THE AVAILABILITY AND PRICE OF HEALTHY FOOD ITEMS IN LEON COUNTY, FL

by

ANGELA FRANCES LEONE

(Under the Direction of Jung Sun Lee)

ABSTRACT

This study analyzed the availability and price of healthy foods by store type, and income level and racial composition of neighborhoods in Leon County, FL. The modified Nutrition Environment Measures Survey in Stores was used to collect store audit data in 73 stores across the county (28.8% supermarkets, 11.0% grocery stores, and 60.3% convenience stores). Availability of all four healthy food items was different by store type ($P<0.001$). Overall, supermarkets provided the cheapest price for the majority of fresh produce, low-fat milk, and whole-grain bread. Availability of half of the fresh produce was significantly different by income level ($P<0.05$), but no trends were seen for the availability or price of healthy food items by neighborhood racial composition. This study suggests that store type is the most influential factor affecting the availability and price of healthy foods. Individuals that do not have adequate access to supermarkets may have limited ability to purchase healthful foods.

INDEX WORDS: Food environment; healthy foods; neighborhood characteristics; NEMS-S

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DEDICATION

I would like to dedicate this thesis to my parents, Rick and Donna Leone. Both of you have sacrificed so much so I could have every advantage in life that would allow me to be successful. I know that I can accomplish great things in life and be the best person I can be because I have both of you as role models. I dedicate this thesis to you because without you, I would not be where I am today. I love you with all of my heart.

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CHAPTER 1

INTRODUCTION

Consumption of healthy foods including fruits, vegetables, low-fat milk products, and whole-grains, is essential to promoting good health and preventing disease. Diets rich in fruits and vegetables have been found to reduce the risk of chronic diseases such as diabetes, cardiovascular disease, obesity, and certain cancers (1-4). Fiber-rich foods such as whole-grain products, fruits, and vegetables, may also contribute to a reduced risk of chronic diseases (1). Other benefits of consuming a fiber-rich diet include weight maintenance (1), insulin and glucose control (5), and overall improved long-term health (6). Including milk products into one's diet has been shown to improve overall diet quality and promote good bone health (1). Federal regulations including the 2005 Dietary Guidelines for Americans and Healthy People 2010 recommend increasing the consumption of healthy foods (1, 7); however, most Americans do not meet these recommendations (8-10).

Each individual's eating behavior is complex and is influenced not only by individual factors, but also nutrition environment factors. Characteristics of certain neighborhoods may make it difficult for consumers to sustain a healthy diet, and are therefore believed to contribute to the growing obesity epidemic and other chronic diseases (11). Results of the Multi-Ethnic Study of Atherosclerosis found that lower availability of healthy foods in the closest store available in the census tract or closest store was associated with a low-quality diet pattern among adults (12). Researchers also

used data from this study to produce the first findings that neighborhoods with greater walkability and availability of healthy foods were less likely to be hypertensive (13). Auchincloss et al. found that individuals living in neighborhoods with higher healthy food availability scores had a 45% reduced incidence of diabetes (Auchincloss et al., unpublished). Sturm and Datar followed kindergarteners through third grade and found that higher prices of fruits and vegetables were linked to greater increases in children's body weight over time (14, 15).

Not all neighborhoods are properly equipped to enable individuals to maintain a nutritious diet. There is evidence that neighborhoods with a high percentage of minorities and/or low-income individuals are at a disadvantage because of their limited surrounding nutrition environment. Research has repeatedly identified supermarkets carry a large amount and variety of food items at a lower cost compared to other small food stores (16, 17), and are less available in disadvantaged neighborhoods. Food stores located in disadvantaged neighborhoods tend to have lower availability and higher prices of food items than advantaged neighborhoods. A study conducted in New York City found only 32% of stores in a predominantly black, low-income neighborhood carried high-fiber bread compared to 74% in a predominantly white, high-income neighborhood. Similarly, low-fat milk was twice as available in the advantaged neighborhood compared to the disadvantaged neighborhood. Prices of high-fiber bread were more expensive in the disadvantaged neighborhood compared to the advantaged neighborhood (18). In order for an individual to have the ability to make healthy food choices and adopt healthy eating behaviors, they must live in an environment that enables these practices (19).

Despite significance and recent interest in studying nutrition environments, little progress has been made to devise reliable and valid methodology. The term "nutrition environment" is loosely defined because the nutrition environment is comprised of many potential elements. The two main elements that have been recently identified as high priority research areas are the "community nutrition environment" and the "consumer nutrition environment." The community nutrition environment is the type, location, and accessibility of food stores. The consumer nutrition environment refers the availability, affordability, and quality of food within food stores (11). Consumer nutrition environment has been particular interest because it could provide insight to challenges and barriers within certain neighborhoods that may influence dietary choices made by consumers. Better understanding on the consumer nutrition environment has a potential to develop programs and policies that ensure adequate availability of healthy foods in disadvantaged neighborhoods. For example, various nutrition and health initiative programs can be developed to promote healthier consumer nutrition environment such as food cooperatives, farmers markets, community cafes, community gardens, and supermarket-funded courtesy buses in order to supply affordable healthy foods to neighborhoods that may be lacking supermarkets.

In past studies, researchers have developed consumer nutrition environment tools that accommodate the food preferences of a specific area, rather than using one standardized tool. Cheadle and colleagues developed one of the first consumer nutrition environment tools nearly twenty years ago, with the purpose of assessing the amount of shelf space devoted to healthy food items (20). Although this is a highly reliable tool, it may be limited by its ability to accurately evaluate contemporary nutrition environments.

The majority of nutrition environment studies that are conducted in food stores most commonly use market baskets as a type of measure, followed by food checklists (21). For example, The Thrifty Food Plan (TFP) is a checklist commonly used by researchers to study consumer nutrition environments. The TFP was developed by the United States Department of Agriculture (USDA) to outline a nutritious diet at a minimal cost, and to serve as the minimum allotment for food stamps (22). Most of these tools and corresponding protocols are not validated and standardized. Having multiple tools of the same or similar constructs available to researchers makes it difficult to compare results across studies. Consumer nutrition environment research shares general shortcomings in consumer nutrition environment research including the lack of consistent methods to define store types, neighborhood boundaries, and neighborhood demographic characteristics. More research using a single standardized, validated tool and standardized methodology is needed to better understand the consumer nutrition environment by different neighborhood characteristics across the country.

Currently, there is a limited understanding of the consumer nutrition environment related to healthy food items. The availability and affordability of fruits and vegetables are commonly studied, but there still remains a need for a single, validated tool to compare results from different studies. There are only a handful of studies that specifically look at the availability and price of low-fat milk products, and fewer studies that specifically look at whole-grain products.

There are even fewer studies that evaluate the effects of nutrition environments on consumption of healthy food items. More research is needed to better understand the availability and affordability of healthy food items among neighborhoods of differing

income levels and race/ethnicities given the potential relationships between the availability and price of healthy food items, the consumption of these products, and health of people living in different neighborhoods.

Therefore, the purpose of this study was to use the recently developed and validated Nutrition Environment Measures Survey in Stores (NEMS-S) tool to evaluate the availability and price of healthy food items (fruits, vegetables, low-fat milk, and whole-grain bread) by store type, and neighborhood income level and racial composition in Leon County, FL. This study is unique because it was initiated, designed, and conducted by Florida Health Department administrators. The administrators adopted the best available consumer nutrition environment research tool and methodology to better understand challenges and barriers in their county's consumer nutrition environment, with the intention of developing and implementing policies and programs to promote healthy food consumption and the nutritional well-being of county residents.

Chapter 2 provides a review of the literature regarding healthy foods, nutrition environments, consumer nutrition environment tools, neighborhood characteristics related to the consumer nutrition environment, and neighborhood characteristics and the availability and price of healthy food items.

Chapter 3 provides a manuscript to be submitted to the Journal of Nutrition Education and Behavior. Per publication guidelines, the manuscript contains a structured abstract, introduction, methods, results, and discussion sections. Data tables are provided at the end of the chapter.

Chapter 4 provides conclusions and implications of the present study regarding the availability and price of healthy food items by store type and neighborhood characteristics.

All references are provided after Chapter 4. These references are followed by Appendix A which provides a copy of the NEMS-S and Appendix B which provides additional data tables and figures.

CHAPTER 2

LITERATURE REVIEW

Healthy Foods

Consumption of healthy foods is critical for an individual to promote good health and prevent disease. Fruits, vegetables, whole-grain products, and milk products are identified by the 2005 Dietary Guidelines for Americans as foods that are likely to have important health benefits for most Americans (1). Diets that are rich in fruits and vegetables are likely to reduce the risk of chronic diseases such as diabetes, cardiovascular disease, obesity, and certain cancers (1-4). Consuming fiber-rich foods such as whole-grain products, fruits, and vegetables, can help reduce the risk of several chronic diseases and may encourage weight maintenance (1). Whole-grain products are also high in vitamins (especially the B vitamins), minerals, and numerous phytochemicals that have been associated with improved long-term health (6). Whole-grains also mediate the insulin and glucose responses (5). Incorporating milk products into one's diet is associated with overall diet quality and adequate consumption of nutrients. Intake of milk products is also important for bone health.

Federal nutrition recommendations including the 2005 Dietary Guidelines for Americans and Healthy People 2010 place great emphasis on increasing the consumption of healthy foods (1, 7). Despite the recommendations and health benefits associated with consumption of healthy foods, a recent study estimated that only 3.7% of the U.S. population meets the recommendation of consuming 9 or more servings of fruits and

vegetables (9), and another study estimated that only 8% of the U.S. adult population consumes the recommended 3 servings of whole-grain products (8). The Bogalusa Heart Study found that 12% of the U.S. adult population complies with the recommended amount of milk (>3 servings/day) (10). All of these statistics are very low compared to what individuals should be eating.

Eating behavior is complex and is influenced not only by individual factors, but also by environmental factors. Living in an environment with limited access to food stores, or having access to stores with a limited supply of healthy food items, may restrict an individual's ability to eat healthy foods. Healthy food items tend to be more expensive than regular items, which may be another barrier to healthy eating, especially among low-income populations (17). Barriers within environments may be one reason why Americans do not meet the recommended daily servings of healthy foods. In order for an individual to have the ability to make healthy food choices and adopt healthy eating behaviors, they must live in an environment that enables these practices (19).

Nutrition Environments

Traditional strategies to promote health and prevent disease have been mainly focused on an individual-level approach, which aims to target high-risk individuals, or individuals who are already ill (23). Recently, more attention has been given to a neighborhood-level approach because it is considered a more preventative and cost-effective way to address common health problems such as obesity, diabetes, and heart disease (23). People living in neighborhoods/communities with limited access to affordable, healthy foods are faced with a greater challenge to adopt healthy eating behaviors that adhere to the recommended dietary guidelines than individuals living in

neighborhoods/communities with ample access to affordable, healthful foods. Characteristics of neighborhoods where people live are widely believed to contribute to the growing epidemic of obesity and other chronic diseases (11).

Results from the Multi-Ethnic Study of Atherosclerosis have shown that lower availability of healthy foods in the closest store available in the census tract was associated with a low-quality diet pattern among adults (24). Using the same data, another study found that residents of neighborhoods with better walkability, availability of healthy foods, greater safety, and more social cohesion were less likely to be hypertensive than their counterpart. Significant differences still remained even after adjusting for income level, but not for race/ethnicity in both studies (13). A few longitudinal studies have also found associations between positive nutrition environments and health outcomes. One study found that individuals living in neighborhoods with higher healthy food availability scores had a significantly 45% reduced incidence of diabetes (Auchincloss et al., unpublished). Another study found that higher prices of fruits and vegetables were linked to greater increase in children's body weight over time (14, 15). In order to make improvements using the neighborhood-level approach, it is critical to have well-defined concepts and valid, reliable measures of nutrition environments.

There is no one agreed-upon definition of the term "nutrition environment" because it is comprised of many potential components. Two components that have been recently identified as high priority areas of nutrition environment research are the "community nutrition environment" and the "consumer nutrition environment." The community nutrition environment is comprised of the number, type, location and

accessibility of food stores. The consumer nutrition environment is what consumers encounter in and around places where they buy food, such as the availability, cost and quality of food (25).

Consumer Nutrition Environment: Tools

Despite the recent interest in nutrition environments, little progress has been made to devise reliable and valid tools that evaluate nutrition environments (25). Cheadle and colleagues published one of the earliest nutrition environment studies nearly two decades ago, measuring the amount of shelf space in food stores devoted to healthy food items (20). Cheadle used a highly reliable tool, but their tool may be limited to accurately evaluate contemporary nutrition environments because current store layouts and food products are quite different from two decades ago. A review by McKinnon et al. (2009) found that most nutrition environment studies that are conducted in food stores most commonly use market baskets as the type of measure, followed by checklists (21). One of the most widely used market baskets is based on the Thrifty Food Plan (TFP). The TFP was developed by the United States Department of Agriculture (USDA) to serve as a national standard for a nutritious diet at a minimal cost, and as the basis for maximum food stamp allotments (22). The TFP is the least expensive of four USDA food plans, each of which specifies the amount of food from different food groups that can be purchased to provide dietary adequacy for a given sex-age group and household size. The TFP based shopping lists are used to form market baskets to evaluate the affordability and availability of food items. The TFP-derived tools do not include procedures for measuring the quality of food items. Another limitation of the TFP-derived tools is that the food lists may not be representative of food patterns in a particular area.

In past studies, researchers have developed tools that accommodate the food preferences of a specific area, rather than using one standardized tool. For example, a recently developed store audit tool was used by researchers in Texas to study healthy and regular food items (26). The audit tool is a comprehensive food list that includes foods emphasized by the federal recommendations of the US Department of Agriculture's MyPyramid and the 2005 Dietary Guidelines (1, 27). Multiple tools of the same or similar constructs make it difficult to compare results across studies (28). Recently, a central repository of existing tools was created in order to provide a platform for sharing information on the use of different tools (29), test the limits of existing tools, specify the tool's level of generalizability, and help provide a scientifically-based rationale for the need for additional tools (28).

Most tools that have been used in studies to assess nutrition environments are not validated and store audit protocols including surveyor training were not standardized. In a review by McKinnon et al. (2009), only 13.1% of the articles mentioned use of a psychometric property of tools. The most commonly cited psychometric property of nutrition environment tools are inter-rater and test-retest reliability. Because inconsistent tools were used in different neighborhoods/communities across studies with unique objectives, it is hard to compare data and generalize the findings from those studies. There is a need for a standardized, validated tool and audit protocols to measure nutrition environments.

One tool that has been recently developed to evaluate consumer nutrition environments is the Nutrition Environment Measures Survey in Stores (NEMS-S). The survey consists of 11 food measures and focuses on the availability, price, and quality of

healthy food options compared to regular food options. Measures include milk, fruits, vegetables, ground beef, hot dogs, frozen dinners, baked goods, beverages (soda/juice), bread, baked chips, and cereal (11). The rationale behind the selection of most of the measures is based on Dietary Guidelines for Americans (1). The NEMS-S validation study showed high inter-rater reliability and high test-retest scores, kappa scores ranging from 0.73 to 1.0 (11). Appropriate training and quality control are required to use the NEMS-S. Three day workshops and online training programs are available to learn how to accurately use the NEMS tools. Modifications can be made to the NEMS-S measures to tailor the tool to a specific research goal or a specific community.

Neighborhood Characteristics Related to the Consumer Nutrition Environment

Although consumption of healthy food is critical to promote optimal health, not all neighborhoods are created equal. There is evidence to show that neighborhoods that have a high percentage of minorities and/or low income population are at a disadvantage because their surrounding nutrition environment may not provide close access to stores that have a variety of healthy food items at an affordable price (30). A national study representing more than 28,000 ZIP codes across the U.S. found that low-income areas had only 75% as many supermarkets available as middle-income areas. Predominantly black neighborhoods were found to have approximately one half as many supermarkets as predominantly white neighborhoods (31).

Availability and price of food items is lower in low-income neighborhoods compared to high-income neighborhoods. One study conducted in New York City found that the neighborhood with the highest median household income had twice as many supermarkets as the neighborhood with one of the lowest household incomes (18). The

New York City study also found that the neighborhood with the highest median income was more likely to supply high-fiber bread, low- or nonfat milk, fresh fruit, and fresh green vegetables than the low-income neighborhood (18). There are inconsistent results from studies that test market basket price differences between low-income and high-income level neighborhoods. A study conducted in two cities in California found the price of a fruit and vegetable market basket to be significantly higher in the high- and middle-income level neighborhoods than the very-low- and low-income level neighborhoods (32). A separate study using the same data found that the cost of an entire healthy market basket was highest in the very-low- and high-income level neighborhoods (16).

Racially segregated neighborhoods are also affected by restrictive nutrition environments. Mixed-race and African-American neighborhoods are less likely to have access to supermarkets than white, higher income areas (33). Within food stores, healthy food items are less available in predominantly African American or mixed race neighborhoods than predominantly white neighborhoods (34). A study conducted in Detroit, Michigan, showed that a predominantly African-American neighborhood of average income level had the fewest number of grocery stores and the fewest stores selling fresh produce compared to two racially heterogeneous neighborhoods of low and average income level (30). A small study conducted in Baltimore assessed the availability of certain healthy food items using the scoring system provided by the NEMS-S methodology. The study found that predominantly black neighborhoods had a significantly larger percentage of stores in the lowest tertile for availability of healthy food items compared to the predominantly white neighborhoods (43% vs. 4%,

respectively). The quality of healthy food items was also significantly lower in the predominantly African-American than the racially heterogeneous neighborhood (24). Studies differ on the prices of healthy food items in different race/ethnic neighborhoods. One study found that prices were lower in a predominantly African-American neighborhood (18), and another study found no difference in price (30). Restrictive nutrition environments among racially segregated and low-income neighborhoods may hinder healthy eating among these populations.

Neighborhood Characteristics and the Availability and Price of Healthy Food Items

Currently, there is a limited understanding of the consumer nutrition environment related to healthy food items. The availability and affordability of fruits and vegetables are commonly studied, but there still remains a need for a single, validated tool to compare results from different studies. There are only a handful of studies that specifically look at the availability and price of low-fat milk products, and fewer studies that specifically look at whole-grain products.

There are even fewer studies that evaluate the effects of nutrition environments on consumption of healthy food items. More research is needed to better understand the availability and affordability of healthy food items among neighborhoods of differing income levels and race/ethnicities given the potential relationships between the availability and price of healthy food items, the consumption of these products, and health of people living in different neighborhoods.

Purpose, Hypothesis, and Specific Aims

The purpose of this study was to provide an in-depth look at the consumer nutrition environment of Leon County, FL. This study was initiated, designed, and

conducted by public health administrators at the Florida Health Department in order to compare the availability and price of healthy foods in low-income vs. medium- to high-income neighborhoods, while adopting the best available consumer nutrition environment research methodology. The data collection was done by using a validated tool (i.e., NEMS-S), to evaluate the nutrition environment characteristics of ten different measures. The secondary data analysis in this study took the original objectives even further and compared the price and availability of healthy food items by store type, and income-level and racial composition of neighborhoods. For the purposes of this study, fruits, vegetables, low-fat milk, and whole-grain bread were analyzed because of their relevance to the Dietary Guidelines for Americans (1).

We hypothesize that the availability and price of healthy food items (i.e. fruits, vegetables, low-fat milk, and whole-grain bread) differ by store type and neighborhood demographic and economic characteristics. The specific aims were to: 1) determine if the availability and price of healthy food items differed by store type, 2) determine if the availability and price of healthy food items differed between low-income and high-income neighborhoods, 3) determine if the availability and price of healthy food items differed between predominantly black, predominantly white, and racially mixed neighborhoods, and 4) determine if an interaction existed between store type and neighborhood characteristic on the availability and price of healthy food items.

Results from this study would provide insight into the shortcomings of Leon County's consumer nutrition environment, and will be used to design and implement programs and policies to enhance the nutrition environment and improve the health and well-being of Leon County consumers.

CHAPTER 3

THE AVAILABILITY AND PRICE OF HEALTHY FOOD ITEMS IN LEON COUNTY, FL[1]

[1]Leone AF, Rigby S, Betterley C, Park S, Lee JS. To be submitted to the *Journal of Nutrition Education and Behavior*.

Abstract

Objective: To examine the availability and price of healthy foods by store type, and income level and racial composition of neighborhoods.

Design: Observational; data collected in 2008 using the modified Nutrition Environment Measures Survey in Stores.

Setting: Leon County, Florida.

Participants: 73 food stores (28.8% supermarkets, 11.0% grocery stores, and 60.3% convenience stores).

Variables Measured: Availability and price of 10 fruits, 10 vegetables, low-fat milk, and whole-grain bread.

Analysis: Descriptive statistics, t-test, ANOVA, Chi-square test. ($P<0.05$ criterion).

Results: Measures of availability for all healthy food items was different by store type ($P<0.0001$). Overall, supermarkets provided the cheapest price for the majority of fresh fruits and vegetables, low-fat milk, and whole-grain bread. Availability of half of the fresh produce was significantly different by income level ($P<0.05$), but no trends were seen for the availability or affordability of healthy food items by neighborhood racial composition.

Conclusions and Implications: This study suggests that store type is the most influential factor affecting the availability and affordability of healthy foods. Individuals that do not have adequate access to supermarkets may have limited ability to purchase more healthful foods.

Key Words: Food environment; healthy foods; neighborhood characteristics; NEMS-S

Introduction

A diet rich in fruits, vegetables, low-fat milk, and whole-grains is essential for an individual to promote good health and prevent disease. Although federal nutrition recommendations including the 2005 Dietary Guidelines for Americans and Healthy People 2010 emphasize the importance of healthy eating (1, 7), studies have found that most Americans do not meet the current recommendations. Individuals that do not consume an overall nutritious diet are more likely to suffer from high rates of diabetes, cardiovascular disease, obesity, and certain cancers (1-4).

An individual's decision to purchase and consume nutritious foods is complex and is influenced by many factors either individual or environmental. One of the environmental factors is the nutrition environment. The term "nutrition environment" is loosely defined because the nutrition environment is comprised of many potential elements. The "community nutrition environment" and the "consumer nutrition environment" have recently been identified as high priority areas of research. The community nutrition environment is the type, location, and accessibility of food stores. The consumer nutrition environment refers the availability, affordability, and quality of food within food stores (11).

The community nutrition environment of certain neighborhoods may not be conducive to promoting healthy eating. Studies have shown that more disadvantaged neighborhoods tend to have less access to supermarkets than their counterpart. Across the U.S., one study found that low-income neighborhoods had 75% as many supermarkets as middle-income neighborhoods, and black neighborhoods had 50% as many supermarkets as white neighborhoods (31). Supermarkets typically carry a large amount and variety of

food items at a lower cost compared to other small food stores (16, 17). A study conducted in the Lower Mississippi Delta region found that 97.0% of fresh fruits and 100% of fresh vegetables on a food list were available in supermarkets, compared to 27.7% of fresh fruits and 45.2% of fresh vegetables in grocery stores, and 7.7% of fresh fruits and 10.0% of fresh vegetables in convenience stores (35). Liese and colleagues found the average price of high-fiber bread to be the least expensive in supermarkets ($1.46), compared to grocery stores and convenience stores ($1.59 vs. $2.04, respectively), even though these results were not statistically significant. Results from the same study found that the price of a gallon of low-fat milk was significantly less expensive in supermarkets ($3.45) compared to convenience stores ($3.99) (17). Therefore, neighborhoods that have limited access to supermarkets have less access to affordable food items, especially healthy food items, which may prevent these individuals from attaining a nutritious diet.

Although healthy food items are not specifically studied very often, it has been found in a few studies that the availability of healthy food items in stores tends to differ between advantaged and disadvantaged neighborhoods. A study conducted in New York found that the neighborhood with the highest median income was more likely to supply high-fiber bread, low-fat milk, and fresh produce than the low-income neighborhood (36). Similarly, a study conducted in Michigan found that a predominantly African-American neighborhood had the fewest stores selling fresh produce compared to two racially heterogeneous neighborhoods (30). The availability and affordability of healthy food items was found to be lower in a low-income, minority neighborhood than a high-income, predominantly white neighborhood in New York City. The study found that only

32% of stores in the disadvantaged neighborhood carried high-fiber bread compared to 74% in the advantaged neighborhood. Similarly, low-fat milk was twice as available in the advantaged neighborhood compared to the disadvantaged neighborhood (92% vs. 49%). Prices of high-fiber bread were more expensive in the disadvantaged neighborhood compared to the advantaged neighborhood ($2.29 vs. $1.79, respectively). This trend was also seen with the price of gallon sized low-fat milk ($3.45 vs. $2.89, respectively) (18).

In order to better understand consumer nutrition environments, it is important that store audit data is collected using a standardized, validated tool. Despite the recent interest in consumer nutrition environments, little progress has been made to devise reliable and valid tools (25). A recently developed tool that has been validated is the Nutrition Environment Measures Survey in Stores (NEMS-S). The NEMS-S assesses the availability, price, and quality of 11 food measures, focusing on the comparisons between healthy and regular options (11).

Determining the availability and price of healthy food items in different neighborhoods is essential to providing useful insight to existing barriers within an environment that may influence a consumer's dietary choices. Data from consumer nutrition environment studies can be used to develop policies that ensure adequate supermarket availability in disadvantaged neighborhoods, and implement programs such as food cooperatives, farmer's markets, community cafes, community gardens, and supermarket-funded courtesy buses to compensate for neighborhoods that have limited access to supermarkets. It is essential to complement any policy changes or health initiative programs with adequate nutrition education. Nutrition education is important to

help consumers realize the importance of eating healthy foods and to help consumers learn how to properly shop for and prepare healthy meals (26).

The purpose of this study was to use the NEMS-S to evaluate the consumer nutrition environment of Leon County, FL in attempts to identify weaknesses in the consumer nutrition environment that may be improved by implementing interventions or policy changes. Leon County is 66.4% white and has approximately 18.2% of individuals living below poverty level (37). Residents of Leon County have higher rates of childhood obesity and diet-related deaths such as stroke, heart failure, and breast cancer compared to most Florida counties, but also have higher fruit and vegetable consumption compared to most Florida counties (38, 39).

We hypothesize that the availability and price of healthy food items will differ by store type and neighborhood demographic and economic characteristics.

Methods

The study used data from the NEMS-S that was initiated, designed, and collected by the Florida Health Department administrators in 2008. Approval by the Institutional Review Board was not required for the implementation of this study. Data was sent to the University of Georgia researchers to analyze and interpret.

Place

This study took place in Leon County, Florida. Leon County resides in the panhandle of the state and is where Florida State University is located. Based on the 2000 U.S. Census data, the population of Leon County was 239,452. The racial composition of the county was 66.4% white, 29.1% black, and 4.5% other races. The median age of the population was 29.5 years. Among the 69.1% of the population in the workforce, the

median household income was $37,517. In the year 2000, Leon County had an unemployment rate of 5.7%, which was higher than the state average of 3.2%. Approximately 18.2% of Leon County individuals and 9.4% of Leon county families lived below poverty level, which was 5.7% and 0.4% higher than the state average, respectively (37).

Census tracts, national geographic boundaries containing approximately 2,500 to 8,000 individuals were used as proxies for neighborhoods (40). Adopting the methodology predominantly used in previous studies (30, 34), the 48 census tracts were dichotomized into a high-income group and low-income group based on the percentage of households under poverty level of the census tracts. The census tracts were classified into three groups by racial composition: predominantly white (<20% of the population as black, n = 11), predominantly black (>80% of the population as black, n = 6), or racially-mixed (if 20-80% of the population as black, n = 31) (34).

Store Sample

A list of supermarkets, grocery stores, and convenience stores in Leon County was obtained from the Florida Department of Agriculture and Consumer Services. There is no standardized definition and classification of food stores that has been consistently used in previous nutrition environment studies. This study used the definition of food stores provided by the Florida Department of Agriculture and Consumer Services Food Administrative Code (41) (**Table 3.1**). For the purposes of this study, the three convenience store types were grouped together. All three convenience store classifications had very similar availability, or lack thereof, the healthy food items analyzed in this study. The Food Administrative Code does not separately classify

wholesale retailers such as Costco and Wal-Mart Supercenters, so these store types were included in the supermarket classification. Eighteen supermarkets and only three Wal-Mart Supercenters were surveyed in this study, for a total of 21 supermarkets surveyed in this study.

All stores available in Leon County or listed in the Florida Department of Agriculture and Consumer Services database were geocoded to census tracts by the Florida Department of Health Office of Planning, Evaluation and Data Analysis. Poverty data for each census tract was obtained using Florida Community Health Assessment Resource Tool Set (42). Sampling of the stores was designed to select different store types and a variety of stores within each store type from each census tract, which in turn to reduce a bias due to the uniform prices of dominant type of stores (i.e., major supermarket chain). If possible, a supermarket was chosen from a census tract. If there was more than one supermarket in a census tract, a store other than Publix, a major supermarket chain, was chosen. If there were no supermarkets, one grocery store and one convenience store were chosen. If there were no supermarkets or grocery stores, two different types of convenience stores were chosen. This selection process yielded 65 stores. Additional store sampling was conducted in the census tracts with contrasting poverty status to ensure the inclusion of stores from high- and low-income neighborhoods. Starting with the census tract with the highest poverty rate, the first census tract that had at least one supermarket and more than two convenience stores was identified and all stores within that census tract were surveyed. The same procedure was followed for the census tract with the lowest poverty rate. This criterion yielded 13 more stores to survey, for a combined total of 78 stores. Upon visiting selected stores, five

stores were excluded from the study, yielding a total sample size of 73 stores (28.8% supermarkets, 11.0% grocery stores, and 60.3% convenience stores). Stores surveyed in this study represent 90% of supermarkets, 20% of grocery stores, and 58.7% of convenience stores available in Leon County. A store was excluded if the store was too small in size and only carried a limited selection of items such as cigarettes and alcohol, the store was in a dangerous location, or if the store did not meet the criteria of being categorized as a supermarket, grocery store, or convenience store.

Food store audit tool

A modified NEMS-S survey tool was used to collect data for this study. Modifications to the survey were made to include items that may be more commonly purchased by low-income individuals (i.e. items most commonly found on the Thrifty Food Plan, and/or might be available in convenience stores). The modifications included additions to the fruit, vegetable, ground beef, and cereal measures. The price and availability of canned fruit cocktail and canned carrots were added to the fruit and vegetable measures, along with documenting the number of varieties of canned and frozen fruits and vegetables. Greens were added to the fresh vegetable measure. Additions to the ground beef measure included meat alternatives such as canned tuna, peanut butter, and dry beans were added. Oatmeal, brown rice, and whole-grain spaghetti were added to the cereal measure. A pilot test was conducted in four stores using the modified NEMS-S. After pilot testing, health administrators made revisions to the modified tool and consulted Emory researchers who developed and validated the original NEMS-S tool before finalizing the modified tool.

Food Store Audit

A three day NEMS-S training course was given to Florida Health Department administrators by researchers from Emory University who developed and validated the original NEMS-S tool. This comprehensive training provided the surveyors with specific instructions on how to evaluate the availability, price and quality for all of the food measures.

The store audits for this study were conducted from January to March 2008. Two trained individuals surveyed each store. Surveyors collected data at supermarkets and grocery stores between 9 a.m. and 4 p.m. in order to ensure that survey items had been stocked for the day and were not sold out. Surveyors collected data at the convenience stores before 4:30 p.m. or after 6 p.m. to ensure that surveyors were not in the stores during the busiest hours. At the end of each store outing, surveyors reviewed the data collected to resolve any discrepancies.

Availability

All availability measurements were conducted following the original NEMS-S protocol. Categorical availability of all items was recorded by bubbling in "yes" or "no" on the survey next to the preferred item. If the preferred item was unavailable (i.e. Red delicious apples), a similar alternate item or brand was written in.

Availability of fresh produce was also measured continuously by counting the total number of fruits and vegetables available in a store, each with a maximum score of ten.

Shelf space was an additional measure used to analyze the availability of milk. Shelf space was recorded only if low-fat milk was available. Shelf space was measured

for skim, 1%, and whole milk in pint, quart, half gallon and gallon size cartons. Skim and 1% milk were combined to represent low-fat milk. Shelf space was measured by counting and recording the total number of available columns of low-fat and whole-fat milk of each carton size for the reference brand. Empty columns that needed to be restocked were not included. The total number of available columns for each carton size were multiplied by the number of inches occupied by the carton (i.e. pint x 2.5", quart x 3", half gallon x 3", gallon x 5") in order to calculate the total inches of shelf space devoted to low-fat and whole-fat milk. This information was used to calculate and compare the proportion of shelf space in a store devoted to low-fat and whole-fat milk.

The availability of whole-grain bread was also measured by recording the number of varieties of whole-wheat bread offered in a store. This number included different brands and types of whole-grain bread, but not different sizes of the same brand. The number of varieties was recorded as 0, 1, 2, 3, 4, 5, or 6 or more varieties available.

Price

The lowest price was recorded for all food items following the original NEMS-S protocol. Sale prices were recorded if they were the only prices available and the regular price could not be calculated from the sale price. The price of fruits and vegetables was recorded by piece or by pound. The price of low-fat (skim or 1%) and whole-fat milk was recorded by quart and half gallon. If low-fat milk was not available, the price of 2% milk was recorded. The price of bread was recorded by loaf. Loaf size in ounces was recorded in order to compare prices.

NEMS-S healthy food availability score

To assess the overall availability of healthy items, the scoring system developed for the original NEMS-S was used. If a store carried low-fat milk, 2 points were awarded. If the proportion of low-fat milk to whole-fat milk was greater than or equal to 50%, an additional 1 point was awarded. If a store had less than 5, 5-9, or 10 varieties of fruit available, 1, 2, or 3 points were awarded, respectively. The same scoring was used for the varieties of vegetables available. If a store carried whole-wheat bread, 2 points were awarded. If the store carried more than 2 varieties of whole-wheat bread, an additional point was awarded. The maximum score that a score could receive was 12 points.

Data Processing

The prices of the fruits and vegetables were standardized to one unit. The price data for each fruit and vegetable was converted to the unit (piece or pound) that was most commonly recorded for that piece of produce to minimize any potential bias. For example, 51 stores surveyed apples- 23 recorded apples by pound and 28 recorded apples by piece. Because apples were more commonly recorded by piece, all of the price data that was recorded by pound was converted to prices per piece. This methodology was used to determine which unit would be used for each fruit and vegetable. The conversions used information provided by the USDA database as shown in **Table 3.2** (43).

Cauliflower and watermelon were recorded by piece in all stores, and peaches and strawberries were recorded by pounds in all stores, so no conversion was needed.

If a fruit or vegetable was recorded as more than one piece per dollar amount, the price was divided by the number of pieces recorded in order to get the price per single

piece. Similarly, when a honeydew or cantaloupe was recorded as "half sliced," the price was multiplied by two in order to get the price of the whole piece of fruit.

Bread was most commonly surveyed as 20-ounce loaves. One survey recorded the price of a 22-ounce loaf and one survey recorded the price of a 24-ounce loaf. The prices for both of these loaves were converted to equal the price of a 20-ounce loaf of bread.

For the purposes of this study, we report the price and availability of all 10 fruits on the original NEMS-S, 10 of 11 vegetables in the modified NEMS-S, low-fat and whole-fat milk (quart and half gallon), and whole-grain and white bread. Greens were excluded from the vegetable analysis because there was inconsistent and unclear reporting of units in the audit data, and because there was no appropriate conversion method provided by the USDA database that would allow for accurate analysis.

Data Analysis

Data for each store was entered into the Nutrition Environment Measures Survey Access database. All analysis was conducted by STATA Data Analysis and Statistical Software, Version 10.1 (College Station, TX). Descriptive analysis was conducted to describe the availability and price measures of healthy food items. Mean, standard deviation, median, and range were calculated for the price and availability of all 10 fruits and 10 vegetables by store type, and neighborhood income level and racial composition. Descriptive analysis was also conducted for the price and availability of low-fat milk (quart and half gallon), whole-fat milk, the proportion of shelf-space devoted to low-fat and whole-fat milk, the price and availability of whole-grain and white bread, and the number of varieties of whole-grain bread. T-tests were used to compare the continuous availability and price measures of healthy food items between the two neighborhood

income-level groups. One-way ANOVA tests were used to compare the continuous availability and price measures of healthy food items among the three neighborhood race groups and the three store types. Fisher's exact tests or Chi-square tests were used to compare the categorical availability measures by store type and neighborhood characteristics. The NEMS-S scores were compared across the three store types and three race groups using ANOVA tests. Scores were compared between the income-level groups using a t-test. Nonparametric tests (Kruskal-Wallis test and the Wilcoxon-rank sum test) were also used to examine the differences in the price measures by store type and neighborhood characteristics, but provided similar results. To examine the potential interaction between store type and neighborhood characteristics on the continuous availability and price measures, ANOVA test was used. An α-level of 0.05 was used as the criterion for statistical significance.

Results

Among the 73 stores included in this study, convenience stores were the predominant store type (60.3%) followed by supermarkets (28.8%) and grocery stores (11.0%). **Table 3.3** shows the distribution and percentage of store types included in this study by wealth and racial composition of neighborhoods. The distribution of each store type in the store sample was significantly different by neighborhood income level (P = 0.03), but not by neighborhood racial composition (P = 0.12). Although close to equal number of supermarkets were selected from high- and low-income level neighborhoods (13 vs. 8, respectively), nearly twice as many convenience stores and seven times more grocery stores were surveyed in low-income level neighborhoods than high-income level neighborhoods.

The majority of stores selected and surveyed were from a mixed race neighborhood (47, 64.4%). The smallest number of stores was selected from predominantly black neighborhoods, 75% of them convenience stores. The distribution and percentage of store types by wealth and racial composition of neighborhoods is shown in **Table 3.4**.

Nearly 78% of stores surveyed in predominantly white neighborhoods were classified as high-income neighborhood stores. All 8 of the stores surveyed in predominantly black neighborhoods were classified as low-income neighborhood stores.

Store type

Availability

The most commonly surveyed fruits were apples (n = 51, 69.9% of stores), bananas (n = 49, 67.1% of stores), and oranges (n = 40, 54.8% of stores). **Figure 3.1 and Appendix B 1.1** display the availability of individual fruits by store type. The availability of all 10 fresh fruits was significantly different by store type (P<0.001). Forty and 60% of the fruits were not available in grocery stores and convenience stores, respectively. The average availability of individual fruits ranged from 81-100% in supermarkets, 0-100% in grocery stores, and 0-50% in convenience stores. **Figure 3.2 and Appendix B 1.2** display the availability of individual vegetables by store type. The most commonly surveyed vegetables were tomatoes (n = 28, 38.4% of stores), cabbage (n = 28, 38.4% of stores), and sweet peppers (n = 27, 37.0% of stores). The availability of all 10 fresh vegetables was also significantly different by store type (P<0.001). All ten vegetables were available in supermarkets and no vegetables were available in convenience stores.

The average availability of individual vegetables ranged from 25-87.5% in grocery stores.

Table 3.5 displays the average fruit and vegetable score by store type and neighborhood characteristics. On average, supermarkets had the highest score for fruits (mean ± SD = 9.6 ± 0.93) compared to grocery stores (mean ± SD = 3.1 ± 1.4) and convenience stores (mean ± SD =1.3 ± 1.3) ($P<0.001$). Supermarkets also had significantly higher scores for vegetables (mean ± SD = 9.9 ± 0.22), on average, compared to grocery stores (mean ± SD = 5.1 ± 3.0) and convenience stores (0) ($P<0.001$). Fruit scores were significantly higher in high-income than low-income neighborhood stores ($P<0.05$), but not by racial composition. Neither fruit nor vegetable scores were significantly different by racial composition.

The availability of low-fat milk was significantly different by store type for both quart and half gallon size containers ($P<0.001$). Half gallon size milk was most commonly available in food stores. All supermarkets carried low-fat half gallon milk, compared to only 62.5% of grocery stores and 36.4% of convenience stores. Whole-fat milk had exactly the same availability as low-fat milk in supermarkets and grocery stores for both size cartons, but whole-fat milk availability in convenience stores was much higher than low-fat half gallon (70.5% vs. 36.4%) and low-fat quart (54.6% vs. 4.5%) availability in convenience stores (**Figure 3.3**).

The percentage of shelf space devoted to low-fat milk was significantly different by store type ($P<0.001$). Supermarkets devoted 52.2% of shelf space to low-fat milk, compared to 23.9% in grocery stores and 11.1% in convenience stores (**Figure 3.4**). Shelf space devoted to whole-fat milk was not significantly different by store type.

Availability and number of varieties of whole-grain bread were significantly different by store type (P<0.001). All supermarkets (100%) carried whole-grain and white bread. A total of 37.5% of grocery stores and 6.8% of convenience stores carried whole-grain bread, which was lower than the availability of white bread (87.5% and 84.1%, respectively) as shown in **Figure 3.5**. On average, supermarkets carried more varieties of whole-grain bread (mean ± SD = 5.9 ± 0.22), compared to grocery stores (mean ± SD = 1.0 ± 2.1) and convenience stores (mean ± SD = 0.07 ± 0.25).

Table 3.6 shows that the healthy food availability score was significantly different by store type (P<0.001). Supermarkets, on average, had a higher score (mean ± SD = 11.4 ± 0.80) compared to grocery stores (mean ± SD = 5.3 ± 3.0) and convenience stores (mean ± SD = 1.6 ± 1.4).

Price

The prices of the most commonly surveyed fruits (apples, bananas, and oranges) were significantly different by store type (P<0.001). The prices of cucumbers, lettuce, and peppers were significantly lower in supermarkets than grocery stores (P<0.05).

There was a significant difference in the price of low-fat and whole-fat half gallon milk (P<0.001), and quart size whole-milk by store type (P<0.01). Both sizes of low-fat and whole-fat milk were least expensive, on average, in supermarkets and most expensive in convenience stores. There was a wide price range for both low-fat half gallon ($2.22-$5.09) and whole-fat half gallon milk ($2.29-$5.09) between store types (**Figure 3.8**).

Whole-grain bread was least expensive in supermarkets (mean ± SD = $2.45 ± 0.17), compared to grocery stores (mean ± SD = $2.68 ± 0.42) and convenience stores (mean ± SD = $2.62 ± 0.12), but did not reach statistical significance (P = 0.11). The

price of white bread was significantly different by store type (P<0.05), but supermarkets, on average, had the highest price of white bread (mean ± SD = $2.50 ± 0.13) compared to grocery stores (mean ± SD = $2.13 ± 0.55) and convenience stores (mean ± SD = $2.41 ± 0.26) (**Figure 3.9**).

Neighborhood Characteristics

Availability

Figure 3.6 and 3.7 show the average availability of fruits and vegetables by income level, respectively. The availability of half of the fresh produce (cantaloupe, grapes, honeydew, peaches, pears, strawberries, watermelon, cauliflower, corn, and lettuce) was significantly different by neighborhood income level (P<0.05). Stores in high-income level neighborhoods had a significantly larger percentage of shelf space devoted to low-fat milk (32.6%) than those in low-income neighborhoods (18.8%) (P = 0.02) (**Appendix B 1.3**). Neighborhood income level was also significantly associated with the number of varieties of whole-grain bread available in stores. High-income level neighborhood stores had a higher number of varieties of whole-grain bread, on average, (mean ± SD = 2.7 ± 3.0) compared to low-income level neighborhood stores (mean ± SD = 1.3 ± 2.4) (P<0.05) (**Appendix B 1.4**). Availability was not significantly different by neighborhood racial composition for any item.

Price

Neighborhood characteristics were not significantly related to the price of healthy food items. There were only a couple of significant findings. Grapes were significantly more expensive in low-income neighborhoods stores ($3.57 ± 0.93) than high-income neighborhood stores ($2.49 ± 0.91) (P = 0.02), and quart size whole-fat milk was

significantly more expensive in predominantly black neighborhood stores ($2.96 ± 1.61) compared to predominantly white ($2.19 ± 0.42) and mixed race neighborhood stores ($2.04 ± 0.41) (P = 0.03).

Store Type and Neighborhood Characteristics

Further analysis was conducted to examine any potential interaction between store type and neighborhood demographic characteristics on the availability and price of healthy food items. Overall, no significant interactions were found.

Discussion

This study analyzed the availability and price of four healthy food items (fruits, vegetables, low-fat milk, and whole-grain bread) in order to have a better understanding of the consumer nutrition environment of Leon County, FL. The findings of this study suggest that store type is the most influential factor associated with the availability and price of healthy food items. Neighborhood income level was related to the availability of some healthy food items, but not price. Neighborhood racial composition was not significantly related to the availability or price of healthy food items. If an individual's surrounding consumer nutrition environment contributes to overall health, these findings suggest that individuals that have barriers to shopping at a supermarket may have limited ability to purchase more healthful foods that promote health and prevent disease.

Higher availability of food items in supermarkets compared to other food stores has been shown in numerous studies (16, 35, 44, 45). As expected, in this study, all healthy food items had the highest availability in supermarkets, followed by grocery stores and convenience stores.

Several studies have found price differences between store types for various food items (17, 45-48). There are few studies that have analyzed the price of healthy food items, but results of past studies have consistently found that supermarkets offer healthy food items at a lower price compared to other food stores (16, 18, 32). This study found significant differences in price by store type for 6 of the 20 fresh fruits and vegetables, and half gallon low-fat milk. These items were significantly lower in price in supermarkets than grocery stores and convenience stores. Some of the insignificant differences in the price of produce by store type may be due to the time of year that the study was conducted, the limited availability of produce items in grocery stores and convenience stores, and the use of the USDA conversion factors to roughly estimate the price of produce by piece or pound. Future studies may benefit from measuring the weight and/or length of a piece of produce in order for the USDA conversion factors to be used more accurately. Although this methodology would be more labor intensive, it may allow for more precise price data to be collected.

Previous consumer nutrition environment studies (32, 34, 36, 44, 46, 47, 49-51) have focused on examining whether the poor and/or minority neighborhoods have less access to affordable foods, and have found inconsistent results. The results of this study found differences in the availability of half of the fresh produce, the percentage of shelf space devoted to low-fat milk, and the number of varieties of whole-grain bread by income level. No price differences were found between high- and low-income level neighborhoods. The availability and price of healthy food items were not significantly different when comparing between the three neighborhood race groups.

Although it appears that stores in predominantly black and low-income neighborhoods in Leon County do provide similar availability and prices of healthy food items compared to those in their counterparts, poor and minority neighborhoods have less access to supermarkets that provide a higher availability and lower prices of healthy food items. Supermarkets are fairly equally distributed between high- and low-income level neighborhoods (9 vs. 11, respectively), but there is a disproportionate distribution of supermarkets by neighborhood racial composition. Zero supermarkets are available in predominantly black neighborhoods, compared to 17 in mixed race and 3 in predominantly white neighborhoods (Rigby et al., unpublished). The disproportionate distribution of supermarkets by differing neighborhood demographic characteristics found in this study is similar to other studies (18, 52), which may significantly influence the purchasing and consumption of healthy foods among these populations. Therefore, although it appears that food stores provide similar consumer nutrition environments between neighborhoods, having less access to supermarkets that provide a large selection of affordable healthy foods, may influence the ability of consumers to purchase healthy items. These findings are different from a previous study showing that supermarket offerings were different between predominantly black Baltimore City and predominantly white Baltimore City (24). The inner-city store offered fewer options of healthy food items. These findings may have resulted from the inherent errors of using InfoUSA, a commercial food list database used in the study. These errors may have led to the omission or misclassification of stores.

The results of this study should be interpreted with caution. As with any consumer nutrition environment study, the findings of this study cannot be easily generalized or

compared with those of previous studies for the following reasons. First, this study used census tracts to define neighborhoods. Neighborhoods are often defined as administrative bound (i.e. ZIP codes, census collectors' districts, and units representing the shortest shopping distance for residents). Although research has found that residents' definition of a neighborhood is comparable to a census tract, most neighborhoods usually include parts of at least two census tracts (53). Making associations between neighborhoods and their accompanying nutrition environment relies on the assumptions of understanding where people shop and how far they will travel for food (54). When defining neighborhoods, it is critical to incorporate various places/contexts where an individual's food related behaviors occur, including in and around areas of work and school.

Second, this study used census tract-level demographic and economic characteristics to determine neighborhood wealth and racial composition. Similar to Morland et al., we defined predominantly black as >80% of the population (34). Other studies have defined predominantly black as >75% (33), and one study used >50% nonwhite and/or Hispanic populations to define a minority population (36).

Third, a broad range of definitions of store types have been used in previous studies. This study used the Florida Department of Agriculture and Consumer Services' Administrative Code for food permits, which is not exactly the same to other definitions commonly used such as the Standard Industry Classification (SIC), InfoUSA, North American Industry Classification System (NAICS), ReferenceUSA, and the Food Marketing Institute. Each source has its own strengths and limitations, and depending on which source is chosen, the results of a study may vary, which may explain why the

availability and price of healthy food items by neighborhood characteristics was found to be inconsistent with previous findings.

This study is unique because it was initiated, designed, and conducted by health department administrators in order to gather information about their county's consumer nutrition environment, with the intention of creating and implementing policies and interventions to improve the county's consumer nutrition environment. Administrators adopted the best available methodology by using the validated, comprehensive NEMS-S tool and related training and protocols. Administrators also collaborated with researchers who developed and validated the NEMS-S on the modification and validation of the NEMS-S tool to best fit their research needs and to uphold the purpose and integrity of the original tool.

This study has additional strengths. The store audit data in this study focuses on the availability and price of foods that are defined by authoritative guidelines and recommendations as foods essential to promoting health and preventing disease. The availability and price of healthy foods, especially low-fat milk and whole-grain bread, have not been specifically analyzed in many studies, but past studies have found greater availability of healthy foods in supermarkets compared to other food stores (18, 26, 35, 55, 56). Although the study was conducted in a single metropolitan county and surveyed a small number of stores at one point in time, research has proven that one observation of an area's consumer nutrition environment is sufficient to provide adequate data (57).

Despite the use of the NEMS-S, a standardized and validated tool, this tool contains flaws that may affect how effectively and efficiently this tool can be used by practitioners to better understand consumer nutrition environments. There is a wide

variation in the comprehensiveness of different tools (21). The NEMS-S is a lengthy, comprehensive tool, which may make the surveying process more challenging. Because of the numerous food measures to survey and protocols to remember, a surveyor may forget or neglect to use the correct methodology for certain food measures, leading to errors in data collection. Other potential sources of error are the limitations in the methodology related to recording units of produce. For example, some surveyors recorded one "piece" as the units representing one bag of grapes, but there is no way of knowing the amount of grapes in the bag. By not knowing the accurate weight of the grapes, it was not possible to accurately assess price. Similar problems arose when surveying watermelons. One "piece" was recorded for the units, but in the comments section, surveyors noted that the watermelon was "mini-size," which again makes it difficult to accurately assess price. Another aspect of this tool to interpret cautiously is the price of bread. The NEMS-S suggests that Nature's Own and Sara Lee brand breads be recorded first, but these breads are typically more expensive than the store brands that consumers may purchase. Health professionals can use this data to get an estimate of bread price in certain neighborhoods and store types, but it is also important to educate consumers that there are less expensive options that are equally nutritious.

Regardless of the limitations, the NEMS-S tool and methodology can be used to provide nutrition professionals with a better understanding of the consumer nutrition environment of certain neighborhoods and this knowledge can be used to tailor nutrition education to the specific needs of a population. Nutrition educators and professionals can also use the NEMS-S to find limitations and barriers within neighborhoods and use the

information to advocate for various policies and programs to be implemented in an area that will benefit the health and well-being of consumers.

Implications for Research and Practice

The findings of this study have several research, practice, and policy implications. Nutrition environments are multilevel and constantly changing. Nutrition environment research is in its infancy and requires more concrete conceptual models, validated measurements, and strong study designs. There are numerous tools that have been used to study nutrition environments, but most have not been validated or standardized. The findings of this study suggest that even a validated comprehensive tool may still need to be refined to be used by practitioners. Further research needs to be done to develop a validated tool or fine-tune the existing tools, and determine the best possible methodology that can be used by researchers as well as practitioners across the country to collect accurate and useful consumer nutrition environment data.

This study suggests that inequalities in the access to supermarkets and healthy food exist between advantaged and disadvantaged neighborhoods. Various solutions to improve the access to healthy food can be considered. For example, public health and nutrition professionals as well as neighborhood residents need to advocate for the recruitment of large retail food stores to disadvantaged neighborhoods. Adding supermarkets would not only increase the amount of affordable, healthy foods to residents, but would also result in further economic benefits including an additional opportunity for employment, increasing the local tax base, and attracting other food retail organizations to build in these neighborhoods (58). For transit dependent areas, where transportation may be a barrier for individuals to shop at supermarkets, increasing

affordable transportation to large food stores would be helpful (59, 60). Another program that can improve the access to produce in disadvantaged neighborhoods would be a farmer's market program. Farmer's markets can be an important access point to high quality, affordable healthy foods such as fresh produce, breads, and eggs (60). Community gardens may be another alternative resource to healthy produce that can be initiated and sustained by residents of neighborhoods.

Research has shown that barriers and limitations within nutrition environments negatively influences an individual's eating behavior. Employing the best available tool and methodology, nutrition environment studies can be used to strengthen the research base related to food deserts and food insecurity. Nutrition environment research can be used by policy makers and community leaders to help advocate for and enforce improvements to be made in environments that are lacking adequate access to affordable, healthful food. Nutrition educators can also use information collected from nutrition environment studies to better inform consumers about the benefits of eating healthy foods and how to practically attain these foods from their surrounding nutrition environment.

Table 3.1: Food store classifications

Store Type	Definition
Supermarkets	A retail food store stocking a wide variety of foods and engaged in retail food processing which contains five or more check-out registers or 15,000 or greater total square footage, including display, preparation and storage areas.
Grocery stores	A retail food store stocking a wide variety of foods and engaged in retail food processing which contains four or fewer check-out registers and less than 15,000 total square footage, including display, preparation and storage areas.
Convenience stores	A business that is engaged primarily in the retail sale of groceries or motor fuels or special fuels and may offer food services limited to coffee from urns, or iced or frozen drinks, and no retail food processing.
Convenience stores with limited food service	A convenience store where food is prepared and intended for individual portion service, but limited to the display of snack foods or pastries, and/or heating or cooking of hot dogs, sausages, prepackaged pizza or meat pastries, regardless of whether consumption is on or off the premises or whether there is a charge for the food, but without retail food processing.
Convenience stores with significant food service	A convenience store that has retail food processing activities consisting of on-site cooking or other preparation of hot entrees, chicken (fried, roasted or grilled), sandwiches, salads, or desserts for consumption on or off the premises. The term also applies to such foods brought to a location for sale on individual customer order or by buffet-style display.

Source: Florida Department of Agriculture and Consumer Services Food Administrative Code

Table 3.2: Fruit and vegetable conversion factors

	Size	Approximate pieces per pound (453.59 g)
Fruit		
Apples	Medium: 3” diameter (182 g)	3
Bananas	Large: 8-8 7/8” long (136 g)	3
Cantaloupe	Large: 6.5” diameter (814 g)	0.5
Honeydew	6-7” diameter (1280 g)	0.35
Oranges	2 5/8” diameter (131 g)	3.5
Pears	Medium (178g)	2.5
Vegetable		
Broccoli	Bunch (608 g)	0.75
Cabbage	Medium head: 5.75” diameter (908 g)	0.50
Celery	Medium stalk: 7.5”-8” long (40 g)	11-1/3
Corn	Medium ear: 6.75-7.5” long (90 g)	5
Cucumbers	8.25” long (301 g)	1.5
Lettuce	Head (360 g)	1.25
Sweet peppers	Medium: 2.5” diameter (119 g)	4
Tomatoes	Medium: 2.6” diameter (123 g)	4

Source: United States Department of Agriculture, Nutrient Data Laboratory.

Table 3.3: Distribution and percentage of store types by income and racial composition of neighborhoods

Neighborhood Classification n (% of store type)	**Total Stores** (n = 73)	**Supermarkets** (n = 21)	**Grocery stores** (n = 8)	**Convenience stores** (n = 44)
Income level[e]				
High-income[a]	29 (39.7%)	13 (61.9%)	1 (12.5%)	15 (34.1%)
Low-income[a]	44 (60.3%)	8 (38.1%)	7 (87.5%)	29 (65.9%)
Racial composition				
Predominantly white[b]	18 (24.6%)	5 (23.8%)	0	13 (29.6 %)
Mixed race[c]	47 (64.4%)	16 (76.2%)	6 (75.0%)	25 (56.8 %)
Predominantly black[d]	8 (11.0%)	0	2 (25.0%)	6 (13.6 %)

[a]Census tracts were dichotomized based on the percentage of the population below poverty level
[b]Predominantly white: <80% of population black
[c]Mixed race: 20-80% of population black
[d]Predominantly black: >80% of population black
[e] $P<0.05$

Table 3.4: Distribution and percentage of stores by income and racial composition of neighborhoods[e]

n (% of row)	**Income level** [a]	
Racial composition	High-income level (n = 29)	Low-income level (n = 44)
Predominantly white (n = 18)[b]	14 (77.8%)	4 (22.2%)
Mixed race (n = 47)[c]	15 (31.9%)	32 (68.1%)
Predominantly black (n = 8)[d]	0	8 (100.0%)

[a]Census tracts were dichotomized based on the percentage of the population below poverty level
[b]Predominantly white: <80% of population black
[c]Mixed race: 20-80% of population black
[d]Predominantly black: >80% of population black
[e]P<0.001

Table 3.5: The average fruit and vegetable score by store type

	Store Type[g]		
Average fruit score Mean (SD) (Range: 0-10)	**Supermarket** (n = 21)	**Grocery store** (n = 8)	**Convenience store** (n = 44)
All stores	9.6 (0.93)	3.1 (1.4)	1.3 (1.3)
Racial Composition			
Predominantly white (n = 18)[b]	9.8 (0.45)	--[e]	2.0 (1.2)
Mixed race (n = 47)[c]	9.5 (1.0)	2.8 (1.3)	1.0 (1.3)
Predominantly black (n = 8)[d]	--[e]	4.0 (1.4)	0.83 (1.3)
Income Level[h]			
High-income (n = 29)[a]	9.6 (0.87)	2.0 (0)	1.5 (1.4)
Low-income (n = 44)[a]	9.5 (1.1)	3.3 (1.4)	1.2 (1.3)
Average vegetable score Mean (SD) (Range: 0-10)	**Supermarket** (n = 21)	**Grocery store** (n = 8)	**Convenience store** (n = 44)
All stores	9.9 (0.22)	5.1 (3.0)	0[f]
Racial Composition			
Predominantly white (n = 18)[b]	10.0 (0)	--[e]	0[f]
Mixed race (n = 47)[c]	9.9 (0.25)	5.3 (2.7)	
Predominantly black (n = 8)[d]	--[e]	4.5 (5.0)	0[f]
Income Level			
High-income (n = 29)[a]	10.0 (0)	3.0 (0)	0[f]
Low-income (n = 44)[a]	9.9 (0.35)	5.4 (3.1)	0[f]

[a]Census tracts were dichotomized based on the percentage of the population below poverty level
[b]Predominantly white: <80% of population black
[c]Mixed race: 20-80% of population black
[d]Predominantly black: >80% of population black
[e]No score due to no stores surveyed in a particular neighborhood characteristic
[f]No score due to lack of available vegetables
[g]Fruit and vegetable scores by store type ($P<0.001$)
[h]$P<0.05$

Table 3.6: The average healthy food availability score by store type

Store type[a]	**Healthy food availability score** (Range: 0-12) Mean (SD)
Supermarket	11.4 (0.80)
Grocery store	5.3 (3.0)
Convenience store	1.6 (1.4)

Low-fat milk available = 2 pts
Percentage of low-fat milk ≥ 50% = 1 pt
<5 varieties of fruit = 1 pt
5-9 varieties of fruit = 2 pts
>9 varieties of fruit = 3 pts
Vegetables: same scoring as fruits
Whole-grain bread available = 2 pts
>2 varieties of whole-grain bread = 1 pt
[a]P<0.001

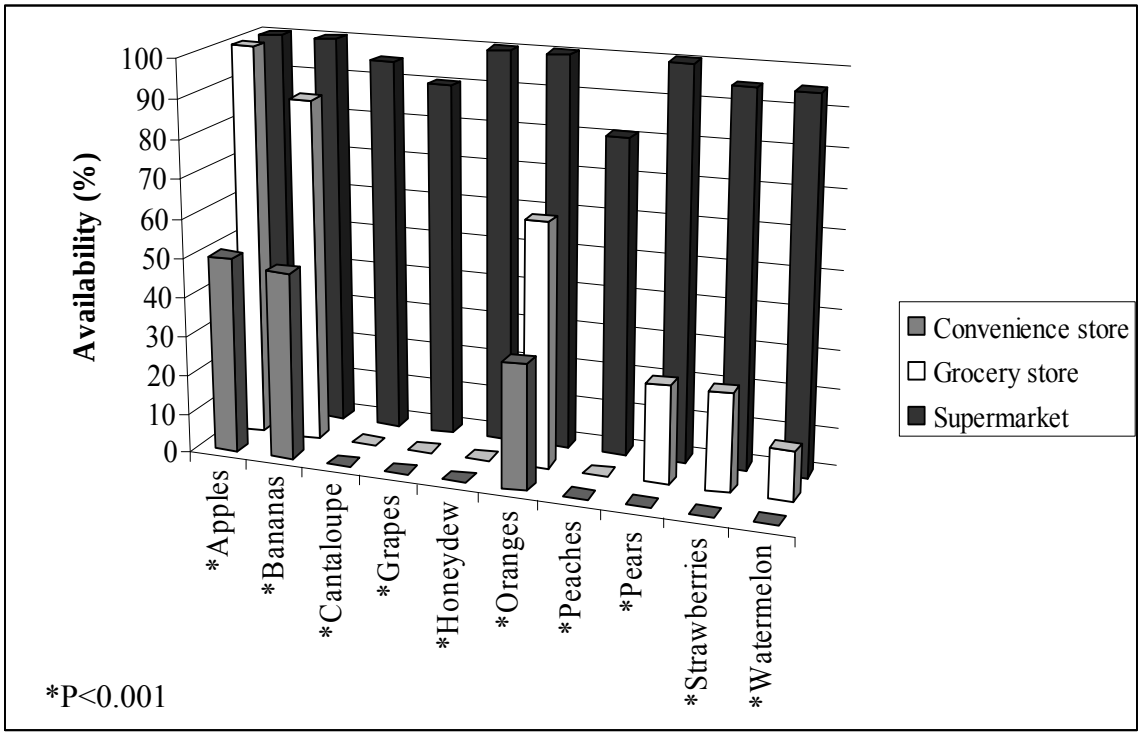

Figure 3.1: The availability of individual fruits by store type

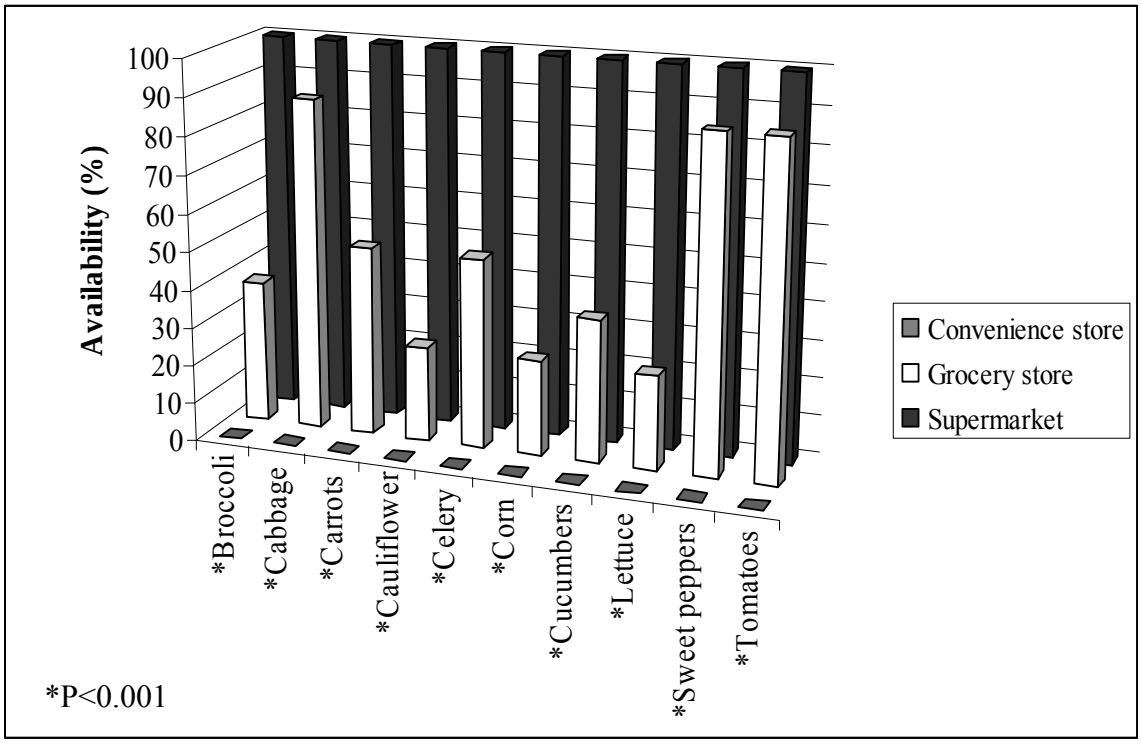

Figure 3.2: The availability of individual vegetables by store type

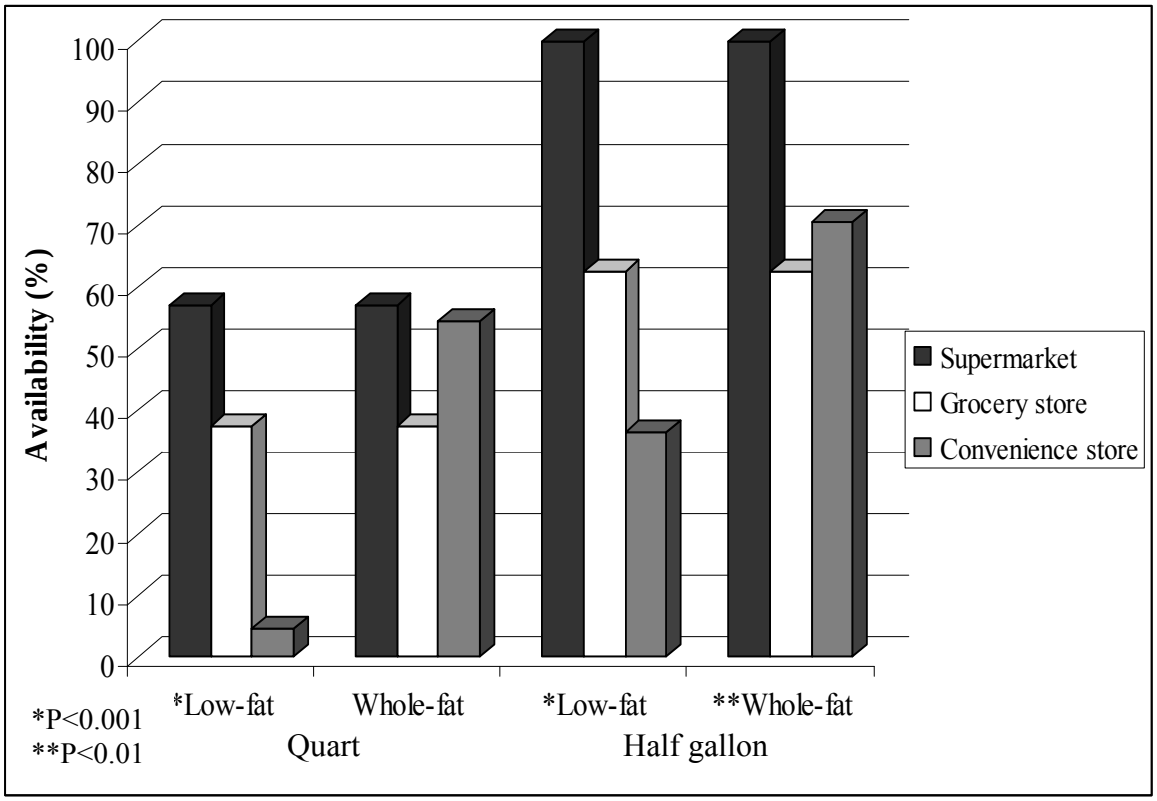

Figure 3.3: The availability of low-fat and whole-fat milk by store type

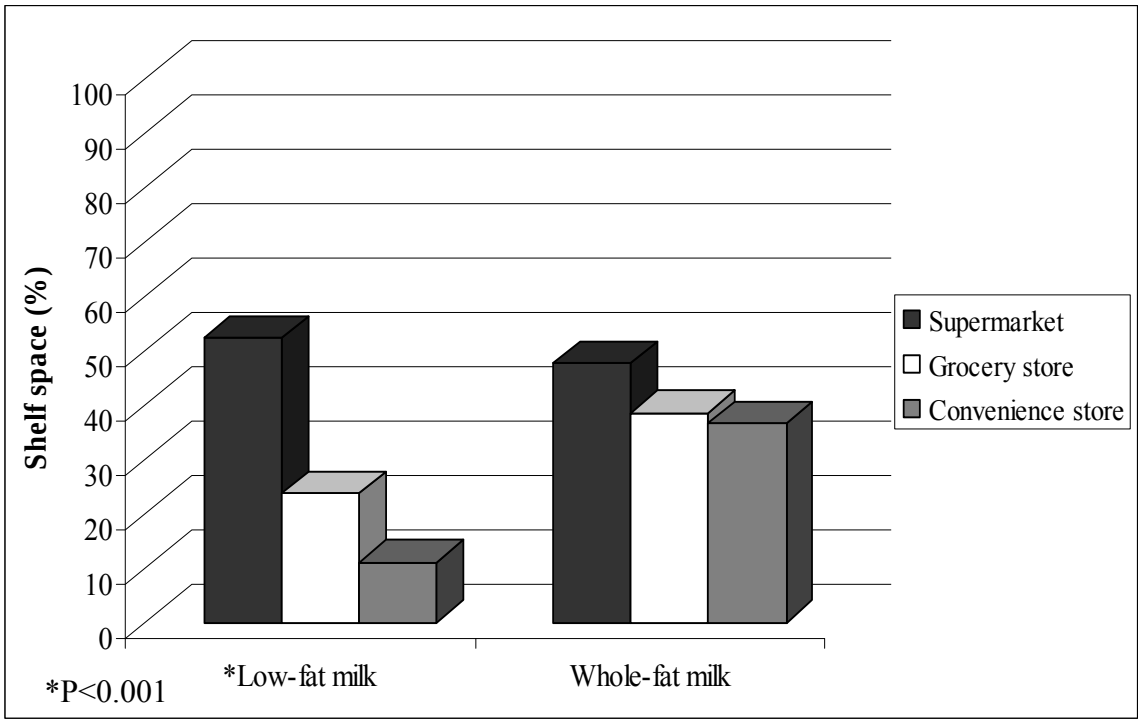

Figure 3.4: The percentage of shelf space devoted to half gallon low-fat and whole-fat milk by store type

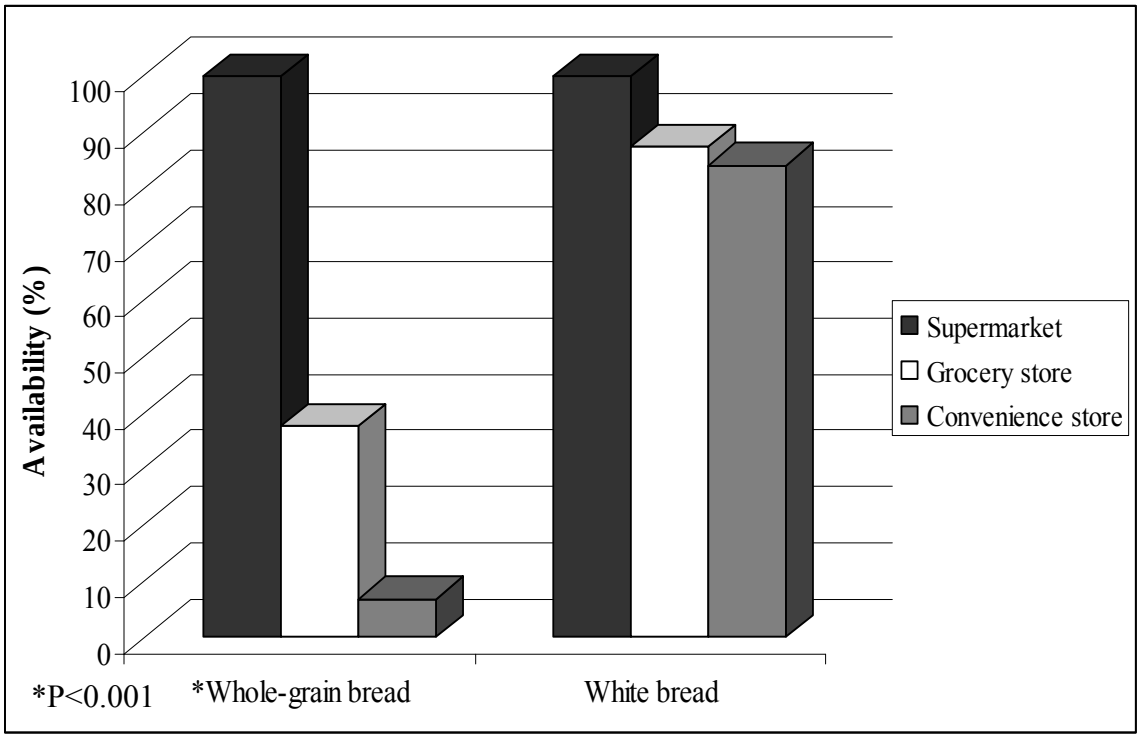

Figure 3.5: The availability of whole-grain and white bread by store type

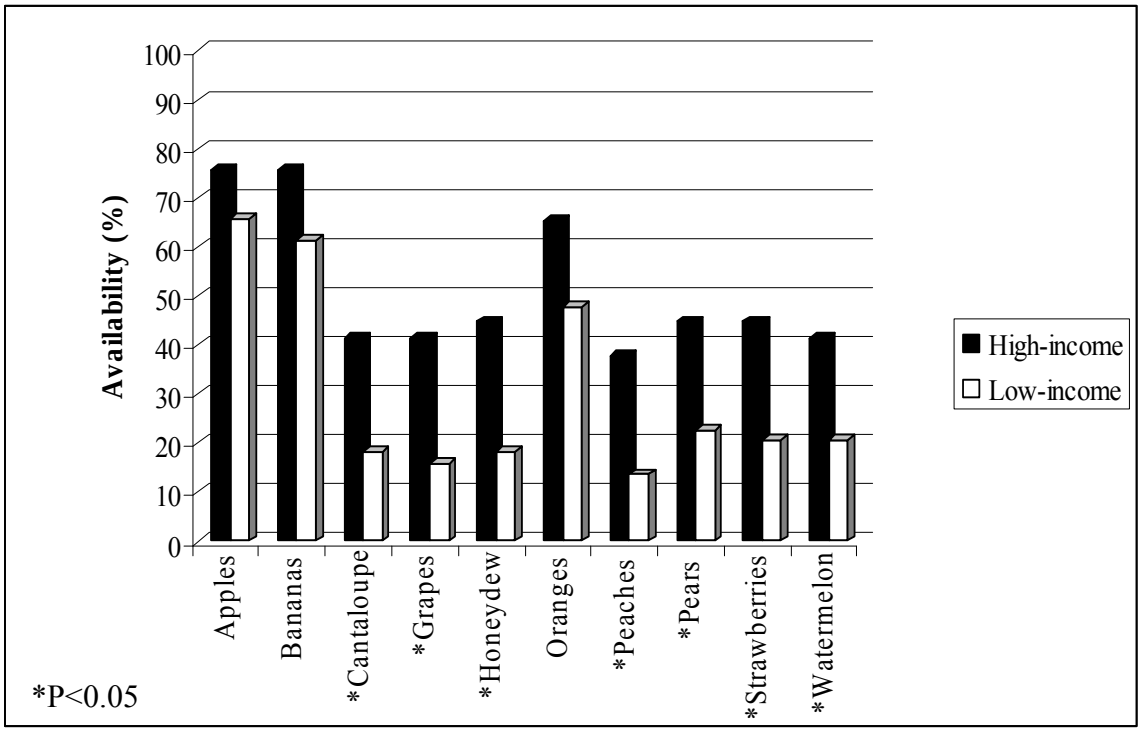

Figure 3.6: The availability of individual fruits by income level

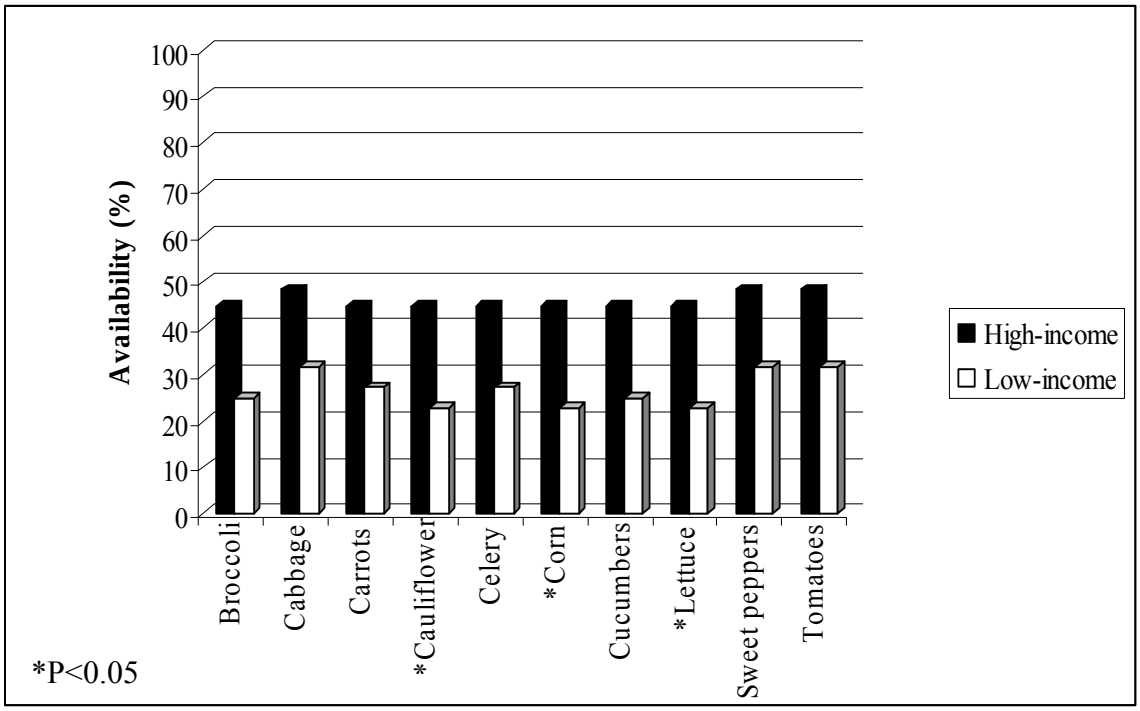

Figure 3.7: The availability of individual vegetables by income level

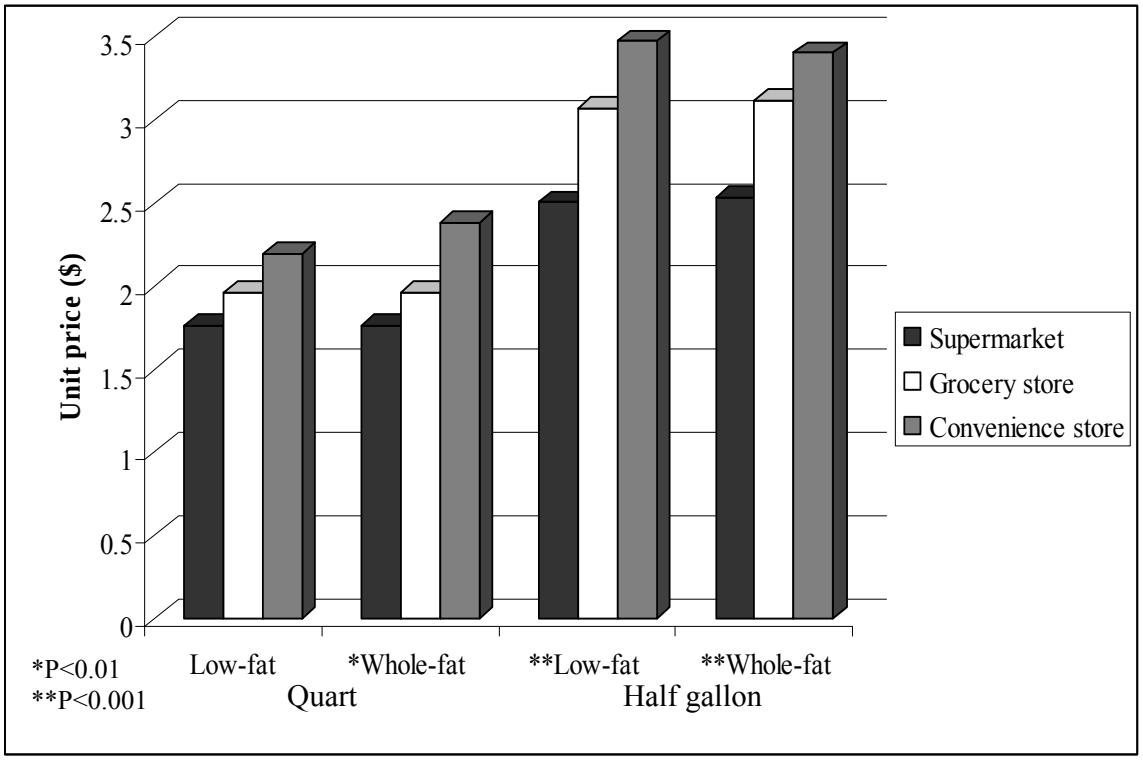

Figure 3.8: The price of low-fat and whole-fat milk by store type

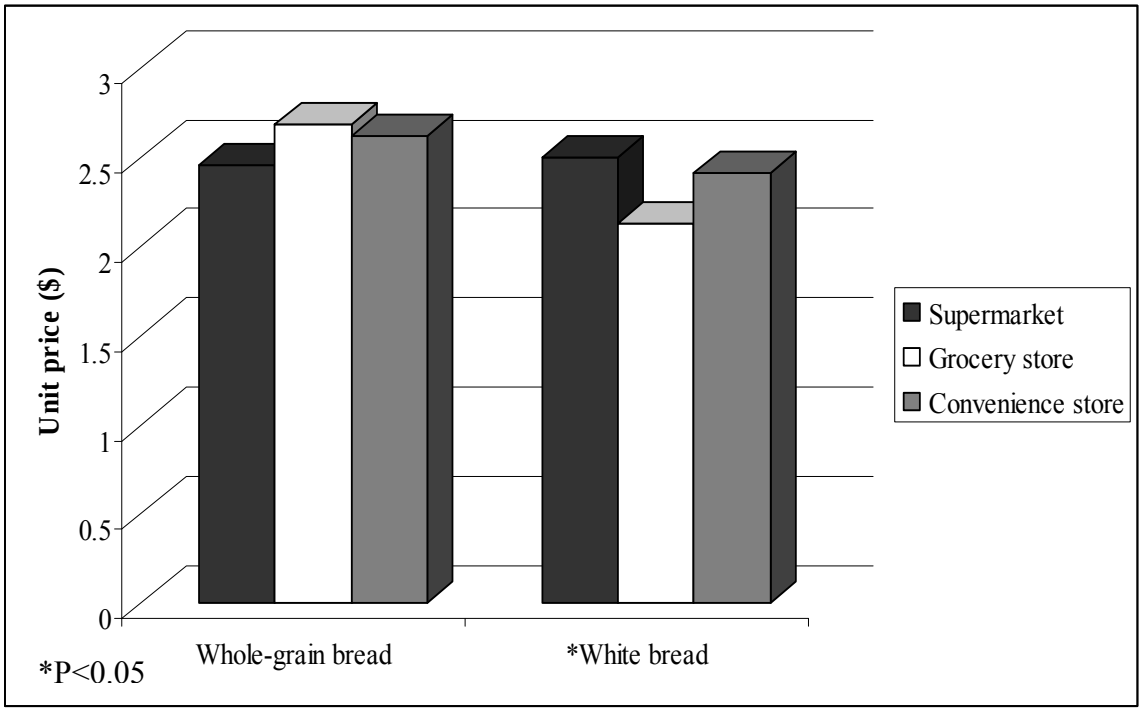

Figure 3.9: The price of whole-grain and white bread by store type

CHAPTER 4

CONCLUSIONS

This study analyzed the availability and price of four healthy food items (fruits, vegetables, low-fat milk, and whole-grain bread) by store type, and neighborhood income level and racial composition in Leon County, FL using the validated Nutrition Environment Measures Survey in Stores (NEMS-S). We hypothesized that the availability and price of healthy food items would differ by store type and neighborhood demographic characteristics. The specific aims were to: 1) determine if the availability and price of healthy food items differed by store type, 2) determine if the availability and price of healthy food items differed between low-income and high-income neighborhoods, 3) determine if the availability and price of healthy food items differed between predominantly black, predominantly white, and racially mixed neighborhoods, and 4) determine if an interaction existed between store type and neighborhood characteristic on the availability and price of healthy food items.

The major results of this study found that store type was the most influential factor affecting the availability and price of healthy food items. The availability of each of the 10 fresh fruits and 10 fresh vegetables and low-fat milk and whole-grain bread was significantly different by store type (all $P<0.001$). Greater availability of food items in supermarkets compared to other food stores has been consistently found across consumer nutrition environment studies (16, 35, 44, 45).

The price of only 6 out of the 20 fresh produce items was different by store type ($P<0.05$). Low availability of fresh produce in grocery stores and convenience stores and the use of the USDA conversion factors to roughly estimate prices of produce by pound or piece may have influenced price data. Because the study was conducted during four consecutive months, the time of year may have also influenced the price of certain fresh produce. The price of low-fat half gallon milk was significantly different by store type ($P<0.001$). There are even fewer studies that analyze the price of healthy food items, but results of past studies have consistently found that the price of food items is significantly less expensive in supermarkets compared to other food stores (16, 18, 32).

Previous consumer nutrition research has found conflicting results regarding the availability and price of food items in advantaged and disadvantaged neighborhoods (16, 32, 34, 36, 44, 47, 49). The availability of certain fresh produce ($P<0.05$), the shelf space devoted to low-fat milk ($P = 0.02$), and the number of varieties of whole-grain bread ($P<0.05$) were significantly different by income level. No price data was significantly different by income level. In discordance with our hypothesis, the availability and price of healthy food items was not significant different by neighborhood racial composition. These findings may be explained by the way store types, neighborhoods, and neighborhood demographic characteristics were defined in this study. Because of the numerous ways that have been used in previous research to define these variables, studies may yield inconsistent results.

Although this study appears to suggest that stores in low-income and predominantly black neighborhoods in Leon County provide comparable availability and prices of healthy food items compared to those in their counterparts, these disadvantaged

neighborhoods have limited access to supermarkets, which may lead to lower availability of affordable, healthy foods in these neighborhoods. Low-income neighborhoods in Leon County have fewer supermarkets than high-income (4 vs. 16, respectively) and predominantly black neighborhoods have fewer supermarkets than predominantly white (0 vs. 3, respectively). The difference in available supermarkets may influence the foods that the residents of these neighborhoods are able to purchase, which consequently influences the diet quality of these individuals.

It is essential to study nutrition environments so policy changes and programs can be implemented within disadvantaged neighborhoods. Public health and nutrition professionals, as well as residents need to advocate for changes to be made such as attracting food retail organizations to neighborhoods in need, implementing an efficient alternate transportation system for individuals living in neighborhoods with limited access to supermarkets, and initiating neighborhood programs such as farmer's markets and community gardens as an alternate method to bringing affordable healthy foods to these neighborhoods.

The results of this study suggest that store type is the most influential factor affecting the availability and price of healthy food items; thus, individuals living in neighborhoods with limited access to supermarkets may not have the opportunity to buy foods that support a nutritious diet. Further research is needed using a validated, reliable store audit tool, to examine the influences of neighborhood demographic characteristics on the availability and price of healthy food items. It is essential to understand nutrition environments so that policy changes can be made and programs can be implemented to improve the health and well-being of consumers.

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APPENDICES

APPENDIX A:

NUTRITION ENVIRONMENT MEASURES SURVEY IN STORES (NEMS-S)

Nutrition Environment Measures Survey (NEMS)
Food Outlet Cover Page

Rater ID: |__|__|

0 Grocery Store
0 Convenience Store
0 Other_____

Store ID: |__|__|__|-|__|-|__|__|-|__|__|__|

Date: __/__/__
Month Day Year

Start Time: |__|__| : |__|__|
0 AM
0 PM

End Time: |__|__| : |__|__|
0 AM
0 PM

Number of cash registers: |__|__|

Comments: _____

_____

Nutrition Measures Survey (NEMS)
Cover Page

Measure Complete

Nutrition Environment Measures Survey (NEMS)
Measure #1: MILK

Rater ID: ___ Store ID: ___-___-___-___

Date: ___/___/___ (Month Day Year)

0 Grocery Store **0** Convenience Store **0** Other

Marking Instructions

Please use a pencil or blue or black ink Correct ● Incorrect ✓ ⊗ ⊖ ⊙

A. Reference Brand

1. Store brand (preferred) **0** yes **0** no

2. Alternate Brand Name ___

Comments: _____

_____

B. **Availability** Comments:

1. a. Is low-fat (skim or 1%) available? **0** Yes **0** No _____

   b. If not, is 2% available? **0** Yes **0** No **0** NA _____

2. **Shelf Space:** (measure only if low fat milk is available)

Type	Pint (16 oz)	Quart (32 oz)	Half gallon (64 oz)	Gallon (128 oz)
a. Skim	___	___	___	___
b. 1%	___	___	___	___
c. Whole	___	___	___	___

C. **Pricing:** All items should be same brand Comments:

1. Whole milk, quart $ ___.___ _____
2. Whole milk, half-gal. $ ___.___ _____
3. Skim or 1% milk, quart (Lowest available) $ ___.___ _____
4. Skim or 1% milk half-gal. (Lowest available) $ ___.___ _____

Alternate Items:

5. 2%, quart $ ___.___ **0** N/A _____
6. 2%, half gal. $ ___.___ **0** N/A _____

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #2: FRUIT

Rater ID: ☐☐ Store ID: ☐☐☐-☐☐-☐☐☐-☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year)

0 Grocery Store **0** Convenience Store **0** Other

Availability and Price

Produce Item		Available Yes	Available No	Price	Unit #	Unit pc	Unit lb	Quality A	Quality UA	Comments
1. Bananas		**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
2. Apples	**0** Red delicious	**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
	0 _____									
3. Oranges	**0** Navel	**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
	0 _____									
4. Grapes	**0** Red Seedless	**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
	0 _____									
5. Cantaloupe		**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
6. Peaches		**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
7. Strawberries		**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
8. Honeydew Melon		**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
9. Watermelon	**0** Seedless	**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
	0 _____									
10. Pears	**0** Anjou	**0**	**0**	$☐.☐☐	☐	**0**	**0**	**0**	**0**	
	0 _____									

11. Total Types: (count # of yes responses) ☐☐

Availability and Price

Canned Produce Item	Available Yes	No	N/A	Price	Ounces	Comments
Healthier option:						
12. Fruit cocktail canned in fruit juice or water, 15oz.	0	0		$ ☐. ☐☐	☐☐	_____
Alternate Item:						
13. ☐☐☐☐☐☐☐☐☐☐	0	0	0	$ ☐. ☐☐	☐☐	_____

14. **# of varieties of fruit canned in fruit juice or water** 0 0 0 1 0 2 0 3 0 4 0 5 0 6+

Regular option:						
15. Fruit cocktail canned in syrup, 15oz.	0	0		$ ☐. ☐☐	☐☐	_____
Alternate Item:						
16. ☐☐☐☐☐☐☐☐☐☐	0	0	0	$ ☐. ☐☐	☐☐	_____

---

17. # of varieties of frozen fruit 0 0 0 1 0 2 0 3 0 4 0 5 0 6+

Measure Complete

Nutrition Environment Measures Survey (NEMS)
Measure #3: VEGETABLES

Rater ID: Store ID: - - - -

Date: / / Month Day Year

0 Grocery Store **0** Convenience Store **0** Other

Availability and Price

Produce Item		Available Yes	Available No	Price	#	Unit pc	Unit lb	Quality A	Quality UA	Comments
1. Carrots	**0** 1 lb bag	**0**	**0**	$.		**0**	**0**	**0**	**0**	
	0 _____									
2. Tomatoes	**0** Loose	**0**	**0**	$.		**0**	**0**	**0**	**0**	
	0 _____									
3. Sweet Peppers	**0** Green bell	**0**	**0**	**$** .		**0**	**0**	**0**	**0**	
	0 _____									
4. Broccoli	**0** Bunch	**0**	**0**	$.		**0**	**0**	**0**	**0**	
	0 _____									
5. Lettuce	**0** Green leaf	**0**	**0**	$.		**0**	**0**	**0**	**0**	
6. Corn		**0**	**0**	$.		**0**	**0**	**0**	**0**	
7. Celery		**0**	**0**	$.		**0**	**0**	**0**	**0**	
8. Cucumbers	**0** Regular	**0**	**0**	$.		**0**	**0**	**0**	**0**	
	0 _____									
9. Cabbage	**0** Head	**0**	**0**	$.		**0**	**0**	**0**	**0**	
	0 _____									
10. Cauliflower		**0**	**0**	$.		**0**	**0**	**0**	**0**	
11. Greens	**0** Collards	**0**	**0**	$.		**0**	**0**	**0**	**0**	
	0 _____									

12.Total Types: (count # of yes responses)

Availability and Price

Canned Produce Item	Available Yes	No	N/A	Price	Ounces	Comments
12. Canned carrots, 15 oz.	0	0		$ ☐ . ☐	☐	_____
Alternate Item:						
13. ☐	0	0	0	$ ☐ . ☐	☐	_____

14. # of varieties of canned vegetables 0 0 0 1 0 2 0 3 0 4 0 5 0 6+

15. # of varieties of frozen vegetables 0 0 0 1 0 2 0 3 0 4 0 5 0 6+

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #4: GROUND BEEF and MEAT ALTERNATIVES

Rater ID: ☐☐ Store ID: ☐☐☐-☐☐-☐☐☐-☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year)

0 Grocery Store **0** Convenience Store **0** Other

Availability and Price

Item	Available Yes	No	N/A	Price/lb.	Comments
Healthier Option:					
1. Lean ground beef, **90% lean, 10% fat** (Ground Sirloin)	**0**	**0**		$ ☐.☐☐	_____ _____
Alternate Items:	**Yes**	**No**	**N/A**		
2. Lean ground beef (<10% fat)	**0**	**0**	**0**	$ ☐.☐☐	_____
☐☐ **% fat**					_____
3. Ground Turkey (≤ 10% fat)	**0**	**0**	**0**	$ ☐.☐☐	_____
☐☐ **% fat**					_____

4. # of varieties of lean ground beef (≤ 10% fat) **0** 0 **0** 1 **0** 2 **0** 3 **0** 4 **0** 5 **0** 6+

Regular option:

5. Standard ground beef, **80% lean, 20% fat**	**0**	**0**		$ ☐.☐☐	_____ _____
Alternate Item:	**Yes**	**No**	**N/A**		
6. Standard alternate ground beef, if above is not available	**0**	**0**	**0**	$ ☐.☐☐	_____ _____
☐☐ **% fat**					

Availability and Price

Item	Available Yes	No	Price	Ounces	Comments
Healthier option:					
7. Bumble Bee chunk light tuna packed in water, 6 oz. can	0	0	$ __.__	__	
Alternate Brand:					
8. _____	0	0 0	$ __.__	__	
Regular option:					
9. Bumble Bee chunk light tuna packed in oil, 6 oz can	0	0	$ __.__	__	
Alternate Brand:					
10. _____	0	0 0	$ __.__	__	

Availability and Price

Item	Available Yes	No	Price	Ounces	Comments
Healthier option:					
9. Reduced fat peanut butter, 18 oz.	0	0	$ __.__	__	
Regular option:					
10. Regular peanut butter, 18 oz.	0	0	$ __.__	__	

11. # of varieties of canned and dry beans, peas, and lentils 0 0 0 1 0 2 0 3 0 4 0 5 0 6+

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #5: HOT DOG

Rater ID: ☐☐ Store ID: ☐☐☐-☐☐-☐☐☐-☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year)

0 Grocery Store **0** Convenience Store **0** Other

Availability and Price

Item	Available Yes	No	N/A	Price/pkg.	Comments
Healthier Option:					
1. Oscar Mayer 98% Fat-free Wieners (turkey/beef) 0g fat	**0**	**0**		$ ☐.☐☐	_____
Alternate Items: (≤ 9 g Fat)	**Yes**	**No**	**N/A**		
2. Fat-free other brand 0g fat ☐☐☐☐☐☐☐☐☐☐ (Brand name)	**0**	**0**	**0**	$ ☐.☐☐ ☐☐☐ Kcal/svg	_____
3. Light Wieners (turkey/pork)	**0**	**0**	**0**	$ ☐.☐☐	_____
4. Light beef Franks, (about 1/3 less calories 50% less fat)	**0**	**0**	**0**	$ ☐.☐☐	_____
5. Turkey Wieners (about 1/3 less fat)	**0**	**0**	**0**	$ ☐.☐☐	_____
6. Other ☐☐☐☐☐☐☐☐☐☐	**0**	**0**	**0**	$ ☐.☐☐	☐☐ oz pkg ☐☐ Hot dogs/pkg ☐☐ g fat ☐☐ kcal/svg _____
Regular option:					
7. Oscar Mayer Wieners (turkey/pork/chicken)-regular 12g fat	**0**	**0**		$ ☐.☐☐	
Alternate Items: (≥ 10g fat)					
8. Beef Franks (regular) 13 g fat	**0**	**0**	**0**	$ ☐.☐☐	
9. Other ☐☐☐☐☐☐☐☐☐☐	**0**	**0**	**0**	$ ☐.☐☐	☐☐ oz pkg ☐☐ Hot dogs/pkg ☐☐ g fat ☐☐ kcal/svg

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #6: FROZEN DINNERS

Rater ID: ☐☐ Store ID: ☐☐☐☐-☐☐-☐☐☐☐-☐☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year) **0** Grocery Store **0** Convenience Store **0** Other

A. Reference Brand

1, Stouffer's brand (preferred) **0** Yes **0** No

2. Alternate brand (with reduced-fat dinners available) Brand Name: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Comments: _____

_____

B. Availability

1. Are reduced-fat frozen dinners available? (≤ 9 g fat/8-11 oz.) **0** Yes **0** No

Shelf Space: (measure only if reduced-fat frozen dinners are available)

2. Reduced-fat dinners/regular dinners: Proportion **0** <=10% **0** 11-33% **0** 34-50% **0** 51%+

C. Pricing (All items must be same brand)

Reduced-Fat Dinner	**Price/Pkg**	**Regular Dinner**	**Price/Pkg**	**Comments**
1. Lean Cuisine **Lasagna**	$☐☐.☐☐	Stouffer's **Lasagna**	$☐☐.☐☐	_____
☐☐ oz ☐☐☐ K cal. ☐☐ g fat		☐☐ oz ☐☐☐ K cal. ☐☐ g fat		
2. Lean Cuisine **Roasted Turkey Breast**	$☐☐.☐☐	Stouffer's **Roasted Turkey Breast**	$☐☐.☐☐	_____
☐☐ oz ☐☐☐ K cal. ☐☐ g fat		☐☐ oz ☐☐☐ K cal. ☐☐ g fat		
3. Lean Cuisine **Meatloaf**	$☐☐.☐☐	Stouffer's **Meatloaf**	$☐☐.☐☐	_____
☐☐ oz ☐☐☐ K cal. ☐☐ g fat		☐☐ oz ☐☐☐ K cal. ☐☐ g fat		
Reduced-Fat Alternate (≤9 g fat)	**Price/Pkg**	**Regular Alternate** (≥10g fat)	**Price/Pkg**	**Comments**
4. Other _____	$☐☐.☐☐	Other _____	$☐☐.☐☐	_____
☐☐ oz ☐☐☐ K cal. ☐☐ g fat		☐☐ oz ☐☐☐ K cal. ☐☐ g fat		
5. Other _____	$☐☐.☐☐	Other _____	$☐☐.☐☐	_____
☐☐ oz ☐☐☐ K cal. ☐☐ g fat		☐☐ oz ☐☐☐ K cal. ☐☐ g fat		
6. Other _____	$☐☐.☐☐	Other _____	$☐☐.☐☐	_____
☐☐ oz ☐☐☐ K cal. ☐☐ g fat		☐☐ oz ☐☐☐ K cal. ☐☐ g fat		

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #7: BAKED GOODS

Rater ID: ☐☐ Store ID: ☐☐☐-☐☐-☐☐☐-☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year) **0** Grocery Store **0** Convenience Store **0** Other

Availability & Price

Low-fat baked goods ≤3g fat/serving

Item	Available Yes	Available No	Amt. per package	g fat/ per item	kcal/ per item	Price	Comments
Healthier option:							
1. Bagel							_____
Single	**0**	**0**		☐☐	☐☐☐	$☐.☐☐	_____
	Yes	**No**	**N/A**				_____
Package	**0**	**0**	**0**	☐☐	☐☐☐	$☐.☐☐	_____
Alternate Items:	**Yes**	**No**	**N/A**				_____
2. English muffin	**0**	**0**	**0**	☐☐	☐☐☐	$☐.☐☐	_____
3. a. Low-fat muffin	**0**	**0**	**0**	☐☐	☐☐☐	$☐.☐☐	_____
☐☐☐☐☐☐☐☐☐							_____
b. # varieties of low fat muffins				**0** 0	**0** 1 **0** 2 **0** 3+		
Regular option (≥4g fat/serving or 400 Kcal/serving):							
4. Regular muffin	**0**	**0**		☐☐	☐☐☐	$☐.☐☐	_____
							_____
Alternate Items	**Yes**	**No**	**N/A**				
5. Regular Danish	**0**	**0**	**0**	☐☐	☐☐☐	$☐.☐☐	_____
							_____
6. Other	**0**	**0**	**0**	☐☐	☐☐☐	$☐.☐☐	_____
							_____

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #8-CS-BEVERAGE

Rater ID: ☐☐ Store ID: ☐☐☐-☐☐-☐☐☐-☐☐☐

Date: ☐☐/☐☐/☐☐ Month Day Year **0** Grocery Store **0** Convenience Store **0** Other

Availability & Price

Healthier option:		**Available** Yes	No		**Price**	**Comments**
1. Diet Coke	12 oz.	**0**	**0**		$☐.☐☐	_____
	20 oz.	**0**	**0**		$☐.☐☐	_____
2. Alternate brand of diet soda		**Yes**	**No**	**N/A**	$☐.☐☐	_____
☐☐☐☐☐☐☐☐☐☐	12 oz.	**0**	**0**	**0**	$☐.☐☐	_____
☐☐☐☐☐☐☐☐☐☐	20 oz.	**0**	**0**	**0**	$☐.☐☐	_____
Regular option:		**Yes**	**No**			
3. Coke	12 oz.	**0**	**0**		$☐.☐☐	_____
	20 oz.	**0**	**0**		$☐.☐☐	_____
4. Alternate brand of sugared soda		**Yes**	**No**	**N/A**		
☐☐☐☐☐☐☐☐☐☐	12 oz.	**0**	**0**	**0**	$☐.☐☐	_____
☐☐☐☐☐☐☐☐☐☐	20 oz.	**0**	**0**	**0**	$☐.☐☐	_____
Healthier option:						
5. **100% juice, 15.2 oz.**		**Yes**	**No**			
0 Minute Maid **0** Tropicana **0** Other		**0**	**0**		$☐.☐☐	_____
Alternate Items:		**Yes**	**No**	**N/A**		
6. **100% juice, 14 oz.**						
0 Minute Maid **0** Tropicana **0** Other		**0**	**0**	**0**	$☐.☐☐	_____
7. **100% juice,** ____ oz.						
0 Minute Maid **0** Tropicana **0** Other		**0**	**0**	**0**	$☐.☐☐	_____
Regular option:		**Yes**	**No**			
8. **Juice Drink, 15.2 oz**						
0 Minute Maid **0** Tropicana **0** Other		**0**	**0**		$☐.☐☐	_____
Alternate Items:		**Yes**	**No**	**N/A**		
9. **Juice Drink, 14 oz.**						
0 Minute Maid **0** Tropicana **0** Other		**0**	**0**	**0**	$☐.☐☐	_____
10. **Juice Drink,** ____ oz.						
0 Minute Maid **0** Tropicana **0** Other		**0**	**0**	**0**	$☐.☐☐	_____

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #8-GS:BEVERAGE

Rater ID: ☐☐ Store ID: ☐☐☐☐-☐☐-☐☐☐-☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year) **0** Grocery Store **0** Convenience Store **0** Other

Availability & Price

		Available			Price	Comments
Healthier option:	**Available size**	**Yes**	**No**	**N/A**		
1. Diet Coke	12 pack 12 oz.	**0**	**0**		$☐.☐☐	_____
	6 pack 12 oz.	**0**	**0**	**0**	$☐.☐☐	_____
2. Alternate brand of diet soda		**Yes**	**No**	**N/A**	$☐.☐☐	_____
☐☐☐☐☐☐☐☐☐☐	12 pack 12 oz.	**0**	**0**	**0**	$☐.☐☐	_____
☐☐☐☐☐☐☐☐☐☐	6 pack 12 oz.	**0**	**0**	**0**	$☐.☐☐	_____
Regular option:		**Yes**	**No**			
3. Coke	12 pack 12 oz.	**0**	**0**		$☐.☐☐	_____
		Yes	**No**	**N/A**		
	6 pack 12 oz.	**0**	**0**	**0**	$☐.☐☐	_____
4. Alternate brand of sugared soda		**Yes**	**No**	**N/A**		
☐☐☐☐☐☐☐☐☐☐	12 pack 12 oz.	**0**	**0**	**0**	$☐.☐☐	_____
☐☐☐☐☐☐☐☐☐☐	6 pack 12 oz.	**0**	**0**	**0**	$☐.☐☐	_____
Healthier option:		**Yes**	**No**			
5. Minute Maid 100% juice, (64 oz., half gallon)		**0**	**0**		$☐.☐☐	_____
Alternate Items:		**Yes**	**No**	**N/A**		
6. Tropicana 100% juice, (64 oz, half gallon)		**0**	**0**	**0**	$☐.☐☐	_____
7. Other: ☐☐☐☐☐☐☐☐☐☐		**0**	**0**	**0**	$☐.☐☐	_____
Regular option:		**Yes**	**No**			
8. Minute Maid juice drink, (64 oz, half gallon)		**0**	**0**		$☐.☐☐	_____
Alternate Items:		**Yes**	**No**	**N/A**		
9. Tropicana juice drink, (64 oz, half gallon)		**0**	**0**	**0**	$☐.☐☐	_____
10. Other: ☐☐☐☐☐☐☐☐☐☐		**0**	**0**	**0**	$☐.☐☐	_____

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #9: BREAD

Rater ID: ☐☐ Store ID: ☐☐☐☐-☐☐-☐☐☐☐-☐☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year) **0** Grocery Store **0** Convenience Store **0** Other

Availability & Price

Item	Available Yes	No	N/A	Loaf size (ounces)	Price/loaf	Comments
Healthier Option: Whole grain bread (100% whole wheat bread and whole grain bread)						
1. Nature's Own 100% Whole Wheat Bread	**0**	**0**		☐☐	$☐.☐☐	_____
Alternate Items:						
2. Sara Lee Classic 100% Whole Wheat Bread	**0**	**0**	**0**	☐☐	$☐.☐☐	_____
3. Other: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐	**0**	**0**	**0**	☐☐	$☐.☐☐	_____

4. # of varieties of 100% whole wheat bread and whole grain (all brands) **0** 0 **0** 1 **0** 2 **0** 3 **0** 4 **0** 5 **0** 6+

Regular Option: White bread (bread made with refined flour)

5. Nature's Own Butter Bread	**0**	**0**		☐☐	$☐.☐☐	_____
Alternate Items:	**Yes**	**No**	**N/A**			
6. Sara Lee Classic White Bread	**0**	**0**	**0**	☐☐	$☐.☐☐	_____
7. Other: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐	**0**	**0**	**0**	☐☐	$☐.☐☐	_____

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #10: BAKED CHIPS

Rater ID: ☐☐ Store ID: ☐☐☐-☐☐-☐☐☐-☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year) **0** Grocery Store **0** Convenience Store **0** Other

Availability & Price

Low-fat chips ≤3g fat per 1 oz. serving

Item	Available	Price	Comments
Healthier Option :	**Yes No**		
1. Baked Lays Potato Chips	**0 0**	$☐.☐☐	_____
0 1 1/8 oz. **0** 10 oz.			
0 2 1/8 oz. **0** Other _____ oz.			
0 5 ½ oz.			
Alternate Item:	**Yes No N/A**		
2. ☐☐☐☐☐☐☐☐☐☐☐☐	**0 0 0**	$☐.☐☐	_____
0 1 1/8 oz. **0** 10 oz.			
0 2 1/8 oz. **0** 12 oz.			
0 5 ½ oz. **0** Other _____ oz.			
3. # of varieties of low-fat chips (any brand)		**0** 0 **0** 1 **0** 2 **0** 3 **0** 4 **0** 5 **0** 6+	

Regular Option (select most comparable size to healthier option available):

	Yes No		
4. Lays Potato Chips Classic	**0 0**	$☐.☐☐	_____
0 1 1/2 oz. **0** 11 1/2 oz.			
0 2 3/4 oz. **0** 20 oz			
0 5 oz **0** Other _____ oz.			
Alternate Item:	**Yes No N/A**		
5. ☐☐☐☐☐☐☐☐☐☐☐☐	**0 0 0**	$☐.☐☐	_____
0 1 1/2 oz. **0** 11 1/2 oz.			
0 2 3/4 oz. **0** 20 oz			
0 5 oz **0** Other _____ oz.			

Measure Complete ☐

Nutrition Environment Measures Survey (NEMS)
Measure #11: CEREAL and OTHER GRAINS

Rater ID: ☐☐ Store ID: ☐☐☐☐-☐☐-☐☐☐☐-☐☐☐☐

Date: ☐☐/☐☐/☐☐ (Month Day Year) **0** Grocery Store **0** Convenience Store **0** Other

Availability & Price

Healthier cereals < 7 g sugar per serving

Item	Available Yes	No	N/A	Size (ounces)	Price	Comments
Healthier Option:						
1. Cheerios (Plain)	**0**	**0**		☐☐	$☐.☐☐	_____
Alternate Item:	**Yes**	**No**	**N/A**			
2. Other _____	**0**	**0**	**0**	☐☐	$☐.☐☐	_____

3. # of varieties of healthier cereals **0** 0 **0** 1 **0** 2 **0** 3+

Regular Options (≥7g of sugar per serving):

4. Cheerios (Flavored) _____	**0**	**0**		☐☐	$☐.☐☐	_____
Alternate Item:	**Yes**	**No**	**N/A**			
5. Other _____	**0**	**0**	**0**	☐☐	$☐.☐☐	_____

Availability and Price

Item	Available Yes	No	N/A	Price	Ounces	Comments
6. Quaker Oats Oatmeal, old fashioned, 18 oz.	**0**	**0**		$☐.☐☐	☐☐	_____
Alternate Brand:						
7. .☐☐☐☐☐☐☐☐☐☐	**0**	**0**	**0**	$☐.☐☐	☐☐	_____
8. Quaker Oats Oatmeal, quick-cooking, 18 oz.	**0**	**0**		$☐.☐☐	☐☐	_____
Alternate Brand:						
9. .☐☐☐☐☐☐☐☐☐☐	**0**	**0**	**0**	$☐.☐☐	☐☐	_____

Availability and Price

Item	Available Yes	Available No	Price	Ounces	Comments
Healthier option:					
10. Brown rice, 16 oz	0	0	$ __.__	__	_____
Regular option:					
11. White rice, 16 oz	0	0	$ __.__	__	_____

Availability and Price

Item	Available Yes	Available No	Price	Ounces	Comments
Healthier option:					
12. Whole wheat spaghetti, 16 oz.	0	0	$ __.__	__	_____
Alternate Item:					
13. _____	0	0 0	$ __.__	__	_____
Regular option:					
14. Enriched spaghetti, 16 oz.	0	0	$ __.__	__	_____
Alternate Item:					
15. _____	0	0 0	$ __.__	__	_____

APPENDIX B

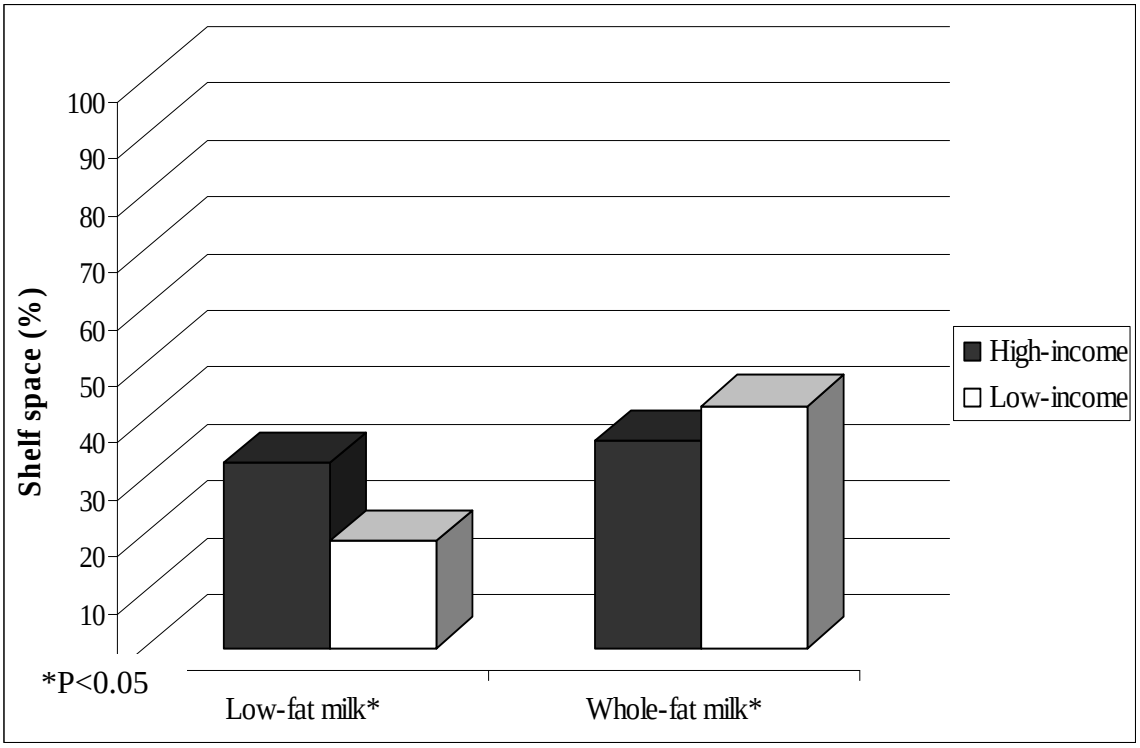
ADDITIONAL TABLES AND FIGURES

Appendix B 1.1: The availability of individual fruits by store type

Fruit	**Supermarket** Mean (%)	**Grocery store** Mean (%)	**Convenience store** Mean (%)
Apples	100	100	50
Bananas	100	87.5	47.7
Cantaloupe	95.2	0	0
Grapes	90.5	0	0
Honeydew	100	0	0
Oranges	100	62.5	31.8
Peaches	81	0	0
Pears	100	25	0
Strawberries	95.2	25	0
Watermelon	95.2	12.5	0

Appendix B 1.2: The availability of individual vegetables by store type

Vegetable	**Supermarket** Mean (%)	**Grocery store** Mean (%)	**Convenience store** Mean (%)
Broccoli	100	37.5	0
Cabbage	100	87.5	0
Carrots	100	50	0
Cauliflower	100	25	0
Celery	100	50	0
Corn	100	25	0
Cucumbers	100	37.5	0
Lettuce	100	25	0
Sweet peppers	100	87.5	0
Tomatoes	100	87.5	0



Appendix B 1.3: The percentage of shelf space devoted to low-fat and whole-fat milk by income level

Appendix B 1.4: The distribution of whole-grain bread varieties in high-income vs. low-income neighborhoods*

	0	**1**	**2**	**3**	**4**	**5**	**6 or more**
High-income (n = 29)	15 (51.7%)	1 (3.4%)	0%	0%	0%	1 (3.4%)	12 (41.4%)
Low-income (n = 44)	31 (70.5%)	3 (6.8%)	1 (2.3%)	0%	0%	0%	9 (20.5%)

*P<0.05