Food Store Audits: Examining Food Price, Availability, and Quailty, Before and After Relocation of Public Housing Residents

ACCEPTANCE

This thesis, FOOD STORE AUDITS: EXAMINING FOOD PRICE, AVAILABILITY, AND QUALITY, BEFORE AND AFTER RELOCATION OF PUBLIC HOUSING RESIDENTS, by Anjenique Anderson was prepared under the direction of the Master's Thesis Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Master of Science in the College of Health and Human Sciences, Georgia State University.

The Master's Thesis Advisory Committee, as representatives of the faculty, certify that this thesis has met all standards of excellence and scholarship as determined by the faculty.

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ABSTRACT

FOOD STORE AUDITS: EXAMINING FOOD PRICE, AVAILABILITY, AND QUALITY, BEFORE AND AFTER RELOCATION OF PUBLIC HOUSING RESIDENTS

By

Anjenique Anderson

In an effort to deconcentrate poverty, Atlanta is attempting to become the first city in the U.S. to completely eliminate public housing by relocating ≈ 10,000 residents. Research has shown that the health status of public housing residents is worse than any other population. Evidence also suggests that there is an inverse relationship between neighborhood availability of healthy, affordable foods and diet intake. The aim of this study was to compare the price, availability, and quality of food items in the public housing residents' communities, before and after relocation. Using Nutrition Environment Measures Survey (NEMS), a total of 42 food store audits were conducted in pre- and post-relocation neighborhoods. The prices in post-relocation middle chain grocery stores were significantly cheaper for total frozen dinners ($p = 0.042$), baked goods ($p = 0.017$), and potato chips ($p = 0.035$). There were no significant differences in produce quality. However, fruits ($p <0 .001$), vegetables ($p < 0.001$), lower fat milk ($p < 0.001$), whole milk ($p =0.041$), ground beef ($p <0 .001$), reduced-fat hot dogs ($p = 0.015$), regular hot dogs ($p < 0.001$), frozen dinners ($p < 0.001$), low-fat baked goods ($p < 0.001$), whole-wheat bread ($p <0 .001$) and 100% juice ($p < 0.001$) were more available in middle chain grocery stores than convenience stores. These results suggest that public housing residents have relocated to a food environment that is similar to their previous environment. Relocation of public housing residence did not have a significant effect on their access to food.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AHA	Atlanta Housing Authority
BMI	Body Mass Index
BRFSS	Behavioral Risk Factor Surveillance System
CVD	Cardiovascular disease
FBS	Food Balance Score
GSU	Georgia State University
HOPE	Housing Opportunity for People Everywhere
HUD	U. S. Department of Housing and Urban Development
NEMS-S	Nutrition Environment Measures Survey- Stores
SES	Socioeconomic status
YPLL	Years of Potential Life Lost

CHAPTER I

Introduction

Designated as the first city to provide low-income project-based public housing in 1936, Atlanta is attempting to become the first city in the United States to eradicate public housing by relocating approximately 10,000 residents by January 2010.[1,2] In 1992, the U.S. Department of Housing and Urban Development (HUD) created the Housing Opportunities for People Everywhere (HOPE) VI program in an effort to transform the current public housing structure by providing housing authorities with multimillion dollar grants to replace the most severely distressed housing units.[3] The main goal of this transformation effort was to deconcentrate poverty by integrating public housing in nonpoverty stricken neighborhoods and promoting mixed-income communities.[4]

In 2007, the Atlanta Housing Authority (AHA) announced its plans to demolish the last 10 family public housing communities and 2 senior high rises.[5] All residents that qualified were given Housing Choice vouchers (formerly Section 8). The Housing Choice voucher program is a federal program that provides housing assistance to very low-income families, the elderly, and the disabled.[6] These individuals are given a voucher that affords them the opportunity to live in the private market. A housing subsidy is paid to the landlord by the public housing agency on behalf of the participating resident, and then the resident pays the difference in price.[6]

In 2008, the Georgia State University (GSU) Urban Health Initiative was created to examine the effect of relocation on the overall quality of life, health, and well-being of public housing residents from a multidisciplinary approach. The departments of nutrition, sociology, public health, criminal justice, communications, and history are currently includedin this Initiative. The GSU Urban Health Initiative is tracking approximately 400 residents from the 6 demolished public housing communities (Bankhead, Bowen, Herndon, Palmer, Hollywood, and Roosevelt House) and Cosby Spears, the one senior high rise not slated for demolition (Appendix).

Throughout the past several decades, there has been a distinct increase in obesity in the U.S., regardless of age, sex, race/ethnicity, socioeconomic status, education level, or geographic region.[7] Research demonstrates that minorities,[8, 9] individuals of low-socioeconomic status [10, 11] with less than a high school education [12] have the highest prevalence of obesity. According to the HUD Resident Characteristics Report using data from June 2009 to September 2010, approximately 80% of residents were classified as low income (defined as 80% of the median income). Of those, 48% were minorities and 24% were Hispanic or Latino.[13] When comparing obesity prevalence by income, the median prevalence of obesity in the U. S. was highest for both very low-income (≤ $15,000; 35%) and low-income ($15,000-24,999; 32%) categories.[14] This marked increase in obesity is of particular concern in public housing communities because results in previous research suggest that these residents have a higher prevalence of chronic diseases than the general population.[3, 15-17]

The etiology of obesity is multifactorial. Although early research focused on individual factors, public health practitioners are now focusing on environmental factors such as neighborhood safety and the local food environment.[18] Evidence has suggested that there is an inverse relationship between neighborhood availability of healthy, affordable foods and diet intake. These studies assessed the food availability in other geographical areas, not including Atlanta, GA. Also, there are currently no research studies evaluating the local food environment of public housing residents before and after relocation. This research could help provide insight on whether or not relocation has the possibility to improve the overall diet quality of public housing residents. The overall aim of this study was to compare the availability of food items in the public housing residents' communities, before and after relocation. Specifically, the study sought to answer the following research questions:

1) Are there differences in the mean prices of individual food items and total food items before and after relocation?
2) Are there differences in the average prices of food items by store type (convenience and middle chain grocery stores) before and after relocation?
3) Is there greater availability of food items after relocation?
4) Is there greater availability of food items by store type (convenience and middle chain grocery stores) before and after relocation?
5) Is the quality of fruits and vegetables after relocation more acceptable than before relocation?

CHAPTER II

Review of Literature

Obesity statistics

Obesity has reached epidemic proportions in the US, where it has more than doubled in the past two decades.[19] Approximately 72.5 million US adults are obese.[12] When comparing the obesity prevalence in the US, in 2009, at least 30% of adults were obese in 9 states, a rate that no state had previously encountered in 2000.[12] Overweight and obesity are established risk factors for hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, respiratory complications, and certain cancers.[18] Universal recommendations to combat obesity include regular exercise and consumption of a healthy diet.[18]

Minorities have been reported to have higher rates of obesity. According to the 2009 Behavioral Risk Factor Surveillance System (BRFSS), African Americans were 51% and Hispanics were 21% more likely than non-Hispanic whites to be obese.[7] Previous research has established a relation between race and low socioeconomic class and obesity.[8-11] In a multivariate analysis, Robert and Reither[9] reported that variation in BMI, a marker for obesity, was dependent on both between-community and within-community factors. Race and low socioeconomic status were each found to be independent risk factors for increased BMI in women.[9] Reasons cited for the association between low-socioeconomic status and obesity include decreased access to healthy foods and unsafe communities that impede physical activity.

Health of public housing residents

Public housing residents are more likely to be poor and members of a racial or ethnic minority. They frequently suffer from poor health.[17] Moreover, from the data collected from a health questionnaire administered to Washington D.C. African American public housing residents, results reported increased prevalence for chronic disease risk factors when compared with an African American District-wide sample utilizing the BRFSS.[15] The women in public housing reported twice the prevalence of obesity and hypertension, and more than 3 times the prevalence of diabetes, when compared to their counterparts. Additionally, both men and women in public housing reported twice the prevalence of hypertension and smoking.[15]

In the HOPE VI Panel study, the incidence of physical and mental health problems among residents from 5 sites where relocation began in 2001 was 41%. These subjects rated their overall health as being fair or poor, 3 times the prevalence of the national population.[20] Harris and Kaye[20] also found that the younger persons in the 18 to 44 year old age group were 2 ½ times more likely to report fair or poor overall health when compared to African American women nationally. One out of 4 respondents reported chronic health problems.[20] Almost ½ of the residents were considered obese and over a 1/3 reported a history of diagnosed hypertension, both of which were significant when compared to the prevalence in black women nationally.[20] Similar results have been reported in a more recent study of Boston public housing residents and their health status.[17] Studies have provided evidence that the health status of public housing residents is worse than other poor people and the national population.[3 20]

Impact of food deserts on health

It has been argued that 'food deserts,' areas with little to no access to affordable, healthy foods, are a major contributor to a poor diet.[21] Pearson and colleagues[21] examined the relationship between food deserts and consumption of fruit and vegetables in the Barnsley area of South Yorkshire. Their results suggest that food deserts were not significantly associated with fruit and vegetable consumption. However, in a study investigating the impact of food deserts in Chicago, the researchers reported that residence of food deserts would likely have increased premature death and chronic health conditions.[22]

Gallagher[22] utilized Food Balance Scores (FBS) that were calculated from a ratio of the distance to the closest grocer divided by the distance to the closest fast food restaurant. After comparing 4 separate groups (2 White groups and 2 African American groups with out-of-balance and in-balance scores) and diet-related death rates, the out-of-balance White group had a slightly higher diet-related death rate than in-balance White.[22] Conversely, the out-of-balance African American group had a considerably higher diet-related death rate than the in-balance African American group. The difference in FBS was almost 1%.[22]

Gallagher[22] also calculated average Years of Potential Life Lost (YPLL) and death rates in 2003 for cancer, diet-related cardiovascular disease (CVD), and diabetes by community area. They measured the total number of life years lost due to premature death from a certain cause. Results suggested that as the FBS increased, the YPLL and death rates increased for cancer, diet-related CVD, and diabetes. There was a statistically significant increase in the rates of premature death due to diabetes, yet the results for cancer and CVD were not statistically significant.

Availability and access of healthy options

Dietary decisions can be impacted by the characteristics of the physical environment. Previous studies have focused on fruit and vegetable availability,[2, 23-25] and access to food stores in low income, minority areas.[26-28] Krukowski and colleagues[2] utilized the Nutrition Environment Measures Survey in Stores (NEMS-S) assessment tool to evaluate primary food stores in Vermont and Arkansas that were used by overweight participants enrolled in a weight loss research program. The results revealed that regular and healthier food varieties were widely available in supermarkets.[2] Furthermore, the median household income was significantly associated with the NEMS healthy food availability score.[2] They also suggest that the store shelf space of low-fat milk was associated with the racial neighborhood characteristics and median family income, with the less availability of low-fat milk in African American communities.[2] Additionally, Krukowski and colleagues[2] found that the average price for purchasing the 10 non-produce healthier items was significantly more expensive ($M = \$29.65 \pm 2.41$) than the standard items ($M = \$27.48 \pm 2.76$; $p < 0.001$), reflecting a significantly higher cost for five of the healthier items compared with the regular options.

Because much of the literature on U.S. food access disparities reference primarily low-income or African American areas,[26, 28] Bodor and colleagues[25] examined the shelf space for food items to evaluate if the absence of supermarkets was offset by the food availability in the other food stores. They concluded that the other food stores had a much greater cumulative food shelf space for snacks than space allotted for fruits and vegetables.[25] In a similar study, Farley and colleagues[29] found that although the supermarket had greater shelf space dedicated to fruits and vegetables when compared to other food stores, they also had significantly greater shelf space devoted to unhealthy snacks ($M = 205$ m, $p < 0.001$) than fruits and vegetables (M = 117 m). Moreover, supermarkets were less likely to be located in predominately African American neighborhoods.[25]

In a comparison of urban to rural fruit and vegetable availability, urban minority neighborhoods had the most barriers to fresh fruits and vegetables due to the lack of supermarkets, not food stores.[23] In a study conducted in Los Angeles on whether or not food pantry clients live within reasonable walking distance of stores with produce, less than ½ (41%) of the food pantry clients were in walking distance to a store with fresh produce.[24] Also, 83% of clients were within walking distance to a food store with limited or no produce, while 13% were not within walking distance to any food stores.[24]

When surveying geographical areas and food store availability, the consensus is that primarily minority and low-socioeconomic areas are less likely to have supermarkets when compared to predominately white and higher socioeconomic areas. For example, Morland and colleagues[28] reported that there were more than 3 times as many supermarkets in wealthier neighborhoods compared to the lowest-wealth areas; plus there were more small grocery stores, convenience stores without gas stations and specialty food stores in the lowest-wealth areas. As wealth increases, fast-food restaurants, bars, and taverns were less available.[28] Furthermore, when accounting for racial makeup, supermarkets were 4 times as likely in predominately white neighborhoods than predominately African American neighborhoods.[28]

Powell and colleagues[26] found comparable results and also reported more prevalence of non-chain supermarkets and grocery stores in low-income and minority neighborhood. Results suggest that residents that have better access to supermarkets and limited access to convenience stores have healthier diets and subsequent reduced risk for obesity.[27] Low-income areas are more likely to have greater access to fast-food restaurants than high-income and predominantly white communities.[27] In majority African American tracts in Chicago, the distance to fast food locations were slightly farther than any other tracts, but grocery stores were nearly twice as far.[22] It is easier to these individuals obtain fast food than any other food types. It can also be argued that residents in predominantly minority and low-income areas are more restricted to their local food environment because they are less likely to have their own transportation.

Price and access of healthy options

Food choices are influenced by several factors such as taste, perceived value (which includes price and portion size), and perceived nutrition.[30] An individual's perceived factor of importance varies. For example, one factor may outweigh the other, depending on an individual's financial capabilities. Over the last 30 years, prices of fruits and vegetables have increased nearly twice as fast as the price of carbonated beverages.[31] The cheapest cost option to the consumer remains to be energy dense foods which contain refined grains, added sugars, or fats.[31]

In an effort to examine the influence price has on purchasing and consumption of healthier food options, researchers have conducted environmental interventions on food choices.[32-34] French and colleagues[32] found that there was a proportionate increase in vending machine sales of low fat snacks when there was a 50%, 25%, and 10% reduction in price at diverse worksites and secondary schools. In a cafeteria intervention of both suburban and urban high schools, results demonstrated a quadruple increase in fresh fruit and a double increase in baby carrot sales after a 50% price reduction.[34] Similar results were replicated on a university campus with low fat vending machine snacks.[33] All interventions consisted of three time point sale measures (baseline, intervention, and post-intervention) and sales at baseline and post-intervention of low fat items were comparable. The data suggest that subjects were substituting low fat options for the regular fat options during the intervention period.

Quality and access of healthy options

Food quality is another aspect that is frequently discussed when examining access to food. When comparing supermarkets to convenience stores, supermarkets have the cheapest prices and more availability.[2, 28] It can also be assumed that along with diverse produce options and frequent consumer selection yields improved food quality. However, there is little research that surveys food quality, more specifically microbial quality, in these small convenient stores. Koro, Anandan, and Quinlan[35] examined if there was a difference in microbial quality and food safety in food available to low-SES versus high-SES populations. They determined that the microbial load was higher on the produce from food stores in low-SES areas when compared to high-SES.[35] There was a significant difference in yeast and mold counts in ready-to-eat salads, strawberries and cucumbers. The level of pathogens in raw meat and poultry in both low-SES and high-SES were high; however the aerobic plate count in ground beef available in high-SES markets was significantly higher.[35]

A marked increase in obesity has resulted in numerous research studies aiming to understand and combat this epidemic. As previously mentioned, these studies have established a relationship between race, obesity, and low SES. Decreased access to healthy foods has been noted as a major contributor to a poor diet. Based on this data, public housing residents would be considered high risk due to their local food environment.

CHAPTER III

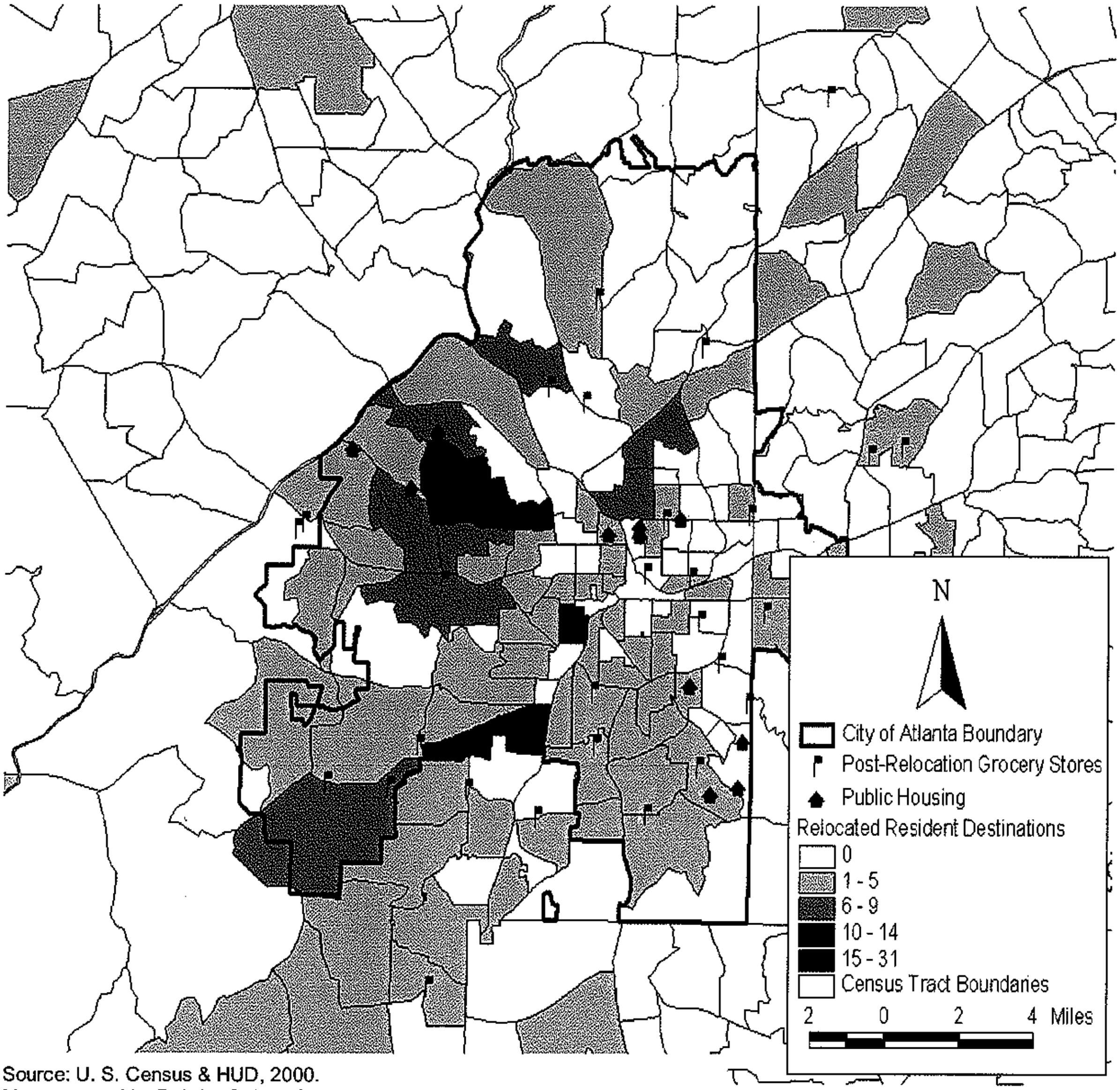
Methods

The purposes of this study were to compare the prices and availability of food items in the public housing residents' communities, before and after relocation. This study was carried out by surveying various food stores in the vicinity of public housing residents, before and after relocation. The study focused on the price, availability and quality of the food items found in the food stores.

Study participants consisted of a sample of approximately 400 Atlanta public housing residents from 7 public housing communities. Of those, 4 were family projects and 3 were senior high rise projects. Store audits were conducted in 11 food stores near the 7 public housing communities before relocation (Figure 1). After relocation (Figure 2), data were collected in 31 food stores in close proximity to 82 new residence addresses.

Initially, Google maps were used to enumerate the total number of food stores located within a 5 mile radius from each address cluster in Atlanta, GA. Addresses were grouped together when they were within < 2 mile radius. The sample of stores was divided into convenience stores and middle chain grocery stores. The location of food stores were confirmed through driving, walking, and calling. Since residential addresses were clustered before relocation, and more dispersed after relocation, a convenience sample was selected with an average of one store type per housing community taken for pre-location data and an

Figure1. Public Housing communities, pre-relocation food stores and percent poverty



Source: U. S. Census & HUD, 2000.
Map prepared by Deirdre Oakley & Erin Ruel, Georgia State University

Figure 2. Public Housing communities, post-relocation food stores and areas of relocation

average of three stores taken per address for post-location audits.

Store observation data were collected from July to August 2009 (pre-relocation) and April to June 2010 (post-relocation). The audits were conducted by a total of 5 trained personnel. A standardized observational measure instrument, Nutrition Environment Measures Survey-Store (NEMS-S),[36] was utilized to assess the food environment of each food store. Each store audit took an average of 35 minutes.

The NEMS-S survey tool was 11-13 pages long with 10-11 measures. The first page was known as the cover page where information such as store id, rater id, number of cash registers, and date and time of audit were recorded (only in post-relocation, not provided in pre-relocation). Each remaining page was designated to a specific measure (milk, fruit, vegetables, ground beef, hot dog, frozen dinners, baked goods, convenience store beverages, grocery store beverages, bread, baked chips, and cereal). Since an older NEMS-S version was utilized for the pre-relocation survey, the cereal measure was not included in the data analysis because the older version did not incorporate this measure.

Upon entering each store, raters counted the number of cash registers (only in post-relocation, information not provided in pre-relocation) to measure store size. Then, they proceeded to the milk section. All raters were instructed to gather all data based on the store/preferred brand or the cheapest brand. However, if that brand or type was not available, there were alternative options that could be recorded. Each item was individually evaluated for availability and pricing. Quality was only assessed in fruits and vegetables.

Data collectors examined the availability and price of 8 pairs of a healthier (i.e. higher fiber, lower fat, lower sugar) and a regular food option within the same brand (Appendix), if possible. The food items measured in the store audits correspond to those that contribute most to the fat and calories in the American diet and their recommended healthier substitute.[36] The quality, availability, and price for 10 fruits (bananas, apples, oranges, grapes, cantaloupe, peaches, strawberries, honeydew melon, watermelon, and pears) and 10 vegetables (carrots, tomatoes, sweet peppers, broccoli, lettuce, corn, celery, cucumbers, cabbage, and cauliflower) were evaluated.

For each measure, raters were instructed to choose 'Yes' or 'No' for availability. However, certain alternative items also had the option of 'N/A.' 'N/A' was marked for secondary items after the preferred item was marked available. For example, low-fat (skim or 1%) milk was the preferred item so if low-fat milk was available then the secondary item (2% milk) was labeled 'N/A.' An item was considered available as long as one option was present.

The units of price for each item in each measure were clearly defined. All prices for items were standardized to a single unit for comparison. Prices per specific size were noted for all measures ranging from price per pound, price per package to price per piece. Packages of items that were not equal in size like potato chips, bread, beverages, and frozen dinners were converted to price per ounce. Each individual fruit and vegetable type was also converted to equal units of measure. For example, some stores listed the price of apples by piece while others provided price by pound. Based off of approximate pieces per pound, 3 medium apples equal 1 pound was the conversion factor that was used. Also, to avoid variability in price, regular prices were used.

A dichotomous acceptable/unacceptable rating was used to determine the quality.[2] Acceptable quality was characterized by peak condition with top quality (firm to touch and minimal bruising and dark spots for more than 50% of the produce). Unacceptable quality was defined as mushy, old-looking, uneatable, or containing several bruises and dark spots in more than 50% of the produce.

Data analysis

Mean prices were calculated for each food item by store classification, pre- and post-relocation. Each mean price was calculated from the total number of items available for each specific group (pre- and post-relocation, store classification). Mann Whitney U test was utilized to test for significance between pre- and post-relocation audits, and store classifications.

Percent availability for each measure (milk, fruit, vegetables, ground beef, hot dog, frozen dinners, baked goods, beverages, bread, and baked chips) was calculated. Any item with at least one option present was considered available. Each quantity per item was tabulated and divided by the total possibly available to obtain a percentage. The percent quality rating was specific to fruits and vegetables. The technique was similar to availability. However, if the item was marked unacceptable ≥ to the number of times it was marked acceptable then the overall quality rating for the item was unacceptable. The opposite was true when the item received an acceptable rating. Fisher's exact test was used to test for significance in each category. The data were analyzed using SPSS 18.0. A p value of ≤ 0.05 was considered significant for all tests.

CHAPTER IV

Results

Description of Sample

There was a total of 11 stores audited pre-relocation and 31 stores post-relocation (Table I). Three of the post-relocation stores were excluded from the analysis due to missing data (i.e. prices were not provided, missing data on beverages, bread, baked chips). Twelve stores (4 pre-location and 8 post-location) were classified as middle chain grocery stores and 30 stores (7 pre-location and 23 post-relocation) were convenience stores.

Table I. Description of grocery store audits

	Middle chain grocery store	*Convenience stores*	**Total**
Pre-relocation	4	7	**n = 11**
Post-relocation	8	23	**n = 31**
Total	**n = 12**	**n = 30**	**n = 42**

Price

Pre- and post-relocation

Two percent milk was only available in stores after relocation therefore a comparison of price was not performed. The mean costs of 1/2 gallon skim milk, quart low fat milk, quart whole milk, and total milk were greater after relocation. The mean cost of 1/2 gallon whole milk was cheaper after relocation. When comparing the price of the higher fat to the lower fat milk, the price of whole milk was slightly cheaper after relocation while the price of the lower fat milk increased after relocation. However, these results were not statistically significant (Table II).

Table II. Prices for food items pre- and post-relocation

			Before		After	
Measure	**Item**	**n[a]**	**Mean (SD)**	**n[b]**	**Mean (SD)**	***p* value[c]**
Milk						
	Whole-quart	3	1.49 (0)	6	1.77 (0.60)	0.17
	Low fat-quart	3	1.49 (0)	4	1.54 (0.06)	0.18
	Whole-half gallon	9	2.64 (0.80)	18	2.32 (0.61)	0.35
	Low fat-half gallon	4	2.06 (0.62)	7	2.30 (0.65)	0.35
Total lower fat milk		4	3.18 (0.14)	11	3.21 (1.27)	1.0
Total whole milk		9	3.14 (0.54)	18	2.91 (1.10)	0.21
Total		9	4.55 (1.85)	18	4.88 (2.73)	0.98
Fruits						
	Banana	7	1.36 (1.07)	18	1.22 (0.83)	0.81
	Apple	5	1.54 (0.10)	14	1.65 (0.68)	0.58
	Orange	5	2.23 (0.78)	11	1.52 (0.65)	0.06
	Grapes	4	1.66 (0.05)	10	2.15 (0.57)	0.10
	Cantaloupe	3	1.05 (0.08)	7	1.04 (0.18)	0.73
	Peaches	4	0.83 (0.05)	2	1.49 (0)	0.05
	Strawberries	4	2.62 (0.63)	9	2.16 (0.71)	0.50
	Honeydew melon	3	1.75 (0.43)	8	1.93 (0.49)	0.50
	Watermelon	4	0.52 (0.10)	10	0.59 (0.20)	0.94
	Pears	4	1.67 (0.94)	10	1.46 (0.42)	0.78
Total		7	9.20 (5.21)	18	9.30 (5.38)	0.88
Vegetables						
	Carrots	4	0.71 (0.24)	10	1.10 (0.43)	0.12

	Tomatoes	4	1.49 (0.34)	10	1.84 (0.77)	0.32
	Sweet peppers	4	1.91 (0.85)	10	2.48 (1.08)	0.29
	Broccoli	4	1.82 (0.42)	10	1.66 (0.37)	0.39
	Lettuce	4	1.59 (0.11)	10	1.56 (0.35)	0.89
	Corn	4	1.33 (0.88)	9	0.89 (0.20)	0.44
	Celery	4	1.12 (0.22)	10	1.22 (0.66)	0.67
	Cucumbers	4	0.67 (0.12)	10	0.59 (0.14)	0.30
	Cabbage	4	0.63 (0.10)	10	0.52 (0.21)	0.25
	Cauliflower	3	1.53 (0.20)	7	1.30 (0.39)	0.30
Total		4	12.42 (1.57)	10	12.69 (3.06)	1.0
Ground beef						
	Lean	3	4.05 (0.61)	7	3.62 (0.82)	0.65
	Regular	4	2.95 (0.30)	11	2.68 (1.24)	0.39
Total		4	5.99 (2.12)	11	4.99 (2.93)	0.47
Hot dogs						
	Low fat	7	2.80 (1.35)	12	2.71 (1.21)	1.0
	Regular	7	2.39 (0.99)	16	2.58 (0.87)	0.57
Total		10	3.64 (2.78)	19	3.89 (2.44)	0.68
Frozen dinner						
	Reduced fat	4	0.28 (0.05)	9	0.23 (0.08)	0.06
	Regular	4	0.23 (0.02)	7	0.24 (0.07)	0.07
Total		4	0.51 (0.03)	9	0.42 (0.15)	0.03*
Baked goods						
	Low fat	4	0.62 (0.28)	8	0.35 (0.08)	0.06
	Regular	9	0.94 (0.42)	30	0.78 (0.45)	0.25
Total		9	1.22 (0.68)	30	0.87 (0.44)	0.18
Beverages						
	Diet soda	11	0.055 (0.02)	28	0.054 (0.02)	0.78

	Regular soda	11	0.055 (0.02)	30	0.056 (0.01)	0.95
	100% juice	11	0.035 (0.03)	30	0.091 (0.03)	0.60
	Juice drink	11	0.077 (0.04)	29	0.088 (0.04)	0.52
Total lower sugar beverages		11	0.14 (0.05)	31	0.137 (0.05)	0.82
Total regular sugar beverages		11	0.13 (0.06)	31	0.136 (0.06)	0.90
Total		11	0.273 (0.10)	31	0.274 (0.10)	0.98
Bread						
	Wheat	5	0.129 (0.02)	15	0.129 (0.02)	0.86
	White	10	0.107 (0.02)	25	0.110 (0.02)	0.38
Total		10	0.17 (0.08)	25	0.19 (0.08)	0.58
Potato chips						
	Baked chips	9	0.55 (0.25)	14	0.69 (0.31)	0.50
	Regular chips	11	0.40 (0.08)	28	0.42 (0.11)	0.45
Total		11	0.85 (0.35)	29	0.74 (0.45)	0.13
Total healthier items[#]		11	5.02	31	3.68	0.45
Total regular items[#]		11	6.65	31	5.39	0.22
Total		11	22 (20.3)	31	18.6 (18.3)	0.48

n = number of stores, SD = standard deviation, [#] All measures except fruits and vegetables

[a] n = 11

[b] n = 31

[c] significance between pre- and post-relocation using Mann-Whitney test

The mean cost of apples, grapes, peaches, honeydew, watermelon, and total fruits were greater after relocation. The mean cost of bananas, oranges, cantaloupe, strawberries and pears were cheaper after relocation. The mean cost of carrots, tomatoes, sweet peppers, celery, and total vegetables were greater after relocation. The mean cost of broccoli, lettuce, corn, cucumber, cabbage, and cauliflower were lesser after relocation. However, these differences in fruits and vegetables were not statistically significant (Table II).

The average cost of lean, standard, and total ground beef decreased after relocation. The average cost of low-fat hot dogs decreased after relocation while the cost of regular hot dogs and total hot dogs increased after relocation. The mean price per ounce of reduced fat frozen dinners and total frozen dinners before relocation was slightly greater than after. The price per ounce of regular frozen dinners was slightly lower before relocation than after. However, these differences were only statistically significant for total frozen dinners ($p = 0.03$; Table II).

The price per baked good decreased after relocation for both low fat and regular varieties, while the total price per baked good decreased after relocation. The mean prices per ounce for regular soda, 100% juice and juice drink were greater after relocation. In addition, there was a slight decrease in mean price per ounce in diet soda after relocation. After combining the lower sugar (100% juice and diet soda) and regular (juice drink and regular soda) sugar varieties, the lower sugar was slightly cheaper after relocation but the regular sugar was slightly greater. However, these differences were not statistically significant.

There was a slight increase in mean price per ounce for white bread and total bread after relocation while there was no noticeable change in price per ounce for wheat bread after relocation. The mean prices per ounce for both baked and regular chips were greater after relocation. The total mean price per ounce for chips was cheaper after relocation. The totals for both healthier and regular items were cheaper after relocation. The mean total price for all ten measures was greater before relocation than after relocation. The differences in bread, chips, and total price were not statistically significant (Table II).

Store Comparison

When compared with middle chain grocery stores, the mean price of a quart and a half gallon of whole, low fat and 2% milk was greater in convenience stores. The total mean price for all milk was cheaper in convenience stores. Quart-sized low fat milk was only found in middle chain grocery stores therefore there was no price comparison performed. In addition, the total prices for whole milk and lower fat milk were greater in convenience stores. Results suggested a significant difference between the middle chain and convenience store mean prices for whole half gallon, low fat half gallon and total milk ($p < 0.001$, $p = 0.007$, $p = 0.02$, respectively; Table III). However, results were not statistically significant for the total price of milk between store classifications.

The mean price of cantaloupe, strawberries, pears, honeydew, and total fruit was cheaper in convenience stores than in middle chain grocery stores. The mean price of bananas, apples, oranges, grapes, and watermelons was greater in convenience stores. Mean price of peaches by store type was not computed because peaches were not available in convenience stores. However, results were only statistically significant for bananas, oranges, and total fruit ($p < 0.001$, $p = 0.015$, $p < 0.001$, respectively; Table III).

Table III. Prices for food items in middle chain and convenience stores

Measure	Item	n[a]	Price in Middle chain stores Mean (SD)	n[b]	Price in Convenience stores Mean (SD)	*p* value[c]
Milk						
	Whole-quart	7	1.52 (0.04)	2	2.24 (1.06)	0.38
	2%-quart	1	1.57	1	2.99	0.32
	Whole-half gallon	11	1.90 (0.32)	16	2.79 (0.63)	<0 .001**
	Low fat-half gallon	8	1.90 (0.36)	3	3.06 (0.11)	0.007*
	2%- half gallon	1	1.99	2	3.24 (0.35)	0.22
Total lower fat milk		10	2.94 (0.72)	5	3.73 (1.54)	0.80
Total whole milk		11	2.87 (0.67)	16	3.07 (1.10)	0.88
Total		11	5.54 (1.59)	16	4.23 (2.80)	0.02*
Fruits						
	Banana	12	0.56 (0.16)	13	1.90 (0.78)	< 0.001**
	Apple	12	1.47 (0.54)	7	1.88 (0.60)	0.061
	Orange	12	1.45 (0.52)	4	2.60 (0.71)	0.015*
	Grapes	12	1.94 (0.48)	2	2.43 (0.77)	0.19
	Cantaloupe	9	1.05 (0.16)	1	0.99	0.38
	Strawberries	12	2.41 (0.60)	1	0.99	0.11
	Honeydew melon	9	1.91 (0.50)	2	1.74 (0.35)	0.52
	Watermelon	12	0.54 (0.16)	2	0.77 (0.11)	0.096
	Pears	12	1.56 (0.62)	2	1.25	0.71
Total		12	13.5 (2.09)	13	5.38 (4.04)	<0.001**
Vegetables						
	Carrots	12	1.03 (0.44)	2	0.74 (0.07)	0.27
	Tomatoes	12	1.78 (0.70)	2	1.49 (0.71)	0.71

	Sweet peppers	12	2.33 (1.06)	2	2.23 (1.04)	0.93
	Broccoli	12	1.78 (0.35)	2	1.27 (0.11)	0.12
	Lettuce	12	1.62 (0.29)	2	1.24 (0.07)	0.08
	Corn	11	1.05 (0.55)	2	0.89 (0.32)	0.16
	Celery	12	1.26 (0.58)	2	0.79 (0)	0.06
	Cucumbers	12	0.63 (0.13)	2	0.50 (0)	0.04*
	Cabbage	12	0.59 (0.18)	2	0.34 (0.07)	0.03*
Total		12	13.13 (2.51)	2	9.50 (0.46)	0.068
Ground beef						
	Lean	9	3.84 (0.75)	1	2.99	0.22
	Regular	11	3.04 (0.85)	4	1.99 (1.35)	0.19
Total		11	6.17 (2.27)	4	2.74 (2.29)	0.031*
Hot dogs						
	Low fat	10	3.62 (1.06)	9	1.78 (0.34)	0.003*
	Regular	11	3.04 (0.78)	12	2.05 (0.72)	0.005*
Total		11	6.33 (2.08)	18	2.25 (1.09)	<0 .001**
Frozen dinner						
	Reduced fat	12	0.26 (0.05)	1	0.10	0.11
	Regular	10	0.22 (0.04)	1	0.37	0.11
Total		12	0.45 (0.13)	1	0.46	0.79
Baked goods						
	Low fat	11	0.39 (0.12)	1	0.99	0.11
	Regular	12	0.70 (0.24)	27	0.87 (0.51)	0.68
Total		12	1.06 (0.30)	27	0.90 (0.58)	0.10
Beverages						
	Diet soda	12	0.032 (0.005)	27	0.064 (0.009)	<0.001**
	Regular soda	11	0.033 (0.002)	30	0.064 (0.008)	< 0.001**

	100% juice	11	0.048 (0.010)	30	0.105 (0.018)	<0 .001**
	Juice drink	11	0.028 (0.008)	29	0.106 (0.017)	< 0.001**
Total lower sugar beverages		12	0.076 (0.020)	30	0.163 (0.025)	< 0.001**
Total regular sugar beverages		12	0.056 (0.017)	30	0.167 (0.032)	< 0.001**
Total		12	0.13 (0.036)	30	0.33 (0.052)	< 0.001**
Bread						
	Wheat	12	0.132 (0.025)	8	0.126 (0.020)	0.35
	White	12	0.113 (0.03)	23	0.107 (0.017)	0.14
Total		12	0.24 (0.052)	23	0.15 (0.07)	0.001**
Potato chips						
	Baked chips	11	0.45 (0.19)	12	0.81 (0.27)	< 0.001**
	Regular chips	12	0.32 (0.11)	27	0.45 (0.07)	< 0.001**
Total		11	0.62 (0.20)	29	0.83 (0.48)	0.46
Total healthier items#		12	9.50	30	1.84	<0.001**
Total regular items#		12	9.49	30	4.21	<0.001**
Total		12	46 (8.8)	30	9 (8.3)	<0.001**

n = number of stores, SD = standard deviation, # All measures except fruits and vegetables

[a] n = 12

[b] n = 31

[c] significance between middle chain and convenience stores using Mann-Whitney test

The mean price for all vegetables except cauliflower was cheaper in convenience stores. Mean price of cauliflower by store type was not computed because cauliflower was not available in convenience stores. However, results were only statistically significant for cucumbers, cabbage, and total vegetable price (Table III).

The mean price of lean, regular, and total ground beef was cheaper in convenience stores. The mean price for low fat, regular, and total hot dogs was significantly less in convenience stores when compared to middle chain grocery stores. The mean price per ounce for reduced fat frozen dinners was cheaper in convenience stores while the mean cost of regular and total frozen dinners were greater in convenience stores. These differences were statistically significant for total ground beef ($p = 0.31$), low fat hot dogs ($p = 0.003$), regular hot dogs ($p = 0.005$), and total hot dogs ($p < 0.001$; Table III).

The mean prices per individual good of both low fat and regular baked goods were greater in convenience stores than in middle chain grocery stores. The total mean price of baked goods was cheaper in convenience stores. All beverage choices (diet soda, regular soda, 100% juice and juice drink), total lower sugar beverages, total regular sugar beverages, and total beverages were significantly greater in mean price per ounce in convenience stores when compared to middle chain grocery stores ($p < 0.001$; Table III). However, these results were not statistically significant for baked goods.

The mean price per ounce for both wheat and white bread was slightly cheaper in convenience stores. The total mean price for bread was significantly cheaper in convenience stores (Table III). The mean price per ounce for baked, regular, and total chips was significantly greater in convenience stores (Table III). The total costs for all items, healthier items, and regular items in convenience stores were significantly cheaper than in middle chain grocery stores (Table III).

Store classification by pre- and post-relocation

Middle chain

The mean prices for whole quarts, whole half gallons, low fat quarts, low fat half gallons, and total milk were greater in post-relocation middle chain grocery stores. The total prices for lower fat and whole milk were cheaper after relocation. The mean costs for honeydew, grapes, peaches, and watermelon were greater in post-relocation stores while the mean costs of bananas, apples, oranges, strawberries, honey dew melon, pears, and total fruits were cheaper. The costs of broccoli, corn, cucumbers, cabbage and cauliflower were cheaper post-relocation when compared to pre-relocation stores. The costs of carrots, tomatoes, sweet peppers, lettuce, celery, and total vegetables were greater post-relocation. These results were only statistically significant for oranges ($p = 0.022$), broccoli ($p = 0.55$) and carrots ($p = 0.049$; Table IV).

The mean prices of standard and lean ground beef were cheaper after relocation (Table IV). The total mean price for ground beef was greater after relocation. The average prices for both varieties of hot dogs were greater after relocation. The total mean price for hot dogs was cheaper after relocation. The mean prices per ounce for reduced fat, regular, and total frozen dinners were cheaper in post-relocation stores. However, the differences were only statistically significant for the total mean price of frozen dinners ($p = 0.042$; Table IV).

Table IV. Prices for food items in middle chain stores pre- and post-relocation

Measure	Item	n[a]	Before Mean (SD)	n[b]	After Mean (SD)	*p* value[c]
Milk						
	Whole-quart	3	1.49 (0)	4	1.53 (0.05)	0.19
	Low fat-quart	3	1.49 (0)	4	1.54 (0.06)	0.18
	Whole-half gallon	4	1.88 (0.12)	7	1.92 (0.41)	0.54
	Low fat-half gallon	3	1.76 (0.06)	5	1.99 (0.45)	0.17
Total lower fat milk		3	3.25 (0.06)	7	2.81 (0.84)	0.91
Total whole milk		4	3.00 (0.63)	7	2.80 (0.73)	0.63
Total		4	5.43 (2.25)	7	5.61 (1.30)	0.92
Fruit						
	Banana	4	0.63 (0.07)	8	0.52 (0.18)	0.33
	Apple	4	1.55 (0.12)	8	1.42 (0.66)	0.059
	Orange	4	1.92 (0.41)	8	1.22 (0.41)	0.022*
	Grapes	4	1.66 (0.05)	8	2.08 (0.55)	0.19
	Cantaloupe	3	1.05 (0.19)	6	1.05 (0.19)	1.0
	Peaches	4	0.83 (0.05)	2	1.49 (0)	0.053
	Strawberries	4	2.62 (0.63)	8	2.31 (0.59)	0.70
	Honeydew melon	3	1.75 (0.43)	6	1.99 (0.55)	0.39
	Watermelon	4	0.52 (0.10)	8	0.54 (0.19)	0.54
	Pears	4	1.67 (0.94)	8	1.51 (0.46)	0.73
Total		4	13.51 (1.38)	7	12.27 (2.29)	0.31
Vegetables						
	Carrots	4	0.71 (0.24)	8	1.19 (0.44)	0.049*
	Tomatoes	4	1.49 (0.34)	8	1.93 (0.81)	0.23
	Sweet peppers	4	1.91 (0.85)	8	2.54 (1.14)	0.23

	Broccoli	4	1.82 (0.42)	8	1.75 (0.34)	0.55
	Lettuce	4	1.59 (0.11)	8	1.64 (0.35)	0.39
	Corn	4	1.33 (0.88)	7	0.90 (0.20)	0.45
	Celery	4	1.12 (0.22)	8	1.33 (0.70)	1.0
	Cucumbers	4	0.67 (0.12)	8	0.61 (0.14)	0.49
	Cabbage	4	0.63 (0.10)	8	0.57 (0.21)	0.49
	Cauliflower	3	1.53 (0.20)	7	1.30 (0.39)	0.30
Total		4	12.42 (1.57)	8	13.48 (2.90)	0.50
Ground beef						
	Lean	3	4.05 (0.61)	6	3.73 (0.84)	0.90
	Regular	4	2.95 (0.30)	7	3.08 (1.08)	0.78
Total		4	5.99 (2.12)	7	6.28 (2.51)	0.85
Hot dogs						
	Low fat	4	3.51 (1.43)	6	3.69 (0.89)	0.83
	Regular	4	2.99 (0.81)	7	3.07 (0.82)	0.77
Total		4	6.51 (2.16)	7	6.23 (2.20)	0.78
Frozen dinner						
	Reduced fat	4	0.28 (0.05)	8	0.25 (0.06)	0.089
	Regular	4	0.23 (0.02)	6	0.22 (0.05)	0.39
Total		4	0.51 (0.03)	8	0.42 (0.16)	0.042*
Baked goods						
	Low fat	3	0.50 (0.17)	8	0.35 (0.08)	0.15
	Regular	4	0.98 (0.18)	8	0.56 (0.10)	0.008*
Total		4	1.35 (0.34)	8	0.91 (0.14)	0.017*
Beverages						
	Diet soda	4	0.0331 (0.001)	8	0.0314 (0.01)	0.41
	Regular soda	4	0.0331 (0.001)	7	0.0336 (0.003)	0.18

100% juice	4	0.050 (0.006)	7	0.046 (0.01)	0.45
Juice drink	4	0.029 (0.001)	7	0.027 (0.01)	0.77
Total lower sugar beverages	4	0.084 (0.006)	8	0.072 (0.02)	0.31
Total regular sugar beverages	4	0.062 (0.002)	8	0.053 (0.02)	1.0
Total	4	0.14 (0.01)	8	0.12 (0.04)	0.49
Bread					
Wheat	4	0.135 (0.01)	8	0.130 (0.03)	0.93
White	4	0.115 (0.03)	8	0.113 (0.03)	0.80
Total	4	0.25 (0.04)	8	0.24 (0.06)	0.86
Potato chips					
Baked chips	4	0.42 (0)	6	0.38 (0.08)	0.22
Regular chips	4	0.34 (0.04)	6	0.25 (0.09)	0.065
Total	4	0.76 (0.04)	7	0.54 (0.21)	0.035*
Total healthier items#	4	10.28	8	9.11	0.61
Total regular items#	4	10.67	8	8.90	0.23
Total	4	47 (8.6)	8	44 (10.1)	.50

n = number of stores, SD = standard deviation, # All measures except fruits and vegetables

[a] n = 4

[b] n = 8

[c] significance between pre- and post-relocation using Mann-Whitney test

The prices per individual item of both varieties of baked goods and total baked goods were cheaper after relocation. The healthier beverages such as diet soda, 100% juice, and total beverages were cheaper after relocation while the mean prices for the regular varieties (regular soda and juice drink) were greater. These differences were only statistically significant for the regular variety and total baked goods ($p = 0.008$, $p = 0.017$, respectively; Table IV).

The mean prices per ounce for white, wheat, and total loaves of bread were cheaper after relocation. The average costs of baked, regular, and total potato chips per ounce were cheaper in post-relocation stores. The overall cost in the post-relocation stores was cheaper than the pre-relocation stores (Table IV). The total prices of healthier and regular items were cheaper after relocation. These results were only statistically significant for total potato chips ($p = 0.035$; Table IV).

Convenience stores

Quart low fat milk was not present in either pre- or post-relocation audits. Quart whole and half gallon 2% milk was only available in post-relocation stores therefore there a price comparison was not performed. The mean prices of half gallon whole milk and total whole milk were cheaper after relocation, while half gallon skim milk, total milk, and total lower fat milk were greater. These results were not statistically significant (Table V).

There was no price comparison for grapes, cantaloupe, strawberries, honeydew melon, watermelon, pears, and peaches because they were not available in both pre- and post-relocation audits. The average costs of apples, oranges, and total fruits were greater post-relocation. The cost of bananas was cheaper post-relocation. There were no computed differences in mean vegetables prices between pre- and post-relocation because vegetables were not present in pre-relocation stores. These results were not statistically significant (Table V).

Ground beef was not found in both pre- and post-relocation convenience stores therefore mean price comparisons were not performed. The mean price of low fat hot dogs was cheaper after relocation, while the mean price of regular and total hot dogs were greater. Frozen dinners were not available in both pre- and post-relocation stores therefore mean price comparisons were not computed. The mean prices per piece for regular and total baked goods were cheaper post-relocation. Low fat baked goods were not available in both pre- and post- relocation audits. The mean price for white, wheat, and total bread was slightly greater in after relocation convenience stores. However, these results were not statistically significant (Table V).

The mean prices for diet and regular soda were cheaper in the after relocation stores, while the 100% juice, juice drink, and total beverages were slightly greater. The total prices for lower sugar and regular sugar beverages were cheaper post-relocation. The average prices for baked and regular chips were greater in post-relocation stores when compared to pre-relocation. The total mean price per ounce of potato chips was slightly cheaper post-relocation. The overall mean price for all items was slightly greater in post- relocation convenience stores when compares to pre-relocations store. Total prices for both healthier and regular items were cheaper after relocation. However, the results were only statistically significant for baked chips ($p = 0.049$; Table V).

Table V. Prices for food items in convenience stores pre- and post-relocation

			Before		After	
Measure	**Item**	**n[a]**	**Mean (SD)**	**n[b]**	**Mean (SD)**	***p* value[c]**
Milk						
	Whole-half gallon	5	3.25 (0.49)	11	2.58 (0.59)	0.097
	Low fat-half gallon	1	2.99	2	3.09 (0.14)	0.480
Total lower fat milk		1	2.99	4	3.91 (1.71)	0.43
Total whole milk		5	3.25 (0.49)	11	2.99 (1.31)	0.31
Total		5	3.85 (1.28)	11	4.41 (3.32)	0.78
Fruits						
	Banana	3	2.32 (0.99)	10	1.77 (0.71)	0.48
	Apple	1	1.50	6	1.94 (0.64)	0.44
	Orange	1	3.46	3	2.31 (0.52)	0.18
Total		3	3.98 (2.66)	10	5.07 (3.81)	0.73
Hot dogs						
	Low fat	3	1.86 (0.23)	6	1.74 (0.40)	0.43
	Regular	3	1.59 (0.53)	9	2.20 (0.74)	0.19
Total		6	1.72 (0.39)	12	2.52 (1.24)	0.22
Baked goods						
	Regular	5	0.92 (0.57)	22	0.86 (0.50)	0.95
Total		5	1.11 (0.90)	22	0.86 (0.50)	0.72
Beverages						
	Diet soda	7	0.07 (0.004)	20	0.06 (0.01)	0.16
	Regular soda	7	0.07 (0.004)	23	0.06 (0.01)	0.14
	100% juice	7	0.10 (0.01)	23	0.10 (0.02)	1.0
	Juice drink	7	0.10 (0.01)	22	0.11 (0.02)	0.88

Total lower sugar beverages		7	0.17 (0.01)	23	0.159 (0.03)	0.33
Total regular sugar beverages		7	0.17 (0.01)	23	0.165 (0.04)	0.64
Total		7	0.34 (0.02)	23	0.32 (0.06)	0.49
Bread						
	Wheat	1	.11	7	0.13 (0.02)	0.51
	White	6	.10 (.01)	17	0.11 (0.02)	0.26
Total		6	.12 (.04)	17	0.16 (0.07)	0.21
Potato chips						
	Baked chips	5	0.65 (0.31)	8	0.93 (0.17)	0.049*
	Regular chips	7	0.43 (0.08)	22	0.47 (0.07)	0.25
Total		7	0.90 (0.45)	22	0.80 (0.49)	0.52
Total healthier items#		7	2.02	23	1.79	0.61
Total regular items#		7	4.35	23	4.16	0.45
Total		7	8 (5.1)	23	9 (8.7)	0.71

n = number of stores, SD = standard deviation, # All measures except fruits and vegetables

[a] n = 7

[b] n = 23

[c] significance between pre- and post-relocation using Mann-Whitney test

Availability

Pre- and post-relocation

There was no statistically significant difference in availability of lower fat milk (skim and 2% milk) and whole milk before and after relocation audits (Table VI). The availability of peaches was significantly greater during pre-relocation and less available post-relocation. Bananas, apples, oranges, grapes, cantaloupe, strawberries, honeydew, watermelon and pears were equally available in pre- and post-relocation audits.

Carrots, broccoli, tomatoes, celery, cabbage, lettuce, sweet peppers and cucumbers were equally available before and after relocation (Table VI). The availability of corn and cauliflower were similar in both pre- and post-relocation audits. Lean ground beef was more available pre-relocation, while regular ground beef was more available post-relocation (Table VI). There was greater availability of low fat and regular hotdogs in pre-relocation audits. Reduced fat and regular frozen dinners were equally available before and after relocation (Table VI). These results were not statistically significant.

Both varieties of baked goods were slightly more available in pre-relocation audits. Whole wheat and regular bread were equally available in pre- and post-relocation audits. All beverages (diet soda, regular soda, 100% juice, and juice drink) were slightly more available before relocation. Results were only statistically significant for baked chips ($p = 0.035$; Table VI).

VI. Food item availability in pre and post-relocation

Measure	Item	n (%)		p value[c]
		Before[a]	After[b]	
Milk				
	Lower fat[d]	5 (45)	15 (48)	1.0
	Whole	11 (100)	22 (71)	0.083
Fruit				
	Banana	7 (64)	18 (58)	1.0
	Apple	5 (45)	13 (42)	1.0
	Orange	5 (45)	11 (35)	0.72
	Grapes	4 (36)	10 (32)	1.0
	Cantaloupe	3 (27)	7 (23)	1.0
	Peaches	4 (36)	2 (6)	0.032*
	Strawberries	4 (36)	9 (29)	0.713
	Honeydew melon	3 (36)	8 (26)	1.0
	Watermelon	4 (36)	10 (32)	1.0
	Pears	4 (36)	10 (32)	1.0
Vegetables				
	Carrots	4 (36)	10 (32)	1.0
	Tomatoes	4 (36)	10 (32)	1.0
	Sweet peppers	4 (36)	10 (32)	1.0
	Broccoli	4 (36)	10 (32)	1.0
	Lettuce	4 (36)	10 (32)	1.0
	Corn	4 (36)	9 (29)	0.72
	Celery	4 (36)	10 (32)	1.0
	Cucumbers	4 (36)	10 (32)	1.0
	Cabbage	4 (36)	10 (32)	1.0

	Cauliflower	3 (27)	7 (23)	1.0
Ground beef				
	Lean	3 (27)	7 (23)	1.0
	Regular	2 (18)	10 (32)	0.46
Hot dogs				
	Reduced-fat	7 (63)	14 (45)	0.48
	Regular	7 (63)	17 (55)	0.73
Frozen dinners				
	Reduced-fat	4 (36)	9 (29)	1.0
	Regular	4 (36)	10 (32)	0.71
Baked goods				
	Low-fat	4 (36)	8 (26)	0.70
	Regular	11 (100)	30 (97)	1.0
Bread				
	Whole wheat	5 (45)	15 (48)	1.0
	Regular	9 (81)	25 (81)	1.0
Beverages				
	Diet soda	11 (100)	28 (90)	0.55
	Regular soda	11 (100)	30 (97)	1.0
	100% juice	11 (100)	30 (97)	0.16
	Juice drink	11 (100)	29 (93)	0.16
Potato chips				
	Baked	9 (81)	13 (42)	0.035*
	Regular	11 (100)	27 (87)	0.56

n = number of stores, SD = standard deviation

[a] n = 11

[b] n = 31

[c] significance between pre- and post-relocation using Fisher's exact test

[d] 2% milk availability only measured if skim milk was not available. The availability of both skim and 2% milk were combined

Store classification

Lower fat milk (skim and 2% milk) and whole milk were significantly more available in middle chain stores than in convenience stores ($p < .001$, $p = 0.041$, respectively; Table VII). Overall, middle chain grocery stores had the greatest fruit availability. Bananas were the most available fruit in both middle chain and convenience stores. All fruits were significantly more available in middle chain stores than in convenience stores. Peaches were the least available fruit in both middle chain and convenience stores. All vegetables were significantly more available in middle chain grocery stores than convenience stores (Table VII). Cauliflower was the least available vegetable in both middle chain and convenience stores.

The availability of both varieties of ground beef was significantly greater in middle chain grocery stores (Table VII). Low fat and regular hot dogs were significantly more available in middle chain grocery stores and less available in convenience stores. Reduced fat and regular frozen dinners were significantly more available in middle chain grocery stores and less available.

Low fat baked goods were significantly more available in middle chain stores and less available in convenience stores (Table VII). Regular baked goods were equally available in middle chain and convenience stores. Wheat bread and white bread were more available in middle chain stores and less available in convenience stores. 100% juice was significantly more available in convenience stores ($p = 0.001$). Baked chips were more available in middle chain grocery stores, while regular chips were more available in convenience stores. However, these results were only significant for whole wheat bread ($p < .001$; Table VII).

Table VII. Food item availability in middle chain and convenience stores

Measure	Item	n (%)		p value[c]
		Middle chain[a]	Convenience[b]	
Milk				
	Lower fat[d]	12 (100)	8 (27)	< 0.001**
	Whole	12 (100)	21 (70)	0.041*
Fruit				
	Banana	12 (100)	13 (43)	<0 .001**
	Apple	11 (92)	7 (23)	<0 .001**
	Orange	12 (100)	4 (13)	< 0.001**
	Grapes	12 (100)	2 (7)	< 0.001**
	Cantaloupe	9 (75)	1 (3)	< 0.001**
	Peaches	6 (50)	0 (0)	< 0.001**
	Strawberries	11 (92)	2 (7)	< 0.001**
	Honeydew melon	9 (75)	2 (7)	< 0.001**
	Watermelon	12 (100)	2 (7)	< 0.001**
	Pears	12 (100)	2 (7)	< 0.001**
Vegetables				
	Carrots	12 (100)	2 (7)	<0 .001**
	Tomatoes	12 (100)	2 (7)	<0 .001**
	Sweet peppers	12 (100)	2 (7)	<0 .001**
	Broccoli	12 (100)	2 (7)	<0 .001**
	Lettuce	12 (100)	2 (7)	<0 .001**
	Corn	11 (92)	2 (7)	<0 .001**
	Celery	12 (100)	2 (7)	<0 .001**
	Cucumbers	12 (100)	2 (7)	<0 .001**
	Cabbage	12 (100)	2 (7)	<0 .001**
	Cauliflower	10 (83)	0 (0)	<0 .001**

Ground beef				
	Lean	9 (75)	1 (3)	<0 .001**
	Regular	9 (75)	3 (10)	<0 .001**
Hot dogs				
	Reduced-fat	10 (83)	11 (4)	0.015*
	Regular	12 (100)	12 (40)	<0 .001**
Frozen dinners				
	Reduced-fat	12 (100)	2 (7)	<0 .001**
	Regular	11 (92)	2 (7)	<0 .001**
Baked goods				
	Low-fat	11 (92)	1 (3)	<0 .001**
	Regular	12 (100)	29 (97)	1.0
Bread				
	Whole wheat	12 (100)	8 (27)	<0 .001**
	Regular	12 (100)	22 (73)	0.08
Beverages				
	Diet soda	12 (100)	27 (90)	0.55
	Regular soda	11 (92)	30 (100)	1.0
	100% juice	6 (50)	29 (97)	0.001**
	Juice drink	11 (92)	24 (80)	0.65
Potato chips				
	Baked	9 (75)	13 (43)	0.091
	Regular	10 (83)	28 (93)	0.57

n = number of stores, SD = standard deviation

[a] n = 12, [b] n = 30

[c] significance between middle chain and convenience stores using Fisher's exact test

[d] 2% milk availability only measured if skim milk was not available. The availability of both skim and 2% milk were combined

Store classification by order of audits

Middle chain

There was 100% availability of milk (lower fat and whole), regular hot dogs, reduced fat frozen dinners, regular baked goods, bread (white and wheat), and diet soda in both before and after relocation middle chain grocery stores (Table VIII). These stores also had 100% availability of most fruits (banana, oranges, grapes, watermelon, and pears) and vegetables (carrots, tomatoes, sweet peppers, broccoli, lettuce, celery, cucumbers and cabbage). Lean ground beef, cantaloupe, and honeydew melon were 75% available in both pre- and post-relocation grocery stores.

Apples, strawberries, corn, reduced fat hot dogs, frozen dinners, chips and most beverages (regular soda, 100% juice and juice drink) were less available in post-relocation stores and more available in pre-relocation stores. Cauliflower, standard ground beef, and low fat baked goods were more available in post-relocation stores. Both pre- and post-relocation middle chain grocery stores had comparable availability for most items. There was no significant difference in the availability of any of the items measured (Table VIII).

Convenience stores

The availability of bananas, peaches, cauliflower, regular soda and 100% juice stayed the same in both pre- and post-relocation stores (Table IX). Several items had greater availability in the after relocation stores. These items include: most fruit (except oranges and bananas), all vegetables (except cauliflower), ground beef, frozen dinners and whole wheat bread. Milk, oranges, hot dogs, baked goods, diet soda, juice drink and chips were less available in post-relocation stores when compared to pre-relocation stores. However, these differences were not statistically significant (Table IX)

Table VIII. Food item availability in middle chain stores pre and post-relocation

Measure	Item	n (%)		p value[c]
		Before[a]	After[b]	
Fruit				
	Apple	4 (100)	7 (87)	1.0
	Cantaloupe	3 (75)	6 (75)	1.0
	Peaches	4 (100)	2 (25)	0.061
	Strawberries	4 (100)	7 (87)	1.0
	Honeydew melon	3 (75)	6 (75)	1.0
Vegetables				
	Corn	4 (100)	7 (87)	1.0
	Cauliflower	3 (75)	7 (87)	1.0
Ground beef				
	Lean	3 (75)	6 (75)	1.0
	Regular	2 (50)	7 (87)	0.24
Hot dogs				
	Reduced-fat	4 (100)	6 (75)	0.51
Frozen dinners				
	Regular	4 (100)	7 (87)	1.0
Baked goods				
	Low-fat	3 (75)	8 (100)	0.33
Beverages				
	Regular soda	4 (100)	7 (87)	1.0
	100% juice	4 (100)	7 (87)	1.0
	Juice drink	4 (100)	7 (87)	1.0
Potato chips				
	Baked	4 (100)	4 (67)	0.47

Regular	4 (100)	5 (83)	1.0

n = number of stores, SD = standard deviation

[a] n = 4

[b] n = 8

[c] significance between pre- and post-relocation using Fisher's exact test

Table IX. Food item availability in convenience stores pre and post-relocation

Measure	Item	n (%) Before[a]	After[b]	*p* value[c]
Milk				
	Lower fat[d]	1 (45)	7 (30)	0.64
	Whole	7 (100)	14 (61)	0.071
Fruit				
	Banana	3 (43)	10 (43)	1.0
	Apple	1 (14)	6 (26)	1.0
	Orange	1 (14)	3 (13)	1.0
	Grapes	0 (0)	2 (9)	1.0
	Cantaloupe	0 (0)	1 (4)	1.0
	Strawberries	0 (0)	2 (9)	1.0
	Honeydew melon	0 (0)	2 (9)	1.0
	Watermelon	0 (0)	2 (9)	1.0
	Pears	0 (0)	2 (9)	1.0
Vegetables				
	Carrots	0 (0)	2 (9)	1.0
	Tomatoes	0 (0)	2 (9)	1.0
	Sweet peppers	0 (0)	2 (9)	1.0
	Broccoli	0 (0)	2 (9)	1.0
	Lettuce	0 (0)	2 (9)	1.0
	Corn	0 (0)	2 (9)	1.0
	Celery	0 (0)	2 (9)	1.0
	Cucumbers	0 (0)	2 (9)	1.0
	Cabbage	0 (0)	2 (9)	1.0
Ground beef				

	Lean	0 (0)	1 (4)	1.0
	Regular	0 (0)	3 (13)	1.0
Hot dogs				
	Reduced-fat	3 (43)	8 (35)	1.0
	Regular	3 (43)	9 (39)	1.0
Frozen dinners				
	Reduced-fat	0 (0)	2 (9)	1.0
	Regular	0 (0)	2 (9)	1.0
Baked goods				
	Low-fat	1 (14)	0 (0)	0.23
	Regular	7 (100)	22 (96)	1.0
Bread				
	Whole wheat	1 (14)	7 (30)	0.64
	Regular	5 (71)	17 (74)	1.0
Beverages				
	Diet soda	7 (100)	20 (87)	1.0
	Juice drink	7 (100)	22 (96)	1.0
Potato chips				
	Baked	5 (71)	8 (35)	0.19
	Regular	7 (100)	22 (96)	1.0

n = number of stores, SD = standard deviation

[a] n = 7

[b] n = 23

[c] significance between pre- and post-relocation using Fisher's exact test

[d] 2% milk availability only measured if skim milk was not available. The availability of both skim and 2% milk were combined

Quality

Pre- and post-relocation

Of all the fruits and vegetables that were available, the majority were reported by the store rater at each audit to be of acceptable quality (Table X). Acceptable quality was characterized by peak condition with top quality, firm to touch, minimal bruising and dark spots. Unacceptable quality was defined as mushy, old-looking, uneatable, or containing several bruises and dark spots. One hundred percent of apples, oranges, grapes, peaches, honeydew melon, watermelon, tomatoes, sweet peppers, broccoli, lettuce, celery, cabbage and cauliflower were acceptable in both pre- and post-relocation stores. Bananas (94%), cantaloupe (86%), strawberries (80%), pears (90%), carrots (90%), corn (89%) and cucumbers (90%) were ranked unacceptable in a small percentage of the post-relocation stores but they were acceptable (100%) in all pre-relocation stores (Table X). There were no significant differences between fruit and vegetable quality in pre- and post-relocation audits.

Store classifications

100% of apples, oranges, grapes, honeydew melon, watermelon, tomatoes, sweet peppers, broccoli, lettuce, celery and cabbage were rated acceptable in both middle chain and convenience stores (Table XI). Convenience store fruits and vegetables were more likely to be rated unacceptable when compared to middle chain grocery stores. However, there were no statistically significant differences between fruit and vegetable quality in store classifications.

Store classification by pre- and post-relocation

Middle chain

All fruits and vegetables, except corn, cantaloupe and strawberries, had 100% quality rating of acceptable for both pre- and post-relocation stores (Table XII). In post-relocation stores, corn (86%), cantaloupe (83%), and strawberries (87%) had the lowest acceptable quality ratings. However, these results were not statistically significant.

Convenience

Only apples and oranges had 100% acceptable quality rating in convenience stores pre- and post-relocation (Table XIII). Of the convenience stores audited, few fruits and vegetables were available. Post-relocation convenience stores had more produce available but a comparison could not be made between pre- and post-relocation data.

These results indicate that there were varying differences in mean price for each individual item by store classification pre- and post-relocation. Most of these differences were not statistically significant. However when comparing prices in middle chain grocery stores to convenience stores, the total mean prices for milk ($p = 0.02$), fruits ($p < 0.001$), ground beef ($p = 0.031$), hot dogs ($p < 0.001$), and beverages ($p < 0.001$) were significantly different. The total prices of frozen dinners ($p = 0.042$), baked goods ($p = 0.017$), and potato chips ($p = 0.035$) were significantly cheaper after relocation in middle chain grocery stores. The overall price for all 10 items was significantly greater in middle chain grocery stores. In addition, all items (except potato chips, regular baked goods, and regular bread) were significantly more available in middle chain stores. When comparing food availability pre- and post-relocation, peaches ($p = 0.032$) and baked chips ($p = 0.035$) were significantly more available in pre-relocation audits. There were no significant differences in quality of fruits and vegetables in either store classification or order of store audits.

Table X. Fruits and vegetables with acceptable ranking in pre- and post-relocation audits

Measure	Item	n (%)[a]		p value[b]
		Before	After	
Fruit				
	Banana	7 (100)	17 (43)	1.0
	Cantaloupe	3 (100)	6 (86)	1.0
	Strawberries	4 (100)	8 (80)	1.0
	Pears	4 (100)	9 (90)	1.0
Vegetables				
	Carrots	4 (100)	9 (10)	1.0
	Corn	4 (100)	8 (89)	1.0
	Cucumbers	4 (100)	9 (90)	1.0

n = number of stores, SD = standard deviation

[a] based off noted availability of each item (Table VI)

[b] significance between pre- and post-relocation using Fisher's exact test

Table XI. Fruits and vegetables with acceptable ranking in middle chain and convenience stores

Measure	Item	n (%)[a]		p value[b]
		Middle chain	Convenience	
Fruit				
	Banana	12 (100)	12 (92)	1.0
	Cantaloupe	8 (89)	1 (100)	1.0
	Strawberries	11 (92)	1 (50)	0.27
	Pears	12 (100)	1 (50)	0.14
Vegetables				
	Carrots	12 (100)	1 (50)	0.14
	Corn	10 (91)	2 (100)	1.0
	Cucumbers	12 (100)	1 (50)	0.14

n = number of stores, SD = standard deviation

[a] based off noted availability of each item (Table VII)

[b] significance between middle chain and convenience stores using Fisher's exact test

Table XII. Fruits and vegetables with acceptable ranking in middle chain stores pre- and post-relocation

Measure	**Item**	**n (%)[a]**		***p* value[b]**
		Before	**After**	
Fruit				
	Cantaloupe	3 (100)	5 (83)	1.0
	Strawberries	4 (92)	7 (87)	1.0
Vegetables				
	Corn	4 (100)	6 (86)	1.0

n = number of stores, SD = standard deviation

[a] based off noted availability of each item (Table VIII)

[b] significance between pre- and post-relocation using Fisher's exact test

Table XIII. Fruits and vegetables with acceptable ranking in convenience stores pre- and post-relocation

Measure	Item	n (%)[a]		p value[b]
		Before	After	
Fruit				
	Banana	3 (100)	9 (90)	1.0

N = number of stores, SD = standard deviation

[a] based off noted availability of each item (Table IX)

[b] significance between pre- and post-relocation using Fisher's exact test

CHAPTER V

Discussion

It is evident when comparing the location of public housing communities to the relocated areas (Figure 1 and Figure 2) that the transformation effort of AHA to deconcentrate poverty in Atlanta by integrating public housing could not be deemed successful. The vast majority of residents still reside in close proximity to their old neighborhoods, moving an average of 5 miles from their original address. Therefore, the food environment was similar and there were few significant differences.

Price

When comparing middle chain stores to convenience stores, these findings were similar to previous research that found larger grocery stores to have more favorable prices for food items, more specifically, the healthier varieties. [2] The majority of prices for healthier alternatives were greater than the regular options.[37] Convenience stores mainly carry energy dense snack items.[25] Consequently, prices for items that are equally available in convenience and middle chain stores such as potato chips (baked and regular), sweetened beverages (diet soda, regular soda, 100% juice and juice drinks), and baked goods (regular muffins) were greater in convenience stores when compared to middle chain stores.

Although residents did not relocate to middle income areas, these findings suggest that moving to an area with slightly less poverty (from 30% to 44%) directly affected the food prices in middle chain grocery stores.[1] The prices for total frozen dinners, baked goods, and potato chips were significantly cheaper in post-relocation middle chain stores. However, there were no significant differences in item prices in convenience stores. Researchers have concluded that low income neighborhoods have higher food prices due to the smaller stores with higher prices.[38] This price difference may also be attributed to better availability of middle chain stores in relocation environments.

In addition, the overall price for middle chain stores was significantly greater than that of convenience stores. These results also suggest convenience store prices are cheaper than middle chain stores for the majority of the items such as milk, almost half of fruits, all vegetables, and bread. However, percent availability of these items provides more insight into an explanation of these results.

Availability

The convenience stores had limited product availability.[2, 23, 29] All of the items found to be cheaper in convenience stores were items that are not typically available, such as: most fruits and vegetables, ground beef, and frozen dinners. In agreement with Bodor and colleagues results,[25] the sample convenience stores had a large supply of energy dense foods. Thus, the anticipated results were achieved for items frequently found in convenience stores (sweetened beverages, chips, and regular muffins). These findings agree with previous studies that have found greater availability of food items in middle chain grocery stores.[2, 29] There was a significantly greater availability of all items (lower fat milk, fruit, vegetables, ground beef, hot dogs, frozen dinners, low fat baked goods, whole wheat bread and 100% juice) in middle chain grocery stores that are not frequently found in convenience stores.

The significance difference in peach availability could be a result of changes to this season's crop because these differences were observed between pre- and post-relocation.

Whole milk was frequently the only milk sold in convenience stores. Krukowski and colleagues also highlighted this significant disadvantage in the availability of lower fat milk in low income neighborhoods.[2] However, there is no plausible explanation as to why milk and baked chips were significantly more available in pre-relocation store audits. It could be due to the disproportionate sampling of convenience and middle chain stores in post-relocation audits. However, when examining the results based on convenience or middle chain stores by pre- and post-relocation, differences were no longer significant for whole milk and baked chips.

Quality

Although Andreyeva found significantly worse produce quality in low versus high SES areas with grocery stores having significantly better quality.[39] It is assumed that there was not a statistical difference in the quality variable because it was based on availability of produce. Convenience stores maintain a limited stock, if any, of perishable items, while the opposite is true about grocery stores, regardless of type.[25, 29] Middle chain grocery stores have more frequent customers and employees that are required to inspect these items. Also, residents did not relocate far and they were essentially in the same food environment.

There were limitations in this present study. Although store auditors were trained, there may have been variability in the surveys. The lapse in time between each group of store audits (pre- and post-relocation) makes it difficult to obtain an accurate comparison. In addition, food prices are influenced by seasonality, weather conditions, and inflation. Availability could have been affected by harvest, delivery or re-shelving schedules. The NEMS-S only measured the availability of fresh produce. A more accurate depiction of the food environment would include all forms (fresh, canned, and frozen) of produce. Another limitation was the lack in methodological sampling which may have resulted in a disproportionate representation of the food environment. A specific percentage of each store type per address would have provided a more accurate picture of stores available.

Conclusion

Although this study did not directly compare the availability of regular versus healthier items, the relocation of public housing residents did not have a significant effect on food availability, price and quality. This is primarily attributed to the fact that residents have not in actuality relocated to new neighborhoods. They are still located in the same or similar food environments. These residents have undergone a change in the comfort and safety of their living environment. Although these residents have reported the feeling of increased safety, they are now faced with other living expenses (water and electric bills). Their disposable income has been decreased more and the money allotted for the groceries are minimal.

Atlanta has led the nation by being the first city to completely demolish family public housing. Other cities will soon follow their lead. There are numerous studies on food environments of low-SES neighborhoods and there are a couple studies that specifically focus on public housing residents. However, there needs to be more research on the effects of relocation on public housing residents' food environment, overall diet quality, and health outcomes.

An individual's food choice is limited to what is available. Public health policies and intervention strategies need to focus on increasing the availability of fresh produce and healthier varieties in economically disadvantaged neighborhoods by incorporating more supermarkets or middle chain grocery stores into the urban setting. There needs to be more emphasize placed on nutrition education for these adults. Additionally, the prices of healthier food items should not cost more than the regular varieties.

References

1. Oakley D, Ruel E, Reid L, Sims C. Public housing relocation and residential segregation in Atlanta: where are families going? 2010. http://www2.gsu.edu/~wwwsoc/docs/SOC/RESEARCH_state_of_black_atlanta_paper.pdf. Accessed August 25, 2010.
2. Krukowski RA, West DS, Harvey-Berino J, Elaine Prewitt T. Neighborhood impact on healthy food availability and pricing in food stores. *J. Community Health.* 2010;35:315-320.
3. Howell E, Harris LE, Popkin SJ. The health status of HOPE VI public housing residents. *J. Health Care Poor Underserved.* 2005;16:273-285.
4. Public and Indian Housing. US Department of Housing and Urban Development. Web site. http://www.hud.gov/offices/pih/programs/ph/hope6/index.cfm. Accessed October 5, 2010.
5. Oakley D, Ruel E, Reid L. Moved out to where? Initial relocation destinations of former public housing residents in Atlanta: a preliminary brief. 2009. http://www2.gsu.edu/~wwwsoc/docs/SOC/RESEARCH_public_housing_initial_report.pdf. Accessed August 27, 2010.
6. Housing Choice Voucher Program. US Department of Housing and Urban Development. Web site. http://www.hud.gov/offices/pih/programs/hcv/about/fact_sheet.cfm. Accessed October 25, 2010

7. National Center for Chronic Disease Prevention and Health Promotion. Obesity-Halting the Epidemic by Making Health Easier At-A-Glance 2010. 2010. http://www.cdc.gov/chronicdisease/resources/publications/aag/pdf/2010/AAG_Obesity_2010_Web_508.pdf.

8. Ruel E, Reither EN, Robert SA, Lantz PM. Neighborhood effects on BMI trends: examining BMI trajectories for Black and White women. *Health Place.* 2010;16:191-198.

9. Robert SA, Reither EN. A multilevel analysis of race, community disadvantage, and body mass index among adults in the US. *Soc. Sci. Med.* 2004;59:2421-2434.

10. Brennan SL, Henry MJ, Nicholson GC, Kotowicz MA, Pasco JA. Socioeconomic status and risk factors for obesity and metabolic disorders in a population-based sample of adult females. *Prev. Med.* 2009;49:165-171.

11. Mobley LR, Root ED, Finkelstein EA, Khavjou O, Farris RP, Will JC. Environment, obesity, and cardiovascular disease risk in low-income women. *Am. J. Prev. Med.* 2006;30:327-332.

12. Center for Disease Control and Prevention. Vital signs: State-specific obesity prevalence among adults-United States, 2009. *Morb. Mortal. Weekly Rep.* 2004;59. http://www.cdc.gov/mmwr/pdf/wk/mm59e0803.pdf.

13. U. S. Department of Housing and Urban Development. Resident Characteristic Report 2010. https://pic.hud.gov/pic/RCRPublic/rcrmain.asp.

14. National Center for Chronic Disease Prevention and Health Promotion. Behavioral Risk Factor Surveillance System. *Prevalence and Trends Data.* 2009.

http://apps.nccd.cdc.gov/BRFSS/income.asp?cat=OB&yr=2009&qkey=4409&state=UB. Accessed November 28, 2010.

15. Rivo ML, Gray K. Health Corners: Reducing Chronic Disease among Black Public Housing Residents in the Nation's Capital. *Am. J. Public Health.* 1992;82(4):611-611.

16. Fauth RC, Leventhal T, Brooks-Gunn J. Short-term effects of moving from public housing in poor to middle-class neighborhoods on low-income, minority adults' outcomes. *Soc. Sci. Med.* 2004;59:2271-2284.

17. Digenis-Bury EC, Brooks DR, Chen L, Ostrem M, Horsburgh CR. Use of a population-based survey to describe the health of Boston public housing residents. *Am. J. Public Health.* 2008;98:85-91.

18. National Institute of Health: National Heart, Lung and Blood Institute. The Practical Guide: Identification, Evaluation and Treatment of Overweight and Obesity in Adults. 2000. http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_c.pdf

19. Center for Disease Control and Prevention. *The Burden of Chronic Diseases and Their Risk Factors: National and State Perspectives 2004.* 2004. http://www.cdc.gov/nccdphp/burdenbook2004. Accessed November 23, 2009.

20. Harris LE, Kaye DR. How are HOPE VI Families Faring? Health *Metropolitan Housing and Communities: A roof over their heads.* 2004. http://www.urban.org/uploadedPDF/311073_Roof_5.pdf.

21. Pearson T, Russell J, Campbell MJ, Barker ME. Do 'food deserts' influence fruit and vegetable consumption?--A cross-sectional study. *Appetite.* 2005;45(2):195-197.

22. Gallagher M. Examining the Impact of Food Deserts on Public Health in Chicago. 2006.

http://www.marigallagher.com/site_media/dynamic/project_files/1_ChicagoFoodDesertReport-Full_.pdf.

23. Hosler AS, Rajulu DT, Fredrick BL, Ronsani AE. Assessing retail fruit and vegetable availability in urban and rural underserved communities. *Prev Chronic Dis.* 2008;5(4). http://www.cdc.gov/pcd/issues/2008/oct/07_0169.htm. Accessed October 15, 2010.

24. Algert SJ, Agrawal A, Lewis DS. Disparities in access to fresh produce in low-income neighborhoods in Los Angeles. *Am. J. Prev. Med.* 2006;30:365-370.

25. Bodor JN, Rice JC, Farley TA, Swalm CM, Rose D. Disparities in food access: does aggregate availability of key foods from other stores offset the relative lack of supermarkets in African-American neighborhoods? *Prev. Med.* 2010;51:63-67.

26. Powell LM, Slater S, Mirtcheva D, Bao Y, Chaloupka FJ. Food store availability and neighborhood characteristics in the United States. *Prev. Med.* 2007;44:189-195.

27. Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy foods in the U.S. *Am. J. Prev. Med.* 2009;36:74-81.

28. Morland K, Wing S, Diez Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. *Am. J. Prev. Med.* 2002;22:23-29.

29. Farley TA, Rice J, Bodor JN, Cohen DA, Bluthenthal RN, Rose D. Measuring the food environment: shelf space of fruits, vegetables, and snack foods in stores. *J. Urban Health.* 2009;86:672-682.

30. French SA. Pricing effects on food choices. *J Nutr.* 2003;133:841S-843S.

31. US White House Task Force on Childhood Obesity. *Solving the Problem of Childhood Obesity within a Generation.* Washington, D.C.: Executive Office of the President of the United States; 2010.

32. French SA, Jeffery RW, Story M, et al. Pricing and promotion effects on low-fat vending snack purchases: the CHIPS Study. *Am. J. Public Health.* 2001;91:112-117.

33. French SA, Jeffery RW, Story M, Hannan P, Snyder MP. A pricing strategy to promote low-fat snack choices through vending machines. *Am. J. Public Health.* 1997;87:849-851.

34. French SA, Story M, Jeffery RW, et al. Pricing strategy to promote fruit and vegetable purchase in high school cafeterias. *J. Am. Diet. Assoc.* 1997;97:1008-1010.

35. Koro ME, Anandan S, Quinlan JJ. Microbial quality of food available to populations of differing socioeconomic status. *Am. J. Prev. Med.* 2010;38:478-481.

36. Glanz K, Sallis JF, Saelens BE, Frank LD. Nutrition Environment Measures Survey in stores (NEMS-S): development and evaluation. *Am. J. Prev. Med.* 2007;32:282-289.

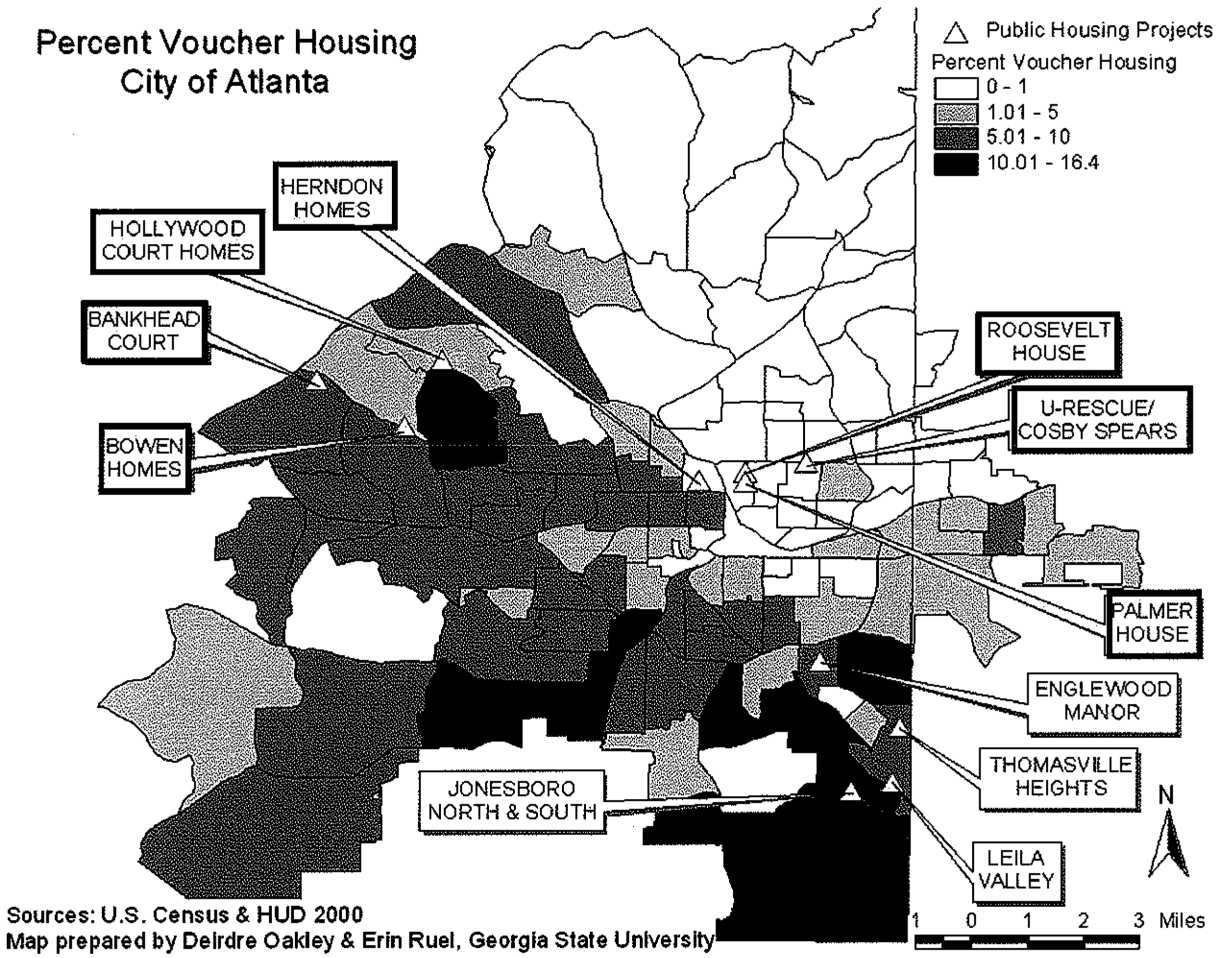
37. Jetter KM, Cassady DL. The availability and cost of healthier food alternatives. *Am. J. Prev. Med.* 2006;30:38-44.

38. Cassady D, Jetter KM, Culp J. Is price a barrier to eating more fruits and vegetables for low-income families? *J. Am. Diet. Assoc.* 2007;107:1909-1915.

39. Andreyeva T, Blumenthal DM, Schwartz MB, Long MW, Brownell KD. Availability and prices of foods across stores and neighborhoods: the case of New Haven, Connecticut. *Health Aff.* 2008;27:1381-1388.

APPENDIX A

Public Housing communities, pre-relocation food stores and % poverty



APPENDIX B

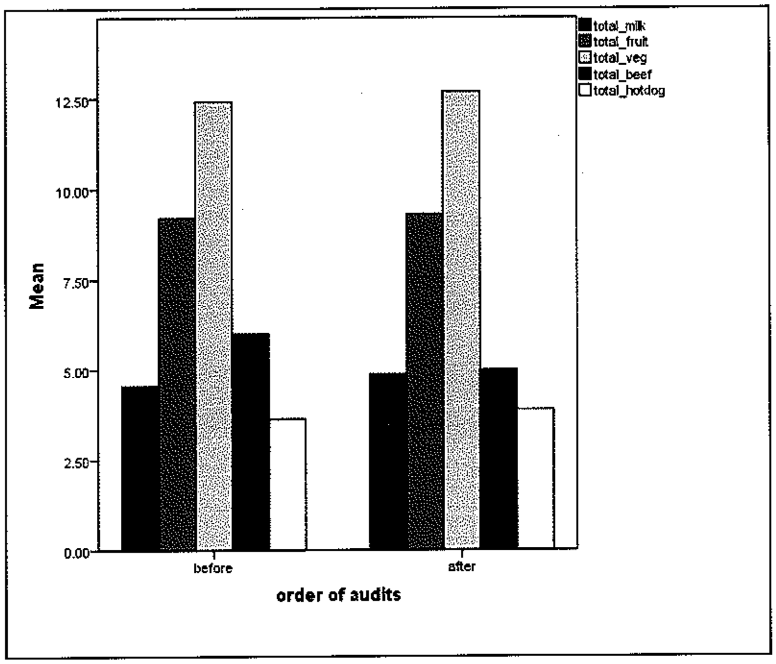
List of items surveyed in food audits

	Regular option	Healthier option
Milk		
	Whole milk	Low fat (skim, 1%) or 2% milk
Fruits		
		Banana
		Apple
		Orange
		Grapes
		Cantaloupe
		Peaches
		Strawberries
		Honeydew
		Watermelon
		Pears
Vegetables		
		Carrots
		Tomatoes
		Sweet peppers
		Broccoli
		Lettuce
		Corn
		Celery
		Cucumbers
		Cabbage
		Cauliflower

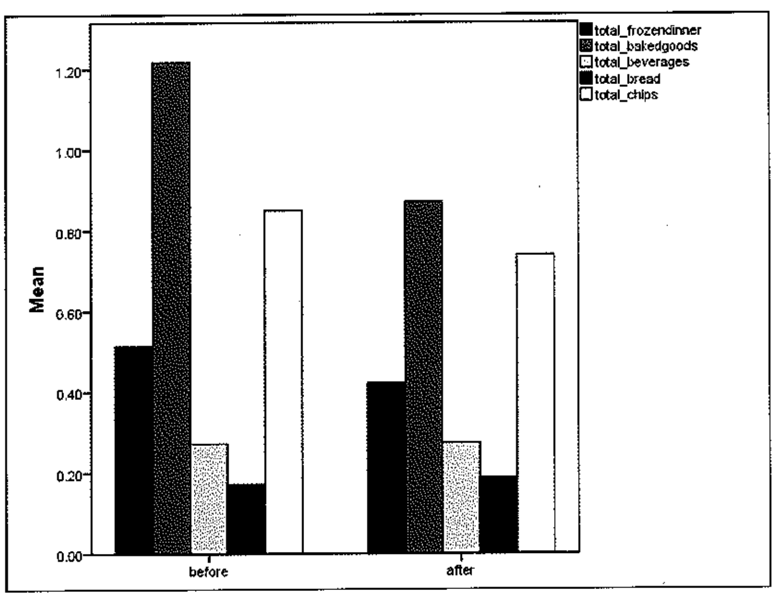
Hot dog		
	Regular	Fat free or Light
	≥ 10 g fat	≤ 9 g fat
Frozen dinners		
	Regular	Reduced fat
		≤ 9 g fat
Baked goods		
	Regular	Low fat
	≥ 4 g fat or 400 Kcal/serving	≤ 3g fat/serving
Beverage		
	Regular soda	Diet soda
	Juice drink	100% juice
Bread		
	White	Whole grain
	made with refined flour	100% whole wheat & whole grain
Chips		
	Regular	Baked
		≤ 3 g fat/ 1 oz serving

APPENDIX C

Price: Pre- and Post-relocation figures

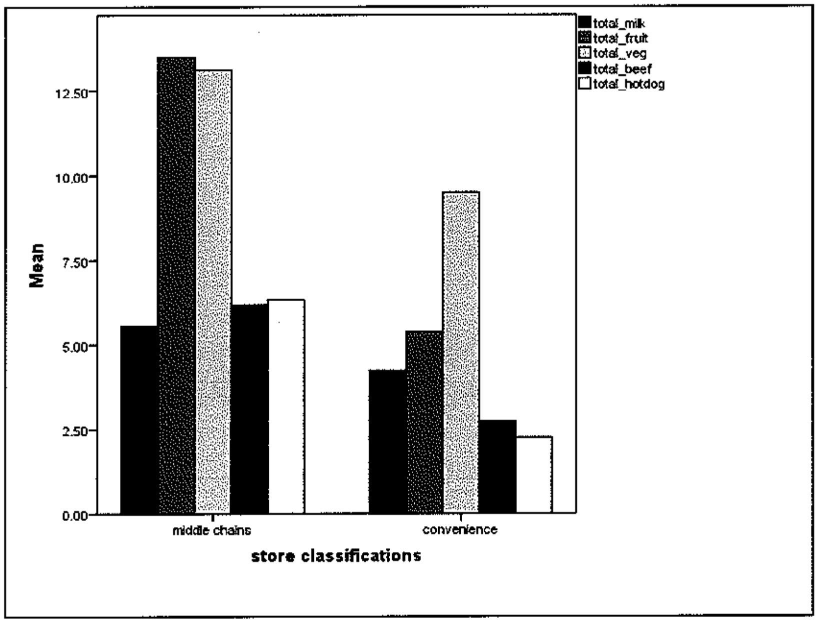


Total mean prices pre- and post-relocation for milk, fruit, vegetables, ground beef, and hot dogs

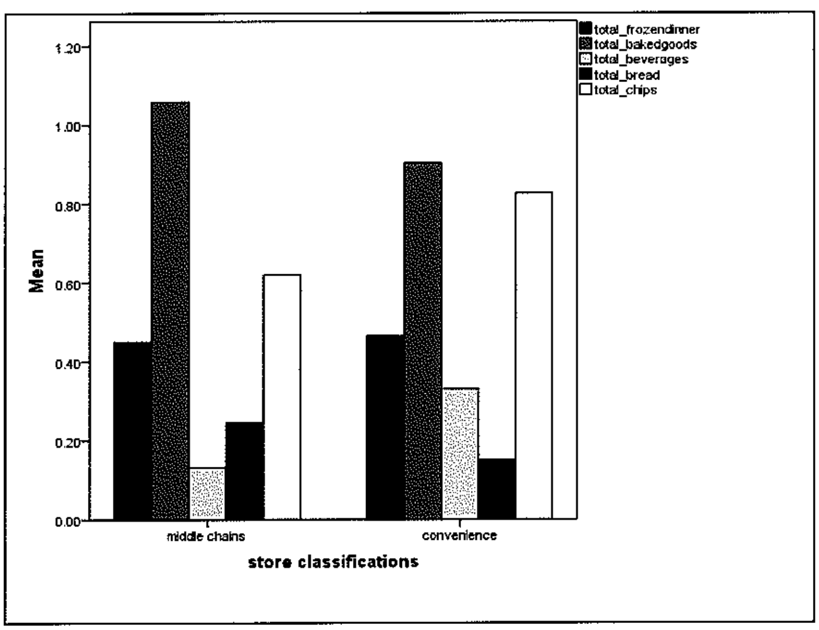


Total mean prices pre- and post-relocation for frozen dinners, baked goods, beverages, bread, and chips

Price: Store classification

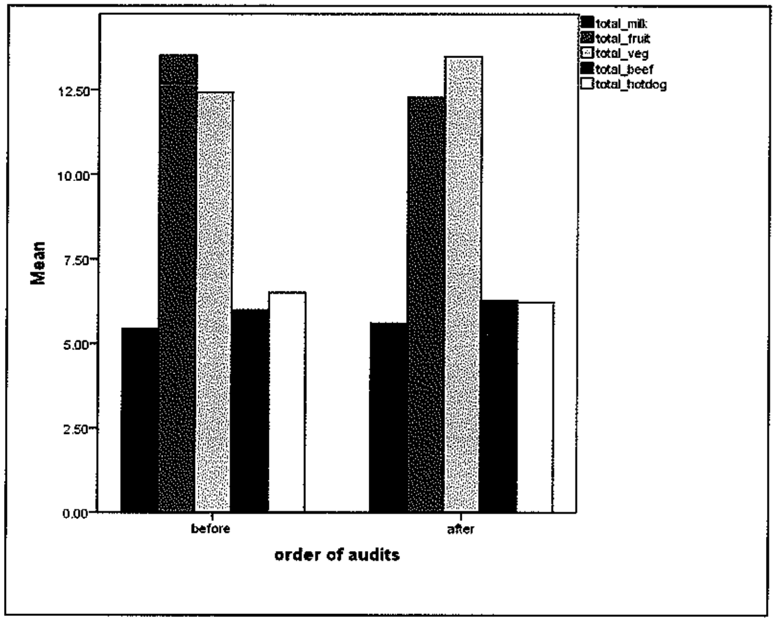


Total mean prices by store classification for milk, fruit, vegetables, ground beef and hot dogs

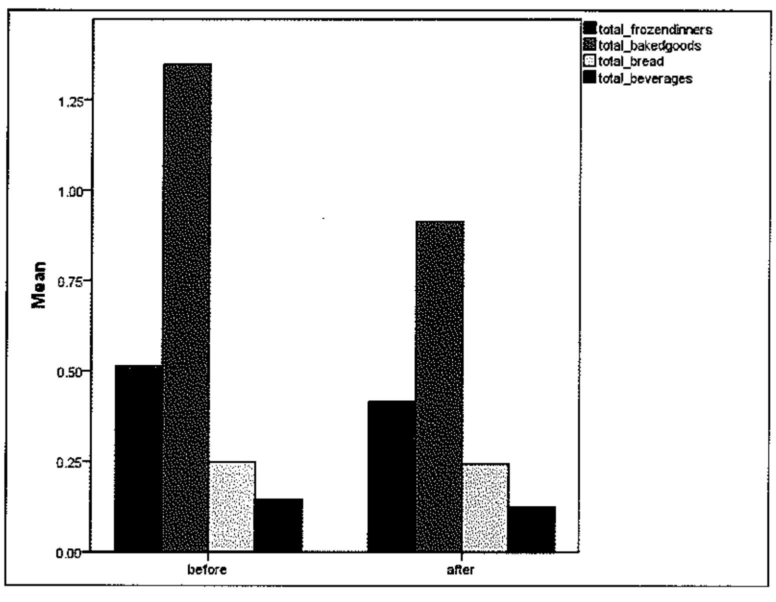


Total mean prices by store classification for frozen dinners, baked goods, beverages, bread, and chips

Price: Pre- and post-relocation middle chain grocery stores



Total mean prices for middle chain by pre- and post-relocation for milk, fruit, vegetables, ground beef, and hot dogs



Total mean prices for middle chain by pre- and post-relocation for frozen dinners, baked goods, beverages, bread, and chips

Price: Pre- and post-relocation convenience stores

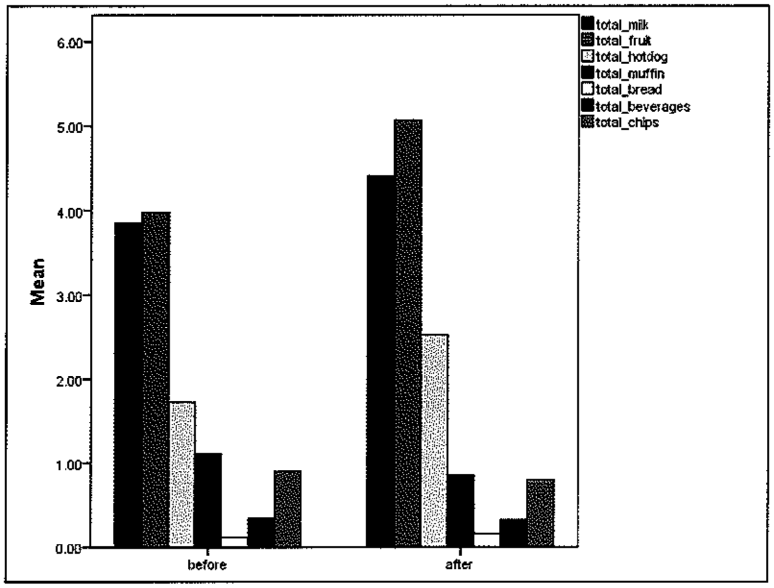


Figure 5. Total mean prices for convenience store by pre- and post- relocation