 (1.81, 8.67)***	.76 (.47, 1.21)
Convenience Stores	1.81 (.62, 5.31)	1.03 (.28, 3.76)	.57 (.15, 2.26)	1.74 (.33, 1.92)
Combination Grocery	.75 (.35, 1.61)	1.69 (.76, 3.78)	1.65 (.31, 4.36)	1.02 (.41, 2.58)
Food Venues (10 mile buffer)				
Supermarkets	.58 (.19, 1.76)	4.30 (.97, 1.91)	.62 (.23, 1.61)	1.60 (.23, 1.32)
Super Centers	1.49 (.91, 2.45)	2.33 (.93, 5.82)	1.01 (.42, 2.43)	1.55 (.47, 5.11)
Grocery Stores	1.16 (.60, 2.22)	1.02 (.57, 1.81)	**3.47 (1.38, 8.74)***	.95 (.51, 1.79)
Convenience Stores	.25 (.02, 3.75)	**3.57 (2.24, 5.25)***	.46 (.04, 6.17)	.98 (.45, 1.32)
Combination Grocery	.34 (.05, 2.37)	**1.19 (1.82, 2.79)***	.97 (.14, 6.66)	.63 (.08, 5.29)

logistic regression model adjusted for household income, distance to store, household size, car ownership, rural census tract designation

* p<.05

Associations between neighborhood food availability and food purchases

There were no statistically significant food purchasing associations found between neighborhood food store availability and types of food purchased (Table 3).

Table 3. Odds of purchasing food categories when different types of food venues are within 1 mile of residence among SNAP participating households, USDA FoodAps 2012

	Food Category Purchases during a one-week period					
Food Venues (1 mile buffer)	SSB	Milk	Water/Low-Calorie	Juice	Fruit/Vegetable	Snack
Supermarkets	.99 (.66, 1.46)	.63 (.38, 1.03)	1.08 (.68, 1.72)	1.01 (.65, 1.60)	.79 (.50, 1.25)	.75 (.52, 1.07)
Super Centers	.89 (.59, 1.34)	.85 (.60, 1.22)	1.19 (.74, 1.92)	.99 (.66, 1.49)	.76 (.47, 1.25)	.76 (.51, 1.13)
Grocery Stores	.92 (.60, 1.42)	.95 (.64, 1.42)	.72 (.49, 1.07)	.97 (.69, 1.36)	1.45 (.85, 2.47)	.84 (.53, 1.34)
Convenience Stores	.98 (.62, 1.55)	.81 (.46, 1.42)	1.53 (.98, 2.36)	1.09 (.62, 1.92)	.76 (.40, 1.46)	.77 (.42, 1.41)
Combination Grocery	1.10 (.66, 1.83)	1.24 (.78, 1.98)	.98 (.62, 1.57)	.99 (.64, 1.53)	.81 (.45, 1.45)	.83 (.53, 1.30)

logistic model adjusted for household income, household size, car ownership, rural residence
5 separate models predicting how neighborhood availability is associated with food purchase categories
similar results were found for 5 and 10 mile buffer

Table 4. Odds of purchasing certain foods when shopping at various food venues over a 1-week period among SNAP, USDA FoodAps 2012

SNAP participating Households

Food Shopping Activities 1-week period	SSB	Milk	Water/Low Calorie Beverages	Juice	Fruit/Vegetable	Snack
Super Center	**1.60 (1.06, 2.41)***	**1.92 (1.36, 2.68)***	**2.01 (1.27, 3.16)***	**2.31 (1.24, 4.30)***	**2.11 (1.36, 3.28)***	**2.23 (1.55, 3.19)***
Super Market	1.22 (.82, 1.83)	1.30 (.84, 2.03)	**1.69 (1.12, 2.54)***	1.12 (.59, 2.12)	**2.50 (1.52, 4.11)***	1.44 (.94, 2.23)
Convenience	**1.59 (1.02, 2.49)***	.66 (.34, 1.27)	1.39 (.87, 2.22)	.57 (.31, 1.05)	**.57 (.32, 1.00)***	1.04 (.63, 1.71)
Grocery	**1.93 (1.06, 3.51)***	.71 (.32, 1.60)	.85 (.48, 1.53)	.82 (.43, 1.60)	**2.92 (1.36, 6.31)***	.77 (.38, 1.55)

logistic model adjusted for hhsize, income, distance to store, car ownership, rural designation census tract
p<.05

CHAPTER 2: Fractional Multinomial Logit Analysis on Shares of Household Weekly Food Purchases at Different Food Venues

Introduction

The Centers for Disease Control and Prevention (CDC) identifies poor nutrition as one of four health risk behaviors that cause much of the illness related to chronic diseases and conditions (e.g., obesity, diabetes, heart disease), which collectively are the leading causes of death and disability in the United States.[1] While unhealthy food consumption may directly lead to adverse health outcomes, a considerable amount of research also looks at how proximal access to food venues (i.e., the neighborhood food environment) affects food consumption, thereby indirectly affecting the impact of chronic diseases and conditions. Such research tends to focus on obesity as the primary adverse health outcome,[2-6] but findings have been mixed in regards to how the neighborhood food environment affects diet and obesity.[7-13] In fact, a systematic review of 71 studies in this literature found limited evidence for correlations between local food environments and obesity.[14] Faced with a similar task in a systematic review of local food environment interventions, one recent review starts by asking not simply what works and what does not, but rather *for whom* and *under what circumstances* does a change in food availability influence diet.[15] This framework accepts that because the role of a food environment in determining food intake is circumstantial, there may be a more generalized model to food acquisition behavior.

Taking a step back, some studies have examined the determinants and impact of food venue choice (i.e., where does a consumer choose to acquire food).[16-18] For example, a 2011 study of Kentucky adults found that food venue choice was significantly correlated with dietary intake relative to food venue availability. This paper also acknowledges that while understanding food venue exposure along regular travel patterns is important, we must also understand if and how food venue choice influences travel patterns, and moreover, if decisions to shop in a disadvantaged neighborhood may be more a function of socio-economic status and transportation than the neighborhood food environment per se.[19]

This and related studies research neighborhood food environments by asking the broader questions: What factors affects food venue choice? And then, how does food venue choice affect dietary intake and health outcomes?

The present research objective addresses the former question by studying the determinants of food venue choice using robust data from the United States Department of Agriculture's (USDA) National Household Food Acquisition and Purchase Survey (FoodAPS), a nationally representative survey of 4,826 American households containing detailed information on household food purchases and acquisitions. Based on a review of the literature, our conceptual model hypothesizes that food venue choice is associated with SNAP participation and eligibility, neighborhood environment, and household socioeconomic characteristics.

The challenge in modeling food venue choice is that consumers often choose more than one food venue from which to acquire their food. For example, within any given week, a household may choose to purchase half of its food from a grocery store, a quarter from a convenience store, and another quarter from fast food restaurants. Therefore, our analysis will use a fractional multinomial logit econometric model to estimate the effect of explanatory variables on shares of weekly food purchases made at several types of stores simultaneously. By modeling shares of food purchases made at store types as outcome variables, we avoid the risk of a simultaneity bias associated with including store choice as an explanatory variable. Thus, the estimates will contribute to the literature on store choice where the analytical focus on a single store type in an environment with several types of stores oversimplifies the household's food purchasing decisions. Using the coefficients generated from the fractional multinomial logit, we will calculate average marginal effects to present how the explanatory variables affect store choices within a household.

Literature review

Where we acquire our food affects which foods we acquire; this food acquisition closely relates to which foods we consume; and food consumption impacts human health. What remains undecided is: how do consumers decide where to acquire their food? A qualitative analysis of interviews of primary household food shoppers identified four main factors: proximity to home and work, financial considerations, produce and meat availability and quality, and store characteristics.[17] The literature informs a conceptual framework used to model food venue choice.

First, as discussed in the introduction, a model of food venue choice must consider the consumer's neighborhood food environment. However, the assumption that consumers shop near their residence (i.e., their neighborhood food environment) is increasing questioned.[16] For example, a study of two low-income urban food deserts found little correlation between the nearest supermarkets and the type of store where residents chose to do their shopping. However, store choice was correlated with BMI, supporting that there is a link between store choice and human health.[20] While a model should allow for travel patterns to be influenced by food venue choice, it is also true that research on food venue exposure along normal travel routes is needed.[19] Due to these dissenting viewpoints, our model conceptualizes the neighborhood food environment via two of its components—proximity to store and access to transportation—recognizing this as a reduced characterization.

There is also a growing body of research that finds that it is not the absolute number, but the relative density (proportion) of certain food venue types in the neighborhood food environment that affects food venue choice.[21-25] For example, one study that a higher ratio of grocery stores and produce vendors relative to fast-food restaurants and convenience stores decreases the odds of obesity.[22] Additionally, a more recent study found that proximity to a high volume of fast-food restaurants had a much larger effect on body weight if they were the predominant restaurant type in the area, suggesting

that consumers were impacted not so much by the absolute number of fast-food restaurants but more by the lack of alternative dining options.[21] The same may be true for food-at-home venues.

Secondly, evidence suggests that store choice is likely influenced by household characteristics, including members' income and education and overall household size and transportation options. For example, a study of rural households found that those with a grade-school education reported relatively limited access to produce and acquiring food at convenience stores and buffets more frequently, perhaps as a result of a lower income.[9] Other studies have found correlations between store choice and education[18] and income. Another study found that while distance travelled to a household's preferred food shopping venue did not significantly vary by race or socioeconomic status, socioeconomic differences did affect the mode of transportation.[16]

Third, SNAP participation may affect food venue choice. Already, evidence suggests that SNAP and non-SNAP households of similar economic backgrounds have dissimilar dietary intake; SNAP recipients are more likely to consume sugar-sweetened beverages, red meat, potatoes and less likely to consume whole grains[26-29]. One way SNAP participation may affect food venue choice stems from the fact that SNAP benefits can only be used to purchase specific items, which may be more or less available at venues. Households with time constraints may prefer larger stores where they can conveniently use all of their SNAP benefits in one trip. Additionally, SNAP-recipient consumers may prefer food venues where electronic benefit transfer (EBT) is accepted and use of SNAP is not shunned.[30] However, there is also a possible confounding relationship between SNAP participation and the neighborhood food environment regarding their effect on food venue choice.[26] Thus, it is critical that both factors are controlled for in our analysis to tease out the different effect on food venue choice.

Conceptual Model

Based on the literature review, we hypothesize that food venue choice is a determinant of

neighborhood environment, household socioeconomic characteristics, and SNAP participation, recognizing that these factors are not necessarily independent from each other.

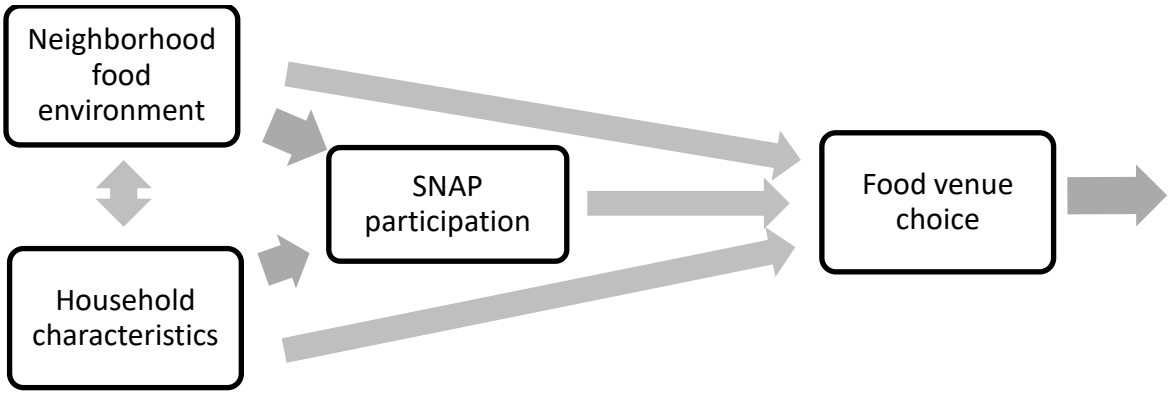

Figure 1: Consumer Determinants of Food Venue Choice

Figure 1 depicts a rudimentary illustration of the model. For any given household, the neighborhood food environment and household characteristics are related. Moreover, both factors may affect SNAP participation; certain household characteristics are required to be SNAP eligible and the neighborhood food environment (e.g., proximity to stores accepting EBT) will affect the decision to participate. All three factors help determine food venue choice. The final arrow reminds that food venue choice itself determines food acquisition and, by extension, food consumption and health outcomes, though testing this part of the theory is beyond the scope of this study.

Two factors absent from Figure 1 are those producer determinants of food venue choice. Of the four main factors identified by primary food shoppers, two were consumer determinants (proximity to home and work and financial considerations), and two were producer determinants (produce and meat availability and quality, and store characteristics).[17] Please note that our model and subsequent analysis focus on consumer determinants due to limitations posed by the econometric methodology.

Data

The data come from USDA's National Household Food Acquisition and Purchase Survey

(FoodAPS), a survey of 4,826 American households containing detailed information on household food acquisitions. The stratified random sampling strategy used for FoodAPS was designed to be nationally representative for SNAP households, low-income households not participating in SNAP, and higher income households, making it ideal for exploring the relationship between SNAP participation, the neighborhood food environment and store choice.

Within each household, data were collected for foods purchased or otherwise acquired for consumption at home and away from home, including foods acquired through assistance programs. Specifically, members of participating households were asked to keep daily records of food acquisitions over a one-week period using barcodes and store receipts. For each food acquisition event, participants were asked to report where the food was purchased and the total amount paid, among other things. To improve reliability, acquisition and purchase data was relayed over the phone by the primary food shopper and then later checked using the records contained in each member's food book. Additionally, the household's primary food shopper completed two in-person interviews and three brief telephone interviews to gather information about household characteristics. For a more detailed description of the methods, or to learn more about other data collected, see information on USDA's FoodAPS website.[31]

Methods

Fractional Multinomial Logit Model

The fractional multinomial logit was developed in 2002,[32] and has been described and applied by a few others.[33-35] The technique combines two variations on the standard logit model: the fractional logit and the multinomial logit. The consequence is a model where the explained variable y is able to represent the different shares of various types of y, all of which sum to one, much like the various categories in a pie chart. For this reason, the model is in the family of multivariate fractional logit models, because it is measuring the changes in shares of multiple variables simultaneously as a result of

some explanatory variables.[36] In other words, it allows one to ask how the slices of a pie chart change between observations as a result of differences in a certain set of related factors. In this analysis, the whole pie chart is a household's total weekly food expenditures, meaning that the fractional multinomial logit model can help to see how changes in household characteristics affect the share of weekly expenditures spent at different types of stores and locations.

Combining some main elements of the fractional logit and the multinomial logit models to come up with the fractional multinomial logit model is fairly straightforward. The fractional logit model differs from the standard logit model as it treats the dependent variable as an expected value defined by an interval rather than a response probability.[37] Similarly, the fractional multinomial logit model must ensure that the expected share of any outcome j lies between parameters A and B and that the sum of shares for all outcomes sums to unity. Mathematically,

$$A \leq E(S_j|x) \leq B, \qquad j = 0, 1, 2, \dots, J, \text{where } A = 0 \text{ and } B = 1. \tag{1}$$

$$\sum_{j=0}^{J} E(S_j|x) = 1 \tag{2}$$

This technique permits the evaluation of shares of an outcome rather than the probability of whether or not the outcome occurred.

The multinomial logit describes a technique for comparing the response probabilities for several categorical variables through use of a pivot outcome, which is the difference between one and the sum of expected shares for all other outcomes. Likewise, the fractional multinomial logit model defines a pivot outcome as well, but again, its dependent variables are fractional outcomes, not response probabilities. Defining $j = 0$ as the pivot outcome, the fractional multinomial model also must establish expressions for every outcome within the logit framework.

$$E(S_j|x) = G(\beta_0 + \beta_k x_k) = G(z) = e^z/(1 + \sum_{j=1}^{J} e^z), \qquad j = 1, 2, \ldots, J. \tag{3}$$

$$E(S_0|x) = G(\beta_0 + \beta_k x_k) = G(z) = 1/(1 + \sum_{j=1}^{J} e^z), \qquad j = 0. \tag{4}$$

Use of the pivot outcome equation (4) to estimate multiple outcomes makes it possible to evaluate the effect of explanatory variables on several variables simultaneously. Therefore, when joined together, the fractional multinomial logit model estimates coefficients which predict the expected share of several categorical outcomes within a defined interval.

By embedding the fractional logit function into the multinomial logit quasi-likelihood function, the econometric model can measure shares of outcomes—not probabilities—in what is a simplified form of the log likelihood function.[34] This new function, as a member of the linear exponential family, uses a quasi-maximum likelihood estimator (QMLE) and is efficient and consistently normally distributed provided the fractional logit function holds true.[33] The QMLE approach will maximize this new function and, with the assistance of a fractional multinomial logit Stata package,[38,39] run until it converges and is able to predict shares.

However, because the multinomial logit estimator requires some normalization, these QMLE estimates will correspond to the coefficients in the multinomial shares model.[34] Thus, it produces coefficients that may be difficult to interpret. For this reason, using the coefficients predicted from an estimation of the fractional multinomial logit model, we calculate average marginal effects (i.e., the mean of the marginal effects for all observation, as opposed to the marginal effect at the variable's mean) for every independent variable on each dependent variable.

Dependent variables

The dependent variables are the share of total weekly food expenditures made at different

locations, which we are calling food venue purchase shares. Share of food expenditures made at superstores and supermarkets were large enough to comprise their own categories, but due to the high number of store types, other expenditures were aggregated. In this manuscript, we aggregated all other FAH expenditures not made at a superstore or supermarket into a third category; this includes grocery stores, convenience stores (including gas stations), and smaller venues like farmers markets. Finally, all FAFH expenditures into a fourth category, which includes all weekly expenditures made at sit-down restaurants and fast-food restaurants. The shares of a household's total food expenditures made at these four location categories are represented by *Superstore Share*, *Supermarket Share*, *FAH Other Share*, and *FAFH Share*. These are the four dependent variables—the food venue purchase shares for superstores, supermarkets, other FAH stores, and FAFH locations—the sum of which represent all weekly food expenditures made by the household.

Table 1 summarizes some basic descriptive information about the dependent variables used in the analysis. Even after group all other FAH stores, *FAH Other Share* is still the smallest category, representing about 14% of food expenditures, on average. Conversely, *FAFH Share* is the largest category at about 35%, followed by *Superstore Share* at 28%. The standard deviations reveal that these shares are heterogeneous between households, and the minimum and maximums suggest that each category is the location for both none and all of at least one household's food expenditures. These statistics suggest that there is sufficient variance between households in shares of food expenditures at these locations for the analysis.

Independent variables

The independent variables selected to predict shares of food venue purchases are intended to represent those factors which our conceptual model hypothesizes most influence shopping behavior. These variables are summarized in Table 2. First, representing the neighborhood food environment, *Mile*

to Superstore and *Mile to Supermarket* are both binary variables indicating if a household's location is within a one-mile radius of a superstore or supermarket, respectively; in both cases, this applies to approximately 43% of households in the analyzed sample. Additionally, *Car* is a binary variable indicating if any household member owns or leases at least one vehicle, which is true for 84% of households in the analyzed sample.

Second, representing household characteristics, *ln(Income)* is a continuous variable derived from household income and given a log transformation to correct its skewed distribution (incomes less than one were coded as 0); as a result, it estimated coefficients should be interpreted as the marginal change resulting from one-percent increase in household income. Moreover, *Size* is a continuous variable representing the total number of members currently living the household, which is about 3 people for the average sampled household; while it is also skewed, a log transformation was not applied as it would complicate interpretation.

Finally, *SNAP* is a binary variable indicating if any member of the household is a recipient of SNAP benefits (32% of the sample). Collectively, these variables will control for distance to major food venues, car access, income, household size, and SNAP participation in the econometric model.

Results

Drawing from 4,664 observations, the fractional multinomial model converged on a log pseudo-likelihood of -157,100,000 with a Wald chi-squared of 468.95. To ensure that standard errors were estimated robustly, observations were "clustered" by a pseudo primary sampling unit (PSU) and adjustments were made for 57 clusters where households in the same PSU.

Table 3 presents the average marginal effects of the independent variables on purchase shares from different food venues. Average marginal effects that are statistically different from zero at the 5%, 1%,

and 0.1% levels are indicated with one, two, or three asterisks, respectively; coefficients that are not statistically different from zero at the 5% level or below receive no asterisk. Of the model's 120 coefficients for average marginal effects, 24 are significant at the 10% level.

A few other points must be made about the interpretation of the coefficients in Table 3. For binary variables, the coefficients represent the average change in purchase shares from different food venues resulting from a shift in the variables' minimum to its maximum, across all households. For continuous variables, the coefficients represent the mean of the change in food venue purchase shares as a result of a marginal change in the explanatory variables for all observations. Furthermore, because food venue purchase shares must always sum to one—as they are defined by a finite amount of total weekly food expenditures—the sum of the average marginal effects for any one explanatory variable is zero; in other words, what an explanatory variable might take away from one share, it gives to other shares. The upcoming discussion will highlight coefficients deemed to have statistical relevance in explaining difference in food venue purchase shares across all households in the sample.

Discussion

It is useful to review these results through the lens of the conceptual model. First, Table 3 provides some statistically significant results relating to one-mile proximity to a superstore or supermarket—variables that represent the neighborhood food environment. Specifically, the model finds that households living within one mile of a superstore are associated with a 5.4% increase in food expenditures at a superstore and a 10% decrease in food expenditures at a supermarket, which are unsurprising. However, this condition is also correlated with a 5.0% increase in food spending on FAFH; this may make sense if FAFH establishments are often located near superstores or if superstores and FAFH locations attract similar customers. Finally, living within one mile of a supermarket is associated with a 12% decrease of food expenditures at superstores, a corresponding 10% increase of food expenditures at supermarkets, and no significant effect on the share of FAFH. While not fully supporting

the assumption that consumers will only shop near their residence, these findings do suggest that proximity to a food venue location is, in fact, an important determinant of store choice for many consumers. If so, then the variety of foods offered at nearby superstores and supermarkets are feasibly correlated to food acquisition, consumption, and health.

Relatedly, car access is a variable with statistically significant results. Specifically, vehicle ownership or lease by a household member is correlated with a 4.7% decrease in food expenditures at other FAH locations and a 3.6% increase at FAFH locations. This may be because consumers are more likely to go some distance for a specific FAFH location, but only frequent other FAH locations that are nearby. Either way, this finding highlights that transportation access is an important consideration along with the neighborhood food environment.

Second, the results find that neither income nor household size is a statistically significant predictor for any food purchase share in model, all else equal. Thus, our results do not find additional evidence that a household's socioeconomic status, on its own, influences store choice. However, there may be particular location types for which income or household size is associated with a greater or lesser share of food expenditure if these effects canceled each other in either of the aggregated categories. Still, we maintain that income and household size remain important controls in the model.

Third, the results in Table 3 suggest that SNAP participation does influence store choice, or to be exact, the percentage of weekly food expenditures that are spent at a particular store. It is important to reiterate that this is true even after controlling for proximity to store type (i.e., neighborhood food environment) and household size and income. Specifically, the model estimates that households with at least one member receiving SNAP benefits will spend 5.7% more of food expenditures at a superstore relative to non-SNAP households. This is compensated by SNAP households spending an estimated 7.3% less of food expenditures on FAFH relative to non-SNAP households. Both coefficients are highly significant and suggest that, all else equal, SNAP participation is associated with a lesser share of weekly

food expenditures being made on FAFH, and a greater share at superstores. One might consider these findings in the context of the literature linking FAFH with adverse nutritional outcomes.[40,41] Together, they support a hypothesis which suggests that SNAP may encourage healthier food consumption, although this contradicts some of the current literature.[26-29] This may be because store choice affects food acquisition differently for SNAP and non-SNAP recipients—that is, SNAP participation affects food venue choice away from FAFH venues, but encourages unhealthy food purchases at FAH stores. Regardless, the results suggest that more research is warranted to understand the complex relationship between SNAP participation, food store choice, food acquisition and health outcomes.

Conclusion

This study aimed to identify and measure the relevance of consumer determinants of food venue choice. After reviewing the literature, a conceptual model was designed that viewed food venue choice as a function of the neighborhood food environment, household characteristics, and SNAP participation. Using nationally representative cross-sectional data from the USDA's FoodAPS, we examined how a set of explanatory proxy variables affected the shares of household weekly food expenditures made at different types of food venues—superstores, supermarkets, other FAH food venues, and all FAFH food venues. This was possible by using the fractional multinomial logit model, which enabled the analysis to consider all food venue choices simultaneously and compare their relative importance for food acquisition via purchase shares.

Results were reported as average marginal effects in Table 3, where the estimated coefficients represent the average change in food purchase shares at the different food venues across the sample given one-unit changes in the explanatory variables. The analysis estimated that close proximity to a superstore or supermarket increased the share of food purchases made at that store type. Car access increases the share of food purchases made at FAFH venues and decreased the share of purchases made at FAH venues other than a superstore or supermarket. SNAP participation also played a role, increasing the share of purchases at superstores and decreasing the share spent at FAFH venues, on average. Notably, neither

income nor household size significantly impact purchase shares between the food venue categories.

This study's limitations should also be considered when interpreting the findings and planning future research. First, as this study uses food purchases to measure the relative importance of one food venue over others, it effectively discounts the importance of markdown food and omits food venues (e.g., family, neighbors, colleagues, soup kitchens) from whom food may be free. As this may serve a larger percentage of caloric intake for lower-income households, this is an important consideration in connecting food venue choice to consumption and health outcomes. For example, future work using the FoodAPS dataset could consider using a fractional multinomial logit analytical framework to look at the shares of calories and nutrients coming from different sources. However, a limitation of the fractional multinomial logit model is that it is unable to incorporate changes to the outcomes that are due to differences in characteristics between the outcomes themselves. Thus, the availability and quality of certain food as well as food venue characteristics—two other factors that are important to primary food shoppers when choosing a food venue[17]—are not controlled for the in the model. Incorporating all of these food venue factors into a decision-making model for consumers is another challenge to excite future work.

These results provide some interesting considerations for the literature, especially given the reliability of the data and the analytical approach. Both the neighborhood food environment, including transportation access, play a role in determining food venue choice for enough consumers for it to matter. While several localized studies have also found this to be true, this evidence is based on a nationally representative sample. In addition, SNAP participation affects food venue choice, though more research is needed to study the relationship between SNAP, food venue choice, food purchasing decisions and health; it may be that while SNAP participation leads to fewer purchases at FAFH venues, it may also negatively affect food purchasing decisions at FAH venues, and it is unclear whether this trade-off results in better or worse health outcomes relative to SNAP-eligible-not-receiving households. What is clear is that the impact of SNAP benefits on food acquisition is complex, and quick endorsements or critiques of its impact on health food purchases should be cautiously considered in light of an ever expanding literature.

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