

**Title: The Impact of a New Nonprofit Supermarket within an Urban Food Desert on Household Food Shopping**

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**Abstract**

Local food environments play an important role in diet-related disease. Research documenting the relationship between poor access to supermarkets and diet-related disease has motivated efforts to bring fresh, healthy food options to food deserts. Few evaluations, however, have been performed to investigate the health impact of new supermarkets. This quasi-experimental study used receipt data as an objective measure to evaluate the impact on purchasing habits of a new non-profit supermarket, self-described as having a focus on fresh healthy foods at everyday low prices. Thirty-five participants collected receipts prior to the opening of the new supermarket and again afterwards. Not everyone in the sample shopped at the new supermarket, which created self-selected control and treatment groups. A difference in difference analysis was used to test for significant differences across these groups and over time. Our results suggest that shopping at the new supermarket is associated with an increase in the purchase of low calorie foods and decrease in the purchase of high calorie foods. Although most of the results were not statistically significant in this small sample, these results are promising. These findings encourage future research on this topic, which would require larger samples to better understand how to maximize the efforts aimed at addressing food environments.

## Introduction

Local food environments play an important role in diet-related disease. Inadequate availability of supermarkets, which provide year-round, lower-cost access to fresh fruits and vegetables, has been shown to negatively influence low-income residents' health [1]. Incidence of obesity and its associated harms are particularly high for ethnic minorities [2,3], which may be partially explained by disproportionately low access to fresh, healthful foods among these populations [4,5].

Research documenting the relationship between poor access to supermarkets and diet-related disease has motivated efforts to bring fresh, healthy options to food deserts. Very little research, however, has evaluated the impact of new supermarkets, even though many government entities offer financial incentives for grocers to open in underserved areas [6]. The few evaluations which have been performed have found mixed results [7-11]. One of the only published U.S. evaluations of the impact of a new supermarket on health found perceptions of fruit and vegetable access improved, although subsequent intake did not [9]. A second evaluation found the supermarket had no effect on food intake habits and minimal effect on household food availability [10]. This may reflect the relatively high cost of healthy foods compared to less healthy options. Given the proliferation of initiatives to add supermarkets to neighborhoods through municipal, state and federally-funded fresh food finance

initiatives, more studies are needed to evaluate the health impact and to understand how these initiatives could be more effective [6].

Existing evaluations of new supermarkets have relied exclusively on self-reported measures of food purchasing and consumption. This is the first study to our knowledge to analyze actual receipt data to evaluate the impact of a new nonprofit grocery store on food purchases in Chester, Pennsylvania, a city of 34,000 just south of Philadelphia on the Delaware River. Plagued by substantial population loss and high poverty, Chester had no supermarkets between 2001 and 2013 until Philabundance, the region's largest food bank, opened a 13,000 square foot supermarket the organization describes as having a focus on fresh healthy foods at everyday low prices. This study assessed 1) where participants chose to shop after the opening of the new supermarket; 2) what types of food they purchased at the new supermarket relative to other types of food stores; and 3) whether utilizing the new supermarket was associated with an increase in the proportion of spending on low calorie food.

## 1. Methods

Participants were recruited between the months of June and November 2013 by distributing flyers at a supermarket outside Chester and a dollar store in Chester and by word-of-mouth. To be eligible, individuals had to be the primary food shopper of the household, a resident of Chester or one of the

surrounding towns within two miles of the new supermarket, at least 18 years of age, and must have heard about the planned opening of Fare & Square. In total, 81 participants were enrolled. The study was approved by the University of Pennsylvania Institutional Review Board.

Once eligibility was determined, participants met with research staff for the initial visit. After providing consent, participants completed an online survey asking about food shopping habits and behaviors as well as an online 24-hour food recall (ASA24). Participants were given an appointment to return in two weeks to complete a second 24-hour food recall. At the conclusion of the second visit, participants were instructed to collect receipts from any retail outlet in which they purchased a food or beverage product over a two week period. Study staff provided participants with a plastic envelope for collecting receipts and a notebook to record items obtained without receipts (e.g., from a corner store without itemized receipts). Before concluding the second visit, the research team scheduled a follow-up appointment to receive and review the receipts with the participant after the two week collection period was over.

During the follow-up visit, a staff member reviewed each receipt line-by-line with the participant to clarify the description and price of the product. Participants also confirmed the name and location of the store, and specified their mode of transportation. All receipts were scanned into a database using a Neat Receipts® scanner, and indexed by participant ID and receipt number (chronological order). Once scanned, the following information was entered into an Access database: food item, original

price, price paid, discount given, food category (described below), store name, and store location. When entering this data, any item that had a recorded weight (fruits, vegetables, meat, and cheese) one pound was considered to be one item in order to account for variances in the amount purchased.

Each item was also categorized by obesity-promoting and obesity-preventing potential using measures validated by Author, 2014 [12]. The coding system measures the obesity-risk of seven common food groups: fruits, vegetables, low-fat dairy, sweet snacks, certain savory or salty snacks, sugar sweetened beverages, and ready-to-eat grain based energy-dense foods. To qualify as a low-calorie food, the item had to contain less than 100kcal/100g. In this coding system, fruits, vegetables, and low-fat dairy are classified as low-calorie, healthier foods (LCF), while sweet snacks, savory or salty snacks, sugar sweetened beverages, and ready-to-eat, grain based energy-dense foods are deemed high-calorie, less healthful foods (HCF). Each of the seven food codes is mutually exclusive. Food groups such as meat, high-fat dairy, grains typically not eaten as snacks (e.g., pasta, bread), condiments, and fats are not included in the low-calorie and high-calorie classifications, but are categorized.

Approximately one year after baseline measurements were collected, all 81 participants were contacted and asked to participate in a second wave of receipt collection. The second wave of receipt collection occurred between June and August of 2014, about 9 months after Fare & Square opened. The same procedures for collecting receipts and

reviewing purchases with participants were employed, with one exception: participants were asked to collect receipts for four, not 2 weeks. After reviewing each receipt, the receipts were processed and entered in to a database as previously described. Participants received a total of \$90 as compensation for the three visits as well as bus tokens for transportation to and from the research office.

Forty-two of the original 81 participants (51.9%) completed receipt collection at follow up. Although contact information was recorded during the baseline visit, participants lost to follow-up were unreachable (disconnected lines), did not return messages, or did not come to their scheduled appointment. Because of missing data from the baseline period, only 35 of the 42 participants could be included in the final analyses. The only significant difference between participants who collected receipts at baseline and those included in the final analyses was age. On average, participants who collected receipts at both time points were five years older than participants who only collected receipts at baseline.

In-store assessments of the availability and cost of healthier and less healthy foods were assessed during summer and fall of 2013 using the Nutrition Environment Measures Survey for Stores (NEMS-S) [13]. NEMS-S considers the availability of more healthful choices among 11 categories of commonly-purchased foods, including meats, cereal, bread, milk, and fruits and vegetables, the quality of produce, and the price of more healthful options relative to standard, less-healthful options. All stores where participants shopped one or more times during the

baseline period were surveyed with the exception of wholesale warehouses because their unconventional format and range of foods makes it difficult to administer NEMS-S.

## 2. Data Analysis

This study employed a standard quasi-experimental identification strategy. First, changes in purchasing across the two time periods were explored with basic descriptive statistics. Second, to account for possible secular, seasonal and other exogenous factors, observed differences in purchasing across the two periods were compared across groups with differing exposure to Fare & Square. The comparisons include: participants who shopped at Fare & Square in the second receipt collection period versus those who did not, those who have ever shopped at Fare & Square versus those who never shopped there, and those living within a mile of Fare & Square versus those who do not. Exposure to the new store prior to completing baseline measures was recorded and controlled for in the subsequent analyses.

The measures of purchasing included change in proportion of dollars spent on LCF at baseline compared to follow-up; change in the proportion of dollars spent on HCF; change in proportion of LCF items purchased; and change in proportion of HCF items purchased. In the case of counting the number of items purchased, if an item amount was not specified, an item count of one was entered. A difference in difference analysis was used to test for significant differences across the groups and over time. All analyses were

performed using SPSS (SPSS Inc. Ver. 22 Chicago, IL).

Lastly, to test whether the timing of the collection period made a difference, we matched receipts based on what part of a month the receipt was from. For example, if a participant collected receipts during the first half of the month during the baseline collection period, but collected receipts throughout the entire four week period of the follow-up, we only analyzed receipts in the first half of the month from both periods.

All stores where participants shopped were categorized according to store format: chain supermarkets, non-chain supermarkets, limited assortment/deep discount supermarkets (such as Aldi and Save-A-Lot), big box stores (such as Walmart and Target), wholesale warehouses (such as Costco and BJ's), dollar stores, chain pharmacies, and smaller grocers. Descriptive statistics were used to determine the total amount spent and items purchased and proportion of LCF and HCF for each type of store. Descriptive statistics were calculated to determine the number of stores where each participant shopped and the store where each participant spent the most during the follow-up period. All home and store addresses were geocoded in ArcGIS 10.2. The Euclidean distance between each participant's home address and location of the store where they spent the most during the follow-up period was calculated using the XY to Line tool. Pearson correlation coefficients were calculated to determine correlations between distance traveled and LCF and HCF spending.

**3. Results**

The average age of the 35 participants with complete data was 52 and 68.6% were women (Table 1). This sample was predominantly African American (82.4%) and a small percentage of the sample was Hispanic (8.8%). About half of the sample was born in Chester (45.7%) and a majority of participants (70.6%) had some high school education (23.5%) or were high school graduates (47.1%). Most participants identified themselves as being in good health; only 37.1% reported fair or poor health. The majority (84.8%) reported being overweight, and about half the sample (51.5%) reported being obese.

Table 1. Characteristics of Study Participants

<b>Total Number</b>	35
<b>Race (%)</b>	
African American	82.4%
Caucasian	5.9%
Asian	0.0%
American Indian or Alaska Native	0.0%
Multi-racial	5.9%
Other	5.9%
<b>Ethnicity (%)</b>	
Hispanic	8.8%
<b>Gender (%)</b>	
Female	68.6%
<b>Education (%)</b>	
8th grade or less	5.9%
Some high school	23.5%
High school or GED	47.1%
Some college or technical school	8.8%
College graduate	8.8%
Graduate or professional degree	5.9%
<b>Age (mean)</b>	
Age	52

The average household size was three people, and about half the sample (51.4%) reported having a child under the age of eighteen in their household. The majority of participants (85.3%) have an annual household income of less than \$25,000. Slightly over three-quarters of the sample received public assistance (79.4%). Most participants had gone to a food pantry in the last year (77.1%), and reported at least some level of food insecurity (94.3%).

During the baseline receipt collection of two weeks, the 35 participants made a total of 188 shopping trips. About twice the number of shopping trips (417) was made during the four week follow-up collection period (Table 2). Together, participants spent a total of \$4,617.25 at baseline and \$10,773.42 during follow-up. The average amount spent per trip remained roughly the same, \$24.65 and \$25.84 respectively. Receipts were collected from seventy different stores across the two collection periods.

Table 2. Characteristics of Food Purchases

	Collect ion Period	Total shopp ing trips	Total amount spent	Aver age spent per trip
Basel ine	2 weeks	188	\$4,617.25	\$24.56
Follo w Up	4 weeks	417	\$10,773.42	\$25.84

Participants purchased a total of 4,555 food and beverage items in the two collection periods. Of these, 229 items

(5.0%) could not be coded because the description could not be deciphered, the receipt was not itemized, or the receipt had been damaged prior to scanning and could not be read. These 229 items were categorized as unknown food items and were included in the analysis of total number of items purchased. The price of 154 of the 4,555 (3.4%) items was unclear because the receipt was not itemized or had been damaged. These items were not included in analysis of the total amount spent. In addition to the items which were coded as unknown, 2467 items (54.2%) were not included in the analysis because they did not fall into either the LCF or HCF classification.

A second new supermarket (limited assortment/deep discount) opened at the opposite end of Chester from Fare & Square just prior to the start of the follow-up data collection period. Euclidean distance to the nearest supermarket decreased for 28 of the participants (80%) because of the opening of the two new supermarkets; for the remaining 7, the nearest supermarket did not change. At baseline, participants were 0.99 miles on average (0.94 median) from the closest supermarket. On average, participants were 0.39 miles closer (0.22 median) to a supermarket during the follow-up period; for four of the participants, the distance to the closest supermarket decreased by a mile or more.

During the follow-up period, participants traveled an average of 2.92 miles (1.84 median) to the store where they spent the largest proportion of their food budget. For 29 of the 35 participants (82.8%), this was a supermarket: chain supermarkets (N=9), non-chain supermarket (N=11), and limited

assortment/deep discount supermarket (N=8). Only one participant spent the largest proportion of their monthly food budget at Fare & Square even though Fare & Square was the closest supermarket for 9 of the participants (25.7%) during the follow-up period. Five participants chose the other new (limited assortment/deep discount) supermarket as their primary food store. The correlations between distance traveled and spending on LCF were not statistically significant; the correlation between distance traveled and HCF spending was positive and statistically significant ( $p < 0.05$ ).

assortment/deep discount averaged 25, non-chain supermarkets averaged 30.5, and chain supermarkets averaged 32.9. Big box stores scored an average of 26. Fare & Square had the highest score of any store surveyed at 43. This higher score reflected similar availability of healthful foods to chain supermarkets but a higher pricing score based on the relative prices of healthful choices to standard, less-healthful, options.

Fourteen of the 417 follow-up period receipts were from Fare & Square, amounting to a total of \$447.54, which only made up a small percentage (4.2%) of the overall amount spent. The average

Table 3. Food Purchases by Store Type

type	N	Total spent	Total items	% spent LCF	% items LCF	% spent HCF	% items HCF
limited assortment/deep discount	5	\$2,083.41	709	15.0%	17.9%	16.2%	22.0%
non-chain supermarket	2	\$1,888.35	656	7.3%	10.4%	15.6%	22.7%
chain supermarket	5	\$1,794.23	610	12.8%	15.4%	25.0%	26.7%
nonprofit (Fare & Square)	1	\$447.54	183	7.9%	11.5%	12.4%	14.2%
big box	3	\$395.23	193	10.2%	9.8%	28.6%	25.4%
national chain pharmacy	2	\$219.01	140	2.1%	3.6%	44.6%	52.1%
dollar store	7	\$214.29	142	0.6%	0.7%	75.4%	75.4%
small grocer	3	\$199.04	125	4.4%	6.4%	62.6%	65.6%
wholesale warehouse	1	\$90.03	27	15.5%	14.8%	37.6%	25.9%

NEMS-S scores varied, by store type. Dollar stores scored the lowest (worst) with an average of 10.5 out of 54 possible points followed by small grocers (including chain convenience stores, small grocery stores, and corner stores) with an average score of 10.6 and chain pharmacies at 17. All types of supermarkets scored much higher: limited

amount spent per visit to Fare & Square was \$31.97. Of the total amount spent at Fare & Square, 11.5% was spent on LCF and 14.2% was spent on HCF. When looking at the total amount spent at all other stores excluding Fare & Square, 11.7% was spent on LCF and 31.5% was spent on HCF.

Table 4 displays results from the difference in difference analyses. For all

shoppers, proportional spending increased 0.94% and 2.23% for LCF and HCF respectively from baseline to follow-up. For the group who shopped at Fare & Square during the follow-up period, there was a median increase in proportional spending on LCF (2.75%) and a large median decrease (-19.55%) in proportional spending on HCF. For the group that did not shop at this store during the follow-up period, proportional spending on LCF increased 0.94% and proportional spending on HCF increased 4.69%. The net difference between changes in proportional spending from baseline to follow-up between were not significant for LCF (p=0.69) or HCF (p=0.12), which could be attributed to the small sample size.

For the group who had ever shopped at Fare & Square, there was a median increase of 1.98% spent on LCF over time and a slight median decrease (-0.91%) on HCF. The group who had never shopped at Fare & Square had a median decrease in the amount spent on LCF (-5.05%) and a median increase in the amount spent on HCF (7.78%). This represents a net difference of 7.03% on LCF between the two groups (p=0.08)

and 8.69% on HCF (p=0.26). Comparisons between participants who live within and beyond one mile of the store were not statistically significant (Table 3).

Compared to changes in the proportion of one’s budget spent on LCF and HCF, the changes in the proportion of LCF items and HCF items showed similar trends for each grouping (Table 3). The proportion of LCF items increased over time while the proportion of HCF items decreased for participants who had shopped at Fare & Square at any point or who live within one mile of the store. For those participants who have never shopped at Fare & Square, who didn’t shop there during the follow-up period, or who lived 1 mile or further, smaller increases or reductions occurred for the proportion of LCF items. All three of these groups had an increase in the proportion of HCF items over time.

Table 4. Differences in low calorie foods (LCF] and high calorie foods (HCF] as a proportion of the total budget and total items purchased based on Exposure to Fare & Square

	Median Change in LCF spending	Diff-in-Diff (p-value)	Median Change HCF spending	Diff-in-Diff (p-value)	Median Change LCF items	Diff-in-Diff (p-value)	Median Change in HCF items	Diff-in-Diff (p-value)
All Participants	0.94%		2.23%		3.52%		3.63%	
Shopped at FS Follow-up	2.75%	1.81% (0.69)	-19.55%	24.24% (0.10)	4.43%	0.91% (0.69)	-15.68%	20.09% (0.13)



(N=3)								
Did not shop at FS Follow-Up (N=19)	0.94%		4.69%		3.52%		4.41%	
Have shopped at FS (N=16)	1.98%	7.03% (0.08)	-0.91%	8.69% (0.26)	6.39%	8.22% (0.24)	-2.00%	11.88% (0.02)
Never shopped at FS (N=6)	-5.05%		7.78%		-1.83%		9.88%	
Live within 1 mile of FS (N=3)	1.46%	0.59% (0.83)	-4.31%	9.00% (0.48)	4.96%	1.55% (0.97)	-2.51%	6.92% (0.51)
Live ≥1 miles (N=19)	0.87%		4.69%		3.41%		4.41%	

Lastly, to determine whether the time of month for the initial receipt collection might have impacted the results, we completed an alternative analysis in which receipts were matched based on time of the month the food was purchased. This analysis did not yield any statistically significant results, except for the reduction over time in the proportion of dollars spent on LCF.

**4. Discussion**

Previous studies have demonstrated that individuals purchase food from many different sources, as opposed to having one main food supply [13]. Opening a new supermarket in a former food desert does not guarantee that people will choose to shop there or

shop there exclusively, as demonstrated by our findings. The opening of a second (limited assortment/deep discount) supermarket in Chester may have further complicated food shopping behavior, but this other new supermarket did not become the primary food store for most participants, either, including those who lived closest to it. Most participants continued to do most of their food shopping at other supermarkets outside the city, as they had prior to the opening of the two new supermarkets. Furthermore choosing to shop at a new supermarket does not necessary lead to changes in food purchasing although we saw some evidence of small changes. This illustrates that household food shopping behaviors are well-established health behaviors and that environmental interventions might require additional interventions (e.g. nutrition education,

changes to in-store marketing) to alter shopping.

While three-quarters of individuals in this study reported shopping at least once at the new nonprofit supermarket since it opened, only a small proportion of foods were purchased from this store across 35 households. Although these findings may not reflect an adoption of the new nonprofit supermarket as their main food source, just this utilization marks the potential for positive change in food purchasing habits. Our findings suggest that Fare & Square may be positively influencing purchasing patterns, even if that influence is indirect rather than direct. Participants who shopped at the new supermarket increased the amount of their budget spent on low calorie, obesity preventing items. These same shoppers purchased proportionally less high calorie, obesity-promoting items over time, which is especially notable because proportional spending on HCF actually increased in the comparison group. Although the sample size is small and the analysis is subject to a number of limitations, these results suggests that shopping at new store, might have impacted their overall purchasing patterns even though only a small proportion of the food budget is spent there. All of the participants were the primary food shopper in their household, which suggests that their purchasing decisions may have positively affected the diets of multiple family members.

In trying to understand why participants who had ever shopped at Fare & Square purchased more LCF and less HCF than those who had never shopped at Fare & Square, even if all or most of

their food purchases during the follow-up period were from other stores, we considered whether Fare & Square shoppers were more motivated to make changes to their diet. We explored correlations between food purchase changes and answers to baseline survey questions relating to: food planning behavior (creating a monthly food budget, preparing a shopping list); checking nutrition facts on food products; intentions to adopt more healthful eating and activity behaviors in the future; chronic diseases; intentions to lose weight; and other health attitudes (importance of healthy eating). None of these indicators correlated with changes in food purchases.

Participants consistently chose to shop at a store other than the closest supermarket, even after the opening of two new supermarkets. The implications on the healthfulness of food purchases are not clear based on this study. The significant positive correlation between distance traveled and spending on HCF was driven largely by one participant who traveled 14 miles to a local supermarket in Philadelphia and spent more than 50% of her total on cases of sugar-sweetened beverages. Store type may have greater implications for the healthfulness of food purchases than distance traveled. Differences in food purchases across LCF and HCF categories are substantial when comparing trips to supermarkets (chain, non-chain and limited-assortment) with trips to dollar stores, small grocers, and chain pharmacies. More than half of all items and more than 40% of food spending at these non-supermarkets were for HCF foods with almost no spending on LCF foods. The relationship between store type and healthfulness of food

purchases deserves more attention in future studies.

This study demonstrates the value of collecting detailed data about food purchasing over time, with attention to the distance and type of food stores chosen, as an approach to assessing the impact of a new supermarket. We were able to observe real changes in purchases as opposed to changes in self-reported measures. This study also is important because it took place in a community vulnerable to nutrition-related disease: a low-income, minority community which had been without a supermarket for ten years. By demonstrating differential changes in purchasing habits, this study suggests that there could be a positive effect of new supermarkets, as long as community members use the store. An important strength of this study is that it focuses on shopping at the store as the pathway for change, rather than proximity to the store. Previous research has shown that simply living in the vicinity of a new store may not be sufficient to change behavior related to diet [9]. Finally by comparing purchasing patterns between groups with varying levels of exposure to Fare & Square, our study accounts for regional factors that influence shoppers in the two time periods.

This study also had several important limitations. Due to time constraints and lack of resources, the receipt collection period at baseline was only two weeks long, as opposed to four weeks at follow up. Although it has been demonstrated that two weeks is a sufficient time period to generate representative shopping habits [14], this population has extremely high food insecurity, with many families relying on

public assistance such as SNAP benefits. Timing of the receipt collection period may influence observed purchasing patterns because SNAP benefits are released at the beginning of each month, and families may have different purchasing strategies in the first half of a month compared to the second half. Our results did not indicate this to be a factor, but due to the small sample size, we recommend the analysis is completed on a larger sample size. Additionally, food received from food banks was not analyzed in this study, which could play an important role in food purchasing habits.

There was considerable loss to follow up between the receipt collection periods, which could be a source of bias if systematically distributed. Another source of potential bias is missing receipts. This study had a small sample size and was limited to one single city, which limits the generalizability of the findings. The study period was relatively short, and nine months may not be a long enough exposure period to change shopping habits. Finally, the main analysis relies on comparisons between treated and untreated groups who are otherwise the same in characteristics likely to influence changes in purchasing. The groups appeared similar across the main covariates but could differ in other ways not assessed here that undermine the treatment and control comparison.

Although most of the results from this study were not statistically significant, they are more promising than other recent evaluations of supermarket impact that look solely at fruit and vegetable consumption and weight status as outcome variables. Replication of these

findings with a larger sample size should be a priority in order to understand how to maximize the efforts aimed at addressing food environments. Like previous published evaluations, they underscore that food shopping behavior is complicated and that additional strategies, such as in-store marketing and lower prices for healthful foods, may be needed to supplement the opening of new supermarkets in food deserts in order to encourage changes in purchasing habits.

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