

**ALLEVIATING URBAN FOOD DESERTS:  
LESSONS FROM THE LITERATURE**

by

Soma D. Nikhanj

**BS, University of Minnesota, 2002**

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this thesis was presented

by

**Soma D. Nikhanj**

It was defended on

**December 2, 2009**

and approved by

**Thesis Advisor:**

Martha Ann Terry, BA, MA, PhD  
Assistant Professor  
Behavioral and Community Health Sciences  
Graduate School of Public Health  
University of Pittsburgh

**Committee Member:**

Ravi Sharma, PhD  
Assistant Professor  
Behavioral and Community Health Sciences  
Graduate School of Public Health  
University of Pittsburgh

**Committee Member:**

Julie Donohue, PhD  
Assistant Professor  
Health Policy & Management, Department of Psychiatry  
Graduate School of Public Health  
University of Pittsburgh

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Martha Ann Terry, BA, MA, PhD

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Soma Nikhanj, M.P.H

University of Pittsburgh, 2010

The goals of Healthy People 2010 are to increase the quality and years of healthy life and eliminate health disparities. Great health disparities occur in the area of nutrition, which is one of the objectives addressed in Healthy People 2010. It is well accepted that a healthy diet, including recommended amounts of fruits, vegetables, and whole grains, provides primary prevention against many chronic diseases, including obesity, diabetes, and certain cancers. Urban minority populations are the most likely to live in food deserts, which are areas with limited access to healthy foods. Research shows that the food environment plays a large role in the foods individuals have available to eat. Alleviating food desert conditions in urban areas has great public health importance because of the impact food environments have on the diet, and therefore health, of the people who reside in urban areas. Policy action can improve food retail access to fresh, healthy foods, decrease the price of these foods, and support the establishment of supermarkets and/or the improvement of existing small food retailers. Local policies that give tax breaks to supermarkets that locate in the center of food deserts might convince large food retailers to locate in these areas. Also, local policies that give grants to small food stores in urban food desert areas may persuade small food stores to offer more fresh produce. The United States could drastically reduce health disparities and make a giant leap towards achieving both of the Healthy People 2010 Goals of increasing years of healthy life and eliminating health disparities if urban food desert conditions were ameliorated.

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## 1.0 INTRODUCTION

Healthy People 2010 is a set of health objectives for the United States to promote health and prevent disease. The goals of Healthy People 2010 are to increase the quality and years of healthy life and eliminate health disparities (healthypeople.gov, 2009). Great health disparities occur in the area of nutrition, which is one of the topics addressed in Healthy People 2010. It is well accepted that a healthy diet, including recommended amounts of fruits, vegetables, and whole grains, provides primary prevention against many chronic diseases, including obesity, diabetes, and certain cancers (Steinmetz and Potter, 1991; Van Duyn and Pivonka, 2000).

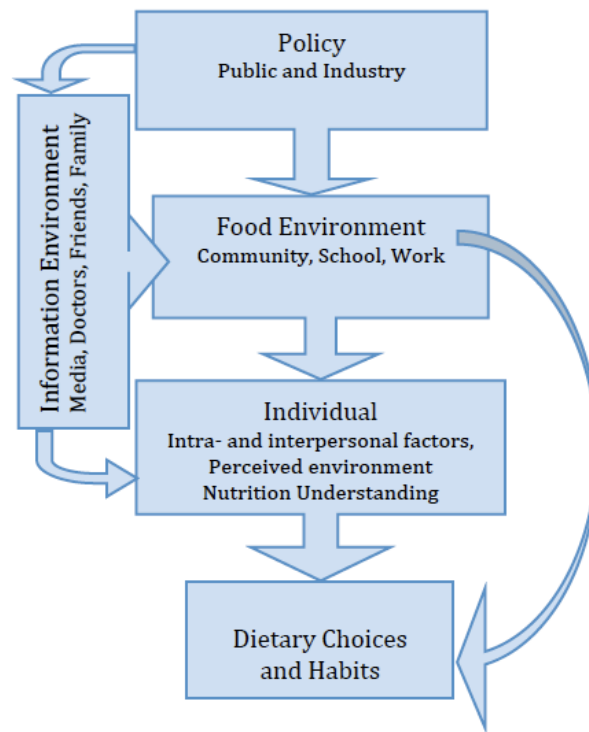
Unfortunately, the populations that are most vulnerable to chronic diseases also have limited access to one form of primary prevention – healthy foods. Urban minority populations are the most likely to live in areas known as food deserts, areas with limited access to healthy foods. These areas are also referred to as food insecure. Food security is defined by the World Health Organization (WHO): “When all people at all times have access to sufficient, safe, nutritious foods to maintain a healthy and active life” (WHO <http://www.who.int/trade/glossary/story028/en/> 2009). The WHO acknowledges physical and economic aspects of access to these foods, and identifies three main ‘pillars’ of food security, without any one of which a population/area would be deemed ‘food insecure’: 1) food availability, 2) food access, and 3) food use. Food availability means that healthy foods are readily available in terms of distance, while food access is defined as having the resources

necessary to obtain nutritious foods, which includes having money to purchase the foods and transportation to get to and from a food retailer. Food use includes having the knowledge about how to use nutritious foods, including basic water and sanitation practices. In recent years, there have been efforts across the United Kingdom, United States, and other industrialized nations to understand the nature of food insecurity – why food deserts exist and how to ameliorate these conditions.

Figure 1 demonstrates how policy, environmental, and individual factors affect eating behavior. Policy affects the foods we have available to eat by giving dietary recommendations, regulating food advertising, regulating what can be sold as food, and regulating the food environment, to name a few. The food environment includes the home, which is especially important for younger adults, adolescents, and those who are homebound, school, work, or anywhere else a person might eat. The informational environment includes newspapers, television or radio news, magazines, doctors, friends and family, or anywhere else a person might get information about food or nutrition. Individual level factors include what friends or family eat, personal preferences, skills (such as shopping and cooking skills), confidence in those skills, and anything else people think or feel that affects their dietary choices. The dietary choices a person makes is determined by all of these factors. Glanz, Sallis, Saelens, and Frank (2005) detail these relationships in a similar manner to that shown in Figure 1.

A complex set of variables contributes to eating patterns, and interventions can affect any one, or all, of these variables. Most of the studies reviewed for this paper involve environmental factors. However, since policies affect every variable contributing to eating patterns, this paper focuses on how policy can affect eating patterns and presents one model for implementing change. It is important to note that the components in Figure 1 can be applied to federal, state,

and local food systems; policies can be implemented at any level and affect the corresponding community. This literature review will discuss the importance of urban food security and food desert conditions in relation to diet and health disparities. This review also includes what current literature has found regarding urban food environments, the role public policy can play in alleviating food deserts, and policy recommendations based on the reviewed literature.



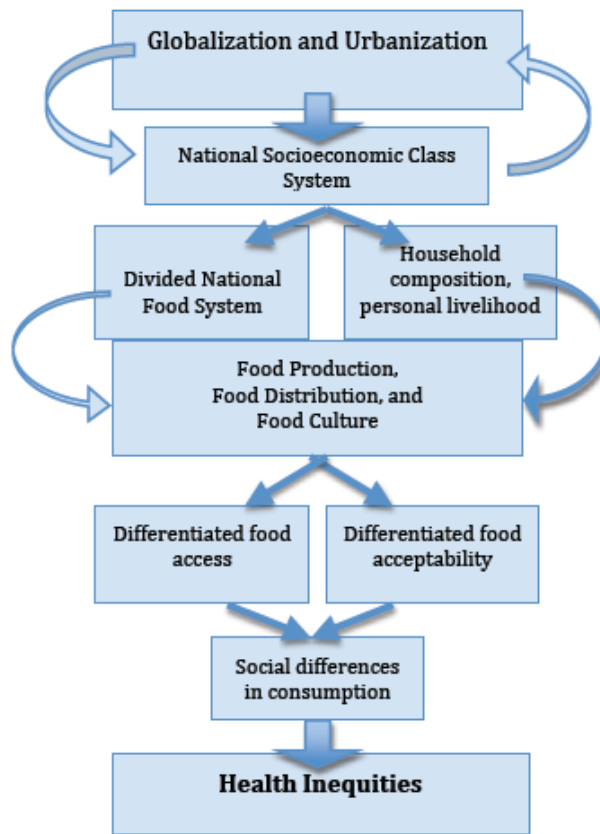
**Figure 1 Direct and Indirect determinants of Dietary Habits**

**Adapted from Glanz, Sallis, Saelens, and Frank (2005).**

## 2.0 BACKGROUND

Food insecurity and hunger are complex problems with many possible causes and solutions. The United States is purported to have enough resources for everyone to have a nutritionally adequate diet, yet this is not the case. Food insecurity is a major problem especially in urban areas. It is thus helpful to look at reasons why an urban environment within an industrialized nation would have these problems.

Figure 2 depicts the effects of globalization and urbanization on food production, distribution, and customs (including consumption). Dixon, Omwega, Friel, Burns, Donati, and Carlisle (2005) demonstrate two direct effects of globalization and urbanization: class distribution of our society and what they call a bifurcated food system. A bifurcated system is a food system differentiated into two parts: one for the wealthy and one for the poor. In Figure 2 a bifurcated food system is labeled a 'differentiated' food system. These authors argue that our food system favors the wealthy at the expense of the poor by allowing higher quality and more affordable nutritious foods to be sold almost exclusively in high socio-economic areas, while low-quality, expensive, nutritionally devoid, deleterious foods are readily available in low socio-economic areas.



**Figure 2 Urban food and nutrition health inequities**

Adapted from Dixon, Omwega, Friel, Burns, Donati, and Carlisle (2005).

The United States is a nation highly affected by urbanization. Therefore, urbanization, or urban sprawl, must be explored further in order to understand the mechanisms by which it affects diet and health and how the effects on diet and health can be ameliorated.

## 2.1 URBAN SPRAWL AND THE RISE OF FOOD DESERTS

Urban sprawl is a phenomenon seen in many, but not all, industrialized nations. Urban sprawl can be defined as the uncontrolled spread of urban development into neighboring regions, or the unplanned, uncontrolled spreading of urban development into areas adjoining the edge of a city (<http://dictionary.reference.com/browse/urban+sprawl>, 2009). It began in the 1920s and rapidly increased in the second half of the 20<sup>th</sup> century (Frumkin, 2002). The rapid increase of obesity has been partly attributed to urban sprawl (Frumkin, 2002). The logic is as follows: since lower intake of fruits and vegetables is associated with increased obesity, and urban sprawl decreased the availability of supermarkets (a primary source of healthy foods), it follows that urban sprawl indirectly contributes to obesity in urban areas. This logic is reflected in both Figure 1 and Figure 2 on the previous pages. In addition to healthy food availability, decrease in physical activity is caused by urban sprawl, which can lead to obesity and other health issues, but this topic is for another paper.

The logic begs the question, how does urban sprawl cause food insecurity? The reason is suggested to be attributed to something called ‘white flight,’ which often occurs in tandem with urban sprawl. Mid- and upper-class whites who have access to private transportation move from the inner-cities to the suburbs (Frumkin, 2002). The effects of white flight are quite evident – wealthier, more educated members of the population move to the outskirts of the city, leaving behind a less affluent, less educated group. With the loss of more affluent members of the community, tax revenue also migrates, leaving urban areas with decreased resources. This can have a profound effect on the diet of those remaining in the inner cities. Mead (2008) describes the effect:

Privatized mobility allowed wealthier people to move outward from city centers toward the suburbs, and with them went many of the supermarkets that used to pervade urban areas. Because many chronic diseases have been associated with decreased consumption of fruits and vegetables, along with increase consumption of sugary or high-fat foods, urban food deserts may be taking a health toll on those who live in socially deprived neighborhoods (pg. A335).

Following these arguments and illustrations, it is not difficult to see how urban sprawl might affect the diet, and thus the health, of people who remain in urban areas.

## **2.2 HEALTH EFFECTS OF HUNGER AND FOOD INSECURITY**

Research shows that there are health effects of hunger and food insecurity; these include Brown and Pollitt (1996); Costello (2007); Hunger in America 2006 ([hungerinamerica.org](http://hungerinamerica.org)), Kleinman Murphy, Little, Pagano, Wehler, Regal, et al. (1998); Manson, Willet, Stampfer, Colditz, Hunter, Hankinson, et al., (1995); Olson (1999); Pi-Sunyer, (1991); Reeves Pirie, Beral, Green, Spencer, and Bull (2007); Seligman Bindman, Vittinghoff, Kanaya, and Kushel (2007); Weber (2006).

One study funded by America's Second Harvest, Hunger In America 2006 ([hungerinamerica.org](http://hungerinamerica.org)), explains that hunger affects all demographic and socioeconomic groups: children, whites, minorities, the elderly, and the working poor. The study found that over half of food insecure or hungry people reside in urban areas. The 2004 USDA report Household Food Security in the U.S. estimates that one out of five Americans will likely participate in at least one food assistance program in a given year. Citing the hunger-obesity paradox, Weber (2006) illustrated that food insecurity and obesity overlap each other in some states. People within these areas are food insecure and hungry, and at the same time at high risk for obesity. According to Weber, "No group in our population – hungry or not - meets this criteria [being well nourished]

well” (pg. 806). We have reached a point where we are over-nourished or under-nourished, and no single group can claim complete health in terms of diet.

Olson (1999) provides startling evidence that food insecurity and hunger have a profound effect on women and children in urban areas, in terms of physical and mental health. Olson found that, in urban populations of women of child-bearing age, food insecurity was correlated to increased body mass index (BMI). Although a mechanism for this has not been proven, it is hypothesized to be similar to that of women who ‘yo-yo’ diet: hunger leads to overconsumption; food deprivation decreases metabolism and encourages the body to store calories in the form of fat, thereby increasing weight gain. After controlling for other known influences on female body weight (height, income, single-parent, employment, and education), food insecurity was still positively and significantly related to BMI by an average of two points. According to Manson, Willet, Stampfer, Colditz, Hunter, Hankinson, et al., (1995), an average difference of two BMI points increases the risk of mortality by 25%. As discussed above, Olson (1999) found food insecurity to be correlated with increased BMI in women of childbearing age. Additionally, Seligman Bindman, Vittinghoff, Kanaya, and Kushel (2007) found food insecurity to be correlated with diabetes in the NHANES (National Health And Nutrition Examination Survey) study, and Reeves Pirie, Beral, Green, Spencer, and Bull (2007) found an increased risk of ten types of cancers in women in the Million Women Cohort Study.

In populations of urban, low-income school-aged children, hunger and risk of hunger were associated with decreased psychosocial functioning and wellbeing (Olson, 1999). ‘Risk of hunger’ is defined similarly to food insecurity. The USDA (<http://www.fns.usda.gov/fsec/>, 2009) adds to the WHO definition of food security: “Food security is, at a minimum, the ready availability of nutritionally adequate and safe foods and assured ability to acquire acceptable



foods in socially acceptable ways.” Socially acceptable ways do not include, for example, emergency food sources, stealing or ‘dumpster diving.’ (Dumpster diving is a form of obtaining food involving searching through garbage bins of homes and businesses such as restaurants.)

In addition to decreased psychosocial functioning in children, food insecurity and hunger can limit long-term intellectual development (Brown and Pollitt, 1996) and promote obesity (Costello, 2007). According to Brown and Pollitt (1996), in 1992 approximately 12 million American children were consuming insufficient diets based on nutrition recommendations at that time. Also, “malnutrition alters educational preparedness and, later, workforce productivity, making it an unacceptable risk for its victims as well as for the nation’s strength and competitiveness,” (pg. 43). Long-term food insecurity and hunger in childhood can thus affect a person his/her entire lives as well as the nation as a whole. Costello (2007) states, “The rise in childhood obesity, clinically defined as malnutrition, is one of the many manifestations of how hunger is affecting American children” (pg. 589). Childhood obesity is therefore another health effect of hunger and food insecurity in the United States that can be reduced by improving food security in urban, food insecure areas.

Kleinman Murphy, Little, Pagano, Wehler, Regal, et al. (1998) agree. Citing statistics from the Community Childhood Hunger Identification Project (CCHIP), they report that 8% of children under the age of 12 experience prolonged hunger yearly. Additionally, 10 million children are at risk for hunger. This original research demonstrated that children of families with hunger are more likely to show behavioral, emotional, and academic problems than families with similar social and economic status (SES) that do not experience hunger. This research demonstrated significantly higher levels of anxiety, irritability, and aggression in hungry children of low SES compared to low SES children who do not experience hunger. In this study, poor

school performance and poor social skills are attributed to hunger but not necessarily SES, indicating the positive effect food security could have on schools, even if poverty cannot be wholly eliminated.

All of this evidence is strong and compelling: food insecurity puts people at risk for high BMI, which increases the risk of cardiovascular disease, hypertension, and high cholesterol (Pi-Sunyer, 1991) in addition to diabetes and many cancers. Children do not learn and grow properly when they are food insecure. Ensuring food security can thus have a profound impact on the health of urban, food-insecure populations and thus the health of the nation.

### 3.0 METHODS

This thesis is based on a literature review of relevant research. Inclusion and exclusion criteria for this literature review were created with the intent of collecting as much relevant literature concerning alleviating urban food insecurity as possible. Included literature must:

1. Be limited to developed nations;
2. Be limited to urban areas where food security has been identified, or is reasonably suspected as, a problem;
3. Address fresh fruit, vegetable, and/or 'healthy food' intake or consumption;
4. Contain information about fresh fruit, vegetable, and/or healthy food access, availability and/or cost;
5. Identify distance or relative location of food retailers in relationship to area of interest;

In addition, either the sixth or seventh criterion was necessary for inclusion:

6. Discuss access, availability and/or cost affects on fresh fruit, vegetable, and/or healthy food consumption; or
7. Discuss possible ways to alleviate food insecurity in urban populations.

### 3.1 LITERATURE SEARCH

This literature search was conducted based on the methodical and detailed guide *Steps in Planning and Implementing a Literature Search* (Folb, 2009). Identifying the problem, population, setting, and outcome of interest allowed the creation of a succinct primary search strategy:

- Problem: Low fresh fruit and vegetable consumption due to food insecurity
- Population: Urban, low socio-economic, and minority populations
- Setting: Urban and inner-city food deserts
- Outcome of interest: increase fresh fruit and vegetable consumption and/or alleviate food insecurity
- Developed question: How can an urban population alleviate food insecurity and increase healthy food consumption in a food desert?

Key concepts from abstracts and titles were then extracted for use in producing a search-tracking table (Table 1). Concepts identified were food security, urban populations/areas, fruits and vegetables/healthy foods, and food deserts. A preliminary PubMed search was conducted to identify synonyms or other terms used in titles and abstracts in place of those identified above. For example, other search terms that would identify literature pertaining to food security might include food insecurity and food access.

**Table 1 Search Tracking**

Food Security	Urban	Fruit and Vegetable (F&V) Availability	Food Desert
Food insecurity	Inner-city	F&V intake	Food environment
Food access	City	F&V consumption	Food retail
Hunger		Produce availability/ intake/consumption	Food resource
		Healthy food availability/ intake/ consumption	Grocery store (access)
			Supermarket (access)

Terms in columns identify similar terms and concepts for the use of a comprehensive search and should be linked together using OR. Terms in rows should be linked together using AND to ensure all terms are included in the results.

### 3.1.1 PubMed Search

The concepts from Table 1 were used together in many combinations for searches using the PubMed database. Terms in rows were connected by the search operative AND while terms in columns were connected by the search operative OR. For example, a search that found 98 results was conducted as follows: ((food insecurity) OR food security) AND ((food desert) OR fruit and vegetable intake). This specific combination of terms yielded 11 usable results; however a total of 42 combinations of the terms listed in Table 1 was entered into PubMed. A total of fifteen articles was accepted for review.

### **3.1.2 PittCat Search**

A second literature search was conducted using the University of Pittsburgh Digital Library, also called PittCat. This search was conducted in a manner similar to that of PubMed, detailed above. For the sake of a more concise search, only articles were searched, and news articles were excluded. The PittCat search yielded 934 results. Many duplicated results from different terms; for example, when searching ‘food deserts’ and ‘urban food insecurity’ 23 results came back for both terms. After reviewing the titles and abstracts for inclusion and exclusion criteria, 16 were usable. Two articles were no longer available through the University’s system. Neither could be found using the PubMed database, so the articles were excluded. A total of 14 articles identified through PitCatt was accepted for review.

### **3.1.3 Google Scholar Search**

A third literature search was conducted using the popular search engine Google, which has a specialized search engine called Google Scholar. Results are limited to scholarly sources. This search engine operates in a much different way from PubMed or PittCat. Searches are conducted primarily by forming questions or sentences with the search terms, such as “How to alleviate food insecurity in urban areas” or “Increasing healthy food consumption in food deserts.” The first search yielded 26,8000 results and the second yielded 97,300 results. Since Google Scholar searches consistently found over 1,000 results, not every result was examined. Instead, as they are sorted in order of relevance, results ceased to be examined after two consecutive pages of rejected literature. In the event that articles were not available online, another search for that

specific article through PittCat or PubMed was conducted. Subsequently, all articles were accessed. A total of 28 articles was accepted for review.

#### **3.1.4 Results Refined**

Abstracts and titles were examined using the inclusion and exclusion criteria discussed above. Articles that did not have available abstracts were initially judged only by title. When the full articles were accessed, the introduction, results, conclusions, and discussions were examined for relevance. Some articles superficially discussed urban food systems in the abstract, but collected few or no data. In another, speculative conclusions were drawn about urban and rural food access, but the data were not organized into urban and rural categories. Of the original 57 articles, 28 were ultimately accepted for review.

## 4.0 RESULTS

Twenty-eight articles were reviewed for this paper, including cross-sectional, before-and-after intervention studies and papers involving policy. Of the 28 articles reviewed for this paper, 16 were cross-sectional studies. These studies comprise the bulk of the literature overall and reviewed here, and though they cannot identify causation, they do provide a powerful body of literature depicting strong correlations that should be investigated further. Three articles were categorized as intervention studies, which are studies that collected data before a food retailer was developed in an area and again after it was in operation, with the establishment of the food retailer being regarded as the intervention. Researchers controlled for differences based on possible confounding factors within the study, and statistical measurements were used to determine the change that could be attributed to the intervention. These studies were conducted in Canada, England, and Scotland.

Nine articles pertained to policy, in addition to some of the cross-sectional studies, which are discussed in both sections. The ‘policy’ section of the thesis discusses those studies in which the authors determined policy could positively affect the issues posed by food security, and thus made policy recommendations based on their findings. It is agreed that in urban, food-desert conditions, low-income populations have limited access to healthy foods. For this reason policy should aim to improve the foods to which this population has access. Authors have different opinions, however, on how this could be effectively accomplished.



## 4.1 CROSS SECTIONAL STUDIES

Cross-sectional studies have found that when residents must travel shorter distances to stores that sell healthy foods, these people are more likely to eat healthy foods. In addition, these studies have found race and ethnicity to be associated with healthy food consumption; regardless of income, African American populations are less likely to eat healthy foods than are white and/or Caucasian populations. Low income, low education, and high cost of healthy foods are all demonstrated to be negatively associated with healthy food consumption. Using GIS mapping systems to analyze associations between many variables, studies have found urban minority neighborhoods to have fewer grocery stores, higher prices and lower quality of produce, and longer distances to healthy foods sources.

However, there are some variations between findings across the United States, Canada, Australia, and the UK. One of the first comprehensive studies was conducted in 1999 in urban areas of Minnesota. In it, Chung and Myers (1999) assessed a vast array of commodities in urban and suburban areas in Minneapolis and Saint Paul, MN, categorized by types of stores and availability of commodities in each stores. Chung and Myers found chain stores twice as likely to carry fruits and vegetables than non-chain stores. They also found fewer chain stores in urban areas. In addition they found every commodity, most notably fruits and vegetables, to be less available in urban environments than in the suburbs or rural areas, and lower prices for fruits and vegetables (and most other foods) in chain stores; therefore, inner city residents are paying much more for these items.

A large majority of recent studies conducted within urban areas of the United States have found distance to stores that sell healthy foods (Baker, Schootman, Barnidge, and Kelly, 2006; Bodor, Rose, Farley, Swalm, and Scott, 2009; Hosler, Rajulu, Ronsani, and Fredrick, 2008; Jago,

Baranowski, Baranowski, Cullen, and Thompson, 2007; Rundle, Nekerman, Freeman, Lovasi, Purciel, Quinn, et al. 2009), cost of healthy foods (Hendrickson, Smith, and Eikenberry, 2006; Moore and Diez Roux, 2006), income (Rose and Richards 2004; Morland, Wing, and Roux, 2002; Powell, Zhao, and Wang, 2002), education (Powell, Zhao, and Wang, 2002; Raja, Ma, and Yadav, 2008; Moore, Diez Roux, Nettleton, and Jacobs, 2008; Zenk, Schulz, Hollis-Neely, Campbell, Holmes, Watkins, et al., 2005), and race and ethnicity (Dubowitz, Heron, Bird, Lurie, Finch, and Basurto-Davila, 2008; Moore, Diez Roux, Nettleton, and Jacobs, 2008; Morland, and Filomena, 2007) to be associated with healthy food consumption and/or BMI.

Baker, Schootman, Barnidge et al. (2006) audited grocery stores and fast food stores in the St. Louis, Missouri metro area for healthy food options. The study utilized a geographic information system (GIS) and geographic clustering software to map option. In addition, racial, ethnic, and poverty data were mapped to determine if neighborhood characteristics were associated with clustering of food option.

The tools used to audit available foods were developed using the 2006 dietary guidelines that include eating a wide variety of fruits and vegetables, low-fat meats, fish and poultry, and low-fat or fat-free dairy products. Whole grain products were not addressed. The audit tool contained 78 total fruits and vegetables and recorded whether they were fresh, frozen, or canned. Types of meat and fat content of dairy items were also recorded. Fast-food restaurants were defined as places without table service, where customers placed their orders at a counter. All stores were audited, in person, by a team of two trained auditors.

These researchers found the food available in high poverty areas consisting of mixed races or mostly white people and areas that are primarily African-American (regardless of income) to be less healthy than the food available in wealthier, primarily white areas. The

authors do recognize the possibility that businesses that sell healthy foods (for example, supermarkets) do not establish themselves in low-income or African American areas. Conversely it is possible fast-food retailers do establish themselves in high poverty areas because they believe their products will sell well in these areas. Because this study was cross sectional, determining causation was not possible. It is only possible to determine a strong association between clustering of supermarkets and wealthy and primarily white populations and the clustering of fast-food restaurants in low-income and primarily African American areas.

Bodor, Rose, Farley, et al. (2007) assessed both store access and in-store availability of foods in four census tracts in New Orleans to determine if there is a relationship to fruit and vegetable consumption. This study utilized a GIS mapping system to determine distance to both small food stores and grocery stores, and density of stores within neighborhoods. Shelf space was determined in person by trained observers. Shelf space was measured separately for fresh, canned, and frozen fruits and vegetables. For fresh produce, varieties were also recorded. Surveys and twenty-four hour diet recalls were administered over the phone. A computer program randomized household phone numbers in order to select participants. Over half of those selected agreed to be interviewed.

The nearest supermarket to any residence was 0.8km, so researchers included only small food stores in their determination of availability of fruits and vegetables (measured independently) within 100m, which is approximately equal to the size of a city block. Shelf space for fresh produce and consumption of fresh produce was assessed at zero meters of shelf space within one block, three meters of shelf space within one block, or greater than three meter within one block. As expected, supermarkets allocated a much higher proportion of shelf space to fresh produce than small stores.

Respondents who had access to zero fresh vegetable shelf space within one block of their residence consumed the lowest amount of vegetables. Respondents with access to greater than three meters of shelf space consumed the most. Therefore, more shelf space of fresh vegetables within one block of a respondent's residence was associated with increased consumption.

Because the average intake of fruits and vegetables among study respondents was higher than the national average, the authors acknowledge the possibility that their survey instrument inflated the amounts of fruit and vegetables consumed. In addition, though the response rate was satisfactory for a random telephone survey, it is possible that those who responded were of a different demographic than those who did not, thereby potentially biasing the study. This study adds to the growing body of literature linking increased fruit and vegetable access to their consumption, but cannot prove causation. The authors suggest more studies, perhaps longitudinal or experimental in nature, to determine causation.

Hendrickson, Smith, and Eikenberry (2006) investigated the nature of four food desert communities in Minnesota, two of them urban neighborhoods within Minneapolis and two of them rural areas outside of Minneapolis. The food stores within these food desert communities were mapped using GIS technology. Size, capacity to hold fresh foods, and the presence of air conditioning were recorded. One survey was developed to assess the stores using the Thrifty Food Plan (TFP). TFP is a meal plan created by the United States government that sets national standards in terms of cost and nutrition of foods. The TFP is a type of market basket standardized by age and reflecting current US nutrition and diet recommendations. Focus groups and self-administered surveys were also conducted to obtain diet information, opinions, the use of food assistance programs, and much more demographic data.

In the urban areas studied, 32-53% of foods were found to be significantly more expensive than the TFP market baskets. Results showed that low-income households paid more for their food than higher income households. In addition, this study found the quality and variety of foods available in the identified food deserts to be poor and limited. The authors conclude that increasing access to high quality, affordable healthy foods would increase the likelihood that urban food desert residents would consume an affordable, healthy diet.

Hosler, Rajulu, Ronsani, et al. (2008) also investigated fruit and vegetable availability in urban and rural areas. The urban study area consisted of four neighborhoods in downtown Albany, New York. All food stores were surveyed, including each farmers market, equaling 263 stores. Among other foods, all varieties of fresh fruits and vegetables were assessed. Stores were categorized based on the amounts of fresh fruits and vegetables they carried. A store denoted as an 'FV store' sold at least two different types of fruits (excluding lemons and limes) and three different types of vegetables. In addition, store density per 10,000 residents was calculated.

Urban minority neighborhoods had the lowest density of FV stores, and thus the lowest availability of fresh fruits and vegetables. The urban primarily white neighborhoods had three supermarkets, which the study termed 'super produce stores,' and the urban minority neighborhood had none. Controlling for income and educational status, this study found urban minorities to be at greatest fruit and vegetable access disadvantage.

Hosler, Rajulu, Ronsani, et al. (2008) acknowledge that the season (late summer) during which the data were collected might have influenced the results. In addition, delivery schedules of stores, re-shelving, and quality of produce were not considered. Like the previously discussed studies, this was a cross-sectional study and does not prove that low availability of fruits and

vegetables causes low consumption. These authors recommended policy action to improve retail access of fresh fruits and vegetables in urban, low-income, minority areas.

Jago, Baranowski, Baranowski, et al. (2007) conducted dietary and environmental assessments with 204 Boy Scouts in Houston, Texas. The study aimed to determine whether fruit and vegetable consumption by adolescent boys was affected by distance from residence to small food stores (SFS, including convenience stores and drug stores) and fast food restaurants.

The participants' consumption of fruits, fruit juices, high-fat vegetables (including French fries, potato salad, and coleslaw) and low-fat vegetables was collected. The survey assessed consumption of four juices, 17 fruits, and 17 vegetables. Addresses were entered into a GIS program. Density of food retailers was assessed within a one mile radius of each participants' home.

This study found less access to SFS within a one mile radius of home to be positively associated with fruit and vegetable consumption. These researchers posit that adolescent boys who live further from SFS ate fruits and vegetables at home, perhaps as snacks, and do not eat as many processed foods. This, however, was not assessed in this study. Living further away from a fast food retailer was associated with lower high-fat vegetable consumption. In other words, the adolescent boys who lived closer to fast food stores ate more high-fat vegetables. The authors admit the limited potential of this study to be generalized because of its study population (adolescent boys) and to prove causation because of its cross-sectional design.

Moore and Roux Diez (2006) determined associations between the food environment of three neighborhoods and the corresponding racial and socioeconomic composition. The study areas included parts of North Carolina, Baltimore City and Baltimore County, Maryland, and Manhattan and the Bronx, New York. Food and liquor stores were included in the study. Based

on complex statistical models, the authors found racial/ethnic and socioeconomic composition of these neighborhoods to be strongly associated with type of food stores available. It is intuitive that a Hispanic neighborhood should have Hispanic *tiendas* (small shops) and other minority areas to likewise have culturally appropriate stores. However, Moore and Roux Diez (2006) found more large supermarkets in mostly white and wealthy areas, while they found more liquor stores in minority and low income areas. In addition, researchers found fewer fruit and vegetable markets, specialty stores and natural food stores in minority and low income areas. Across the three study areas, researchers found low-income and minority neighborhoods to have less diverse food environments than wealthier and mostly white areas. Minority neighborhoods had less diverse food environments regardless of income.

This study did not analyze race and socioeconomic status as independent variables. While this raises concerns, the authors did run statistical tests on these variables. They found a strong association between census tract ethnic status and socioeconomic composition. Nevertheless, it is possible that the decision to combine race with socioeconomic status could have affected their results in unexpected ways. The associations found by this study are in agreement with those found in the previously discussed cross-sectional studies, as well as studies soon to be discussed.

Morland, Wing, and Roux (2002) investigated the association between the food environment of a neighborhood and the prevalence of heart disease risk factors, specifically overweight, obesity, and hypertension. Because this was part of a much larger study, investigators were able to obtain data from individual interviews. Food stores were classified into chain or non-chain supermarkets, grocery stores, and convenience stores. Supermarkets and grocery stores were defined primarily by their sizes, with grocery stores being smaller than supermarkets but bigger than convenience stores. Restaurants were classified as full-service,

franchised fast food, and limited service. This study did not detail at what distance a food store was considered accessible to a participant. However, the authors found strong associations between the presence of convenience stores and overweight, obesity, and hypertension. Presence of supermarkets was found to be associated with decreased prevalence of these same indicators. The availability of only supermarkets and grocery stores was also associated with a decreased prevalence of overweight, obesity, and hypertension. The availability of only grocery stores and convenience stores was associated with increased prevalence of these indicators. Based on this study, it seems as though grocery stores can be associated with health based on the environment they are part of.

The authors concluded that neighborhood food environments could play a role in the health of a neighborhood. Causality is not proven here, but it is likely if the food environment were to change, so would the risk factors for heart disease. The authors state that while individuals are growing up, the food environment may be more important than their current food environment, but research is needed in order for this to be determined. The authors suggest that healthy food environments may be achieved with multiple, small stores that sell healthy foods as opposed to large supermarkets. Though causation could not be determined with this cross-sectional study, the authors determined that policy measures to improve nutrition environments could improve cardiovascular disease risk factors.

Powell, Zhao, and Wang (2009) studied young adults' fruit and vegetable consumption and the possible associations with demographic and socioeconomic variables and the food environment. The authors examined price sensitivity to fruit and vegetable consumption by socioeconomic status. Food available in the home and outside of the home was also assessed,



along with prices of other foods in order to compare price sensitivity of fruits and vegetables to that of meat, dairy, and bread.

Data were at collected at the individual and household levels and taken from a broader study, the 1997 National Longitudinal Survey of Youth. Data from the 2002 wave of the study were used for this research. Vegetables did not include french fries or potato chips, and fruit juice did not count as a fruit. Age, race, gender, educational status, college student status, marital status, family structure, number of hours of work (annually), parental income, mother's education, and residential status (urban, suburban, or rural) were controlled for. Food prices were collected from the American Chamber of Commerce Researchers' Association (ACCRA), which collects information on prices across the United States. Four price indices were created: 1) fruit and vegetable, 2) meat, dairy, and bread, 3) food at home, and 4) fast food.

Based on this research, fruit and vegetable consumption among young adults in the US was significantly associated with price. Young adults of higher socioeconomic status were less price sensitive, and those of lower socioeconomic status were highly price sensitive. Because the data used for price indexing came from CCRA, the authors posit that these associations might have been stronger if the data available were of a wider scope (for example, contained more fruit and vegetable varieties and city or neighborhood level data, as opposed to county level data). Researchers suggest, based on their findings, that policy actions to reduce the prices of fruits and vegetables may increase their consumption by low SES young adults.

Ard, Fitzpatrick, Desmond, Sutton, Pisu, Allison, et al. (2007) conducted a school-based study in Birmingham, Alabama regarding in-home availability of fruits and vegetables of children in the fourth grade. Thirty-three schools in three districts were included, and the sample was representative of the Birmingham metropolitan area in terms of income and race.

Availability of thirteen fruits, eighteen vegetables, and three 100% fruit juices was assessed via questionnaires, which were conducted in person by investigators. The order of the schools to be assessed was also randomized. Availability was defined as an item having been in the home, available for consumption in the past two weeks. Height and weight of parents and children were taken and BMIs were calculated. Costs of items were obtained through the United States Department of Agriculture (USDA) Research Service. The average cost of each food item was recorded.

Based on results of study, the authors concluded that the high cost of fruits and vegetables was a barrier to in-home availability and consumption of fruits and vegetables. They also found that African Americans have higher in-home availability of fruits and vegetables compared to white Americans. The authors cited numerous reasons for why their results differ from other similar studies. The difference is the traditional diet of African Americans in Alabama, which includes greens and okra, as opposed to that of white Americans, which includes fewer vegetables.

A study in Australia (Winkler, Turell, and Paterson, 2006) had findings that differed from those of the majority of studies conducted in the United States and the UK. Fifty districts were randomly sampled in Brisbane as part of the Brisbane Food Study. Each supermarket, 'greengrocer' (also known as a specialty grocery store or whole food store), and convenience store within 2.5km of the neighborhood was reported, however gas-station convenience stores were excluded. Researchers recorded the prices in each store of the 10 most commonly consumed fruits and vegetables in Australia.

Results from the Brisbane Food Study found that, though Brisbane is a densely populated urban area with distinct areas of poverty, the city was not a food desert (Winkler, Turrell, and

Patterson, 2006). Because food deserts could have very different characteristics than other high poverty areas, these findings cannot be extrapolated to include food deserts. The authors of this particular study found no significant difference in the cost or availability of high quality fresh fruits and vegetables in areas with lower socioeconomic status. The authors attributed this difference between Australian urban cities and those in United States and UK to the lack of urban sprawl in Australia. Winkler, Turrell, and Patterson (2006) explain that the more affluent populations of Australia are drawn to the cities, not suburbs, and therefore supermarkets, farmers markets, and specialty food shops are abundant in Brisbane. In addition, it is likely that the socioeconomically disadvantaged populations in Brisbane are not necessarily as deprived as those in the UK or the United States (Winkler, Turrell, and Patterson, 2006).

These cross-sectional studies have amassed an important body of information about food environments in urban areas. Since studies that had contradictory findings to the majority are also quite different from the majority, it is reasonable to formulate hypotheses. First, food deserts may have different characteristics than other areas of deprivation, and therefore may have different results when researched. Second, race may be a larger factor than is currently being assumed. Since findings associated race and ethnicity with lower availability of unhealthy foods and unhealthy eating practices regardless of income, it is important to note that race is likely to be playing a significant role in the food environment and should therefore be investigated further. In addition, findings suggest that both price of healthy foods and distance to healthy food sources are inversely associated with healthy food consumption. These are all issues that should be considered carefully when interpreting results and proposing research studies.

## 4.2 INTERVENTION STUDIES

Three major intervention studies have been conducted regarding the development of food retail in urban food desert areas. These studies collected data before a food retailer was developed in an area and again after it was in operation, with the development of the food retailer being regarded as the intervention. The difference between the before data and after data was tested for significance, based on the criteria for each study. Known confounding factors were identified and controlled for when possible. These studies have been conducted in London, Ontario, Canada; Leeds, England; and Springburn, Glasgow, Scotland.

Two of the three intervention studies found food desert conditions to be alleviated with the establishment of a large, centrally located food retailer. These studies were conducted in London, Ontario, Canada and Leeds, England. The third study, conducted in Springburn, Scotland, did not find a significant change in the food environment with the introduction of a large food retailer. It is important to note that the study with contradictory findings was quite different from the other two. First and foremost, the authors stated that Springburn could not be identified as a food desert, although it was highly deprived. This indicates that a food desert may respond differently to an intervention than a 'highly deprived' area. In addition, the Springburn study allowed one year between the pre-intervention and post-intervention data collection periods, while the Canadian and English studies allowed three years. This indicates the possibility that adequate time is needed before changes produced by the intervention can be detected.

## **London, Ontario, Canada**

Larsen and Gilliland (2008) found that, after three years of operation, a new farmers market introduced in the Old East neighborhood of London, Ontario, Canada made a significant impact on the food environment. The Old East neighborhood of London, Ontario had previously been identified as a food desert. The farmers market was developed in a central location and had over 50 food vendors and just as many, or more, non-food vendors. The introduction of the market substantially decreased the cost of food for households in the neighborhood and greatly increased access to those foods.

This study used the Ontario Nutritious Food Basket (ONFB) to assess cost and availability of healthy food. A food basket represents what a person or family would ideally eat over a given period of time, such as one week or one month and includes nutritious and realistic foods. The ONFB is a tool that measures where foods are accessed and how much each item costs (only the lowest cost identified is recorded) and consists of 66 varied, healthy food items. In each neighborhood, every food retailer in the area was studied in order to find each of the 66 necessary items at the lowest cost available. The prices of healthy foods were compared by assessing the average costs of filling an ONFB across the city at supermarkets, and then again in the study region, which did not have a supermarket.

Though this study assessed cost and availability of healthy food, and not consumption, it is widely agreed that increased access and availability and decreased cost of fresh produce correlate with an increase in consumption of fresh produce (Rose, Hutchinson, Bodor, Swalm, Farley, Cohen, et al, 2009; Spence, Cutumisu, Edwards, et al, 2009; Powell, Zhao, and Wang, 2009). Analysis occurred three years after the intervention, and Larsen now asserts that this neighborhood is no longer a food desert due to the impact of the farmers market on price and

availability of fresh, healthy, affordable foods. These findings could have major policy implications for the alleviation of food deserts.

### **Leeds, England**

Published in 2003, the Leeds Food Deserts Study (Wrigley, 2003) was the first before and after study “...of food consumption in a highly deprived area of a British city experiencing a sudden and significant change in its food-retail access” (pg. 151). A new supermarket was placed near the center of the city, in an area called Seacroft, which was within the top 5% of the most deprived wards in England. The ‘after’ portion of the study was conducted three years after the establishment of the new supermarket, Tesco. Prior to the establishment of the new supermarket the average travel distance for a Seacroft’s residents to their primary food source was 2.5km. Post-intervention, the average distance fell to 0.98km. In addition, the residents with the highest deprivation, and therefore the highest nutritional risk, switched to Tesco as their primary food source in the greatest numbers. Being at nutritional risk in this study is defined as the people who ate the fewest fruits and vegetables. The large-scale switch to Tesco as the primary food retailer for families was largely due to the fact that Tesco was strategically placed in the most deprived area, and therefore easily became the primary food source of the nearby residents (Wrigley, 2003).

Information was gathered via surveys and interviews of over 1,000 low-income households in the areas of interest pre-intervention and over 600 low-income households post-intervention. Trained interviewers administered surveys and interviews; information gathered was primarily self-reported (seven-day food recall, for example, requires respondents to remember everything they ate for the past consecutive seven days).

Over 60% of people who were at highest nutritional risk had significantly increased their fruit and vegetable intake (Wrigley, 2003). In addition, those who switched to the new store significantly increased their fruit and vegetable consumption by 0.23 portions per day while those who did not change their primary food source did not. In terms of nutrition, an average change of ¼ of a serving is substantial, given the difficulty in changing dietary patterns and the small number of servings required per day (three servings of vegetables and two servings of fruits). This effectively minimized the disparity between the group that switched to the new store and the group that did not change its primary food source.

This study also found, post-intervention, three times more people walked to their primary source of food (in this case, most were people who switched to the new store) than before. In addition, those who lived within 750m of the new store improved their fruit and vegetable intake the greatest amount. The respondents who lived the furthest away improved less than those who lived closer, indicating a direct and important link between distance to healthy food sources and the consumption of healthy foods.

### **Springburn, Glasgow, Scotland**

Cummins, Petticrew, Sparks, and Findlay (2008) had findings that were different from the Canadian and UK studies. This study was also designed as a before-and-after intervention study. Data were collected via postal surveys in Springburn, the intervention area, and Shettleston, the comparison area. Surveys had a very poor pre-response rate, only about 15% in both areas pre-intervention. Pre-intervention and post-intervention surveys were matched, so individual changes were measured. Post-intervention response rates were between 65-70%, indicating that many of those who initially took the survey did respond post-intervention. The low pre-intervention

response rate has the potential to bias the study, as the author admits, citing that highly deprived populations typically have low postal survey response rates. This may mean that the people who are the most affluent in the area were the ones who returned the surveys, and since these are also the people who are least likely to need to make dietary changes, data gathered may not reflect true changes within the neighborhood. Surveys were self-administered and, like the Leeds study, based on self-report. Qualitative data were gathered via focus groups.

The authors found no evidence that the new 'hypermarket' changed fruit and vegetable consumption, though other benefits were found, including improved mental health, more positive attitude towards neighborhood, and the creation of 450 jobs, over half given to locals (Cummins, Petticrew, Sparks, et al. 2008).

There are several possible explanations for the different findings of this study from those previously discussed. First, the Leeds study had over twice the response rate of the Springburn study. This has a great potential to bias the results, as the poorest and least educated populations are the least likely to respond to postal surveys (Cummins, Petticrew, Sparks, et al. 2008). This implies that, since the Leeds study found the poorest to be the most nutritionally at risk, and the poorest are also less likely to respond, that the population that benefited the most in the Leeds study is the same population less likely to respond in the Springburn study. If the poorest populations in Springburn and the Leeds study behave similarly, it is predictable that the Springburn study would not detect any changes. In addition, Cummins, Petticrew, Sparks et al. (2008) admit that Springburn cannot be identified as a food desert, though it is deprived by Scottish standards. The implication is that there might be a level of deprivation experienced by individuals that results in a larger response to interventions involving new food stores, and it is possible that Springburn did not meet this level.



Another major difference between this study and the two studies discussed above is the length of time between the intervention and post-intervention data collection. Both the Canadian and English studies discussed above had a three-year interval between intervention and data collections, during which time the populations changed their behavior drastically. Given only one year of intervention in the study discussed here, and the slow nature of human behavior change, it is possible that this study simply did not wait long enough to detect the effect of a new market on the food environment. These differences possibly indicate an inadequate study design, and therefore the results should be interpreted carefully.

Two of the three intervention studies, conducted in Canada and England, found food desert conditions to be alleviated with the establishment of a large, centrally located food retailer. The third study, conducted in Scotland, did not find a significant change in the food environment with the introduction of a large food retailer. It is important to note that the Scotland study was quite different from the other two. First and foremost, the authors stated that Springburn could not be identified as a food desert, even though it was highly deprived. This indicates that a food desert may respond differently to an intervention than a ‘highly deprived’ area. In addition, the Springburn study allowed one year between the pre-intervention and post-intervention data collection periods, while the Canadian and English studies allowed three years. This indicates the possibility that adequate time is needed before changes produced by the intervention can be detected.

More quality before and after studies are needed in food deserts in order to properly identify the magnitude of change a new healthy food source can have on the diet of urban food-insecure populations. In addition, these studies are needed in the US in order to determine if food deserts within the US respond similarly to those in Canada and England.

### 4.3 POLICY

It is agreed that in urban food-desert conditions, low-income populations have limited access to healthy foods. For this reason policy should improve the foods to which this population has access. Authors have differing opinions, however, on how this could be effectively accomplished. Some authors believe that policy should support the construction of supermarkets in food deserts to alleviate unhealthy food environments while others believed policy should focus on supporting small stores and farmers markets. Some researchers conclude that price manipulation to decrease the cost of healthy foods and increase the cost of unhealthy foods would be an effective way to improve eating habits of food-insecure urban populations. Other researchers believe that simply changing the mix, or selection, of foods offered in a given area would improve eating habits.

Many of the studies reviewed for this paper gave policy recommendations based on their findings to either alleviate food desert conditions or improve access to and availability of high quality, fresh, healthy foods. There is support for development of large chain supermarkets within food deserts, enhancement of current convenience stores and small grocers to supply healthy foods, the creation of farmers markets, and partnerships between schools and local food producers. In addition, there is support for a combination of these and others to create sustainable, healthy urban food systems.

Recent evidence indicates a need for public health policies that will increase fruit and vegetable access in disadvantaged communities, and a need for policy makers to consider urban minority populations a priority (Hosler, Rajulu, Ronsani, et al., 2008). It is clear that public policy needs to play a central role in order to change the dietary habits of urban dwellers, since

“individual behavior change is difficult to achieve without addressing the context in which people make decisions” (Story, Kaphingst, Robinson-O’Brien, and Glanz, 2008, pg. 266). In short, for people to make healthy choices, healthy choices must be so easy as to be the default behavior, much like unhealthy eating is currently.

### **4.3.1 Food Retailers**

Many contend that the best way to improve diets of urban populations is to improve the food retailers available to them (Rose and Richards, 2004; Zenk et al. 2005, Chung and Myers, 1999; Guy, 2004; Bodor, Rose, Farley et al. 2009; Moore and Diez Roux, 2006; Whitacre, Tsai, and Mulligan 2009). This can include either supermarkets or small food retailers, though improving each has different meanings and consequences.

#### **4.3.1.1 Support for Supermarkets**

It is agreed upon in the reviewed literature that easy supermarket access is associated with increased household fruit and vegetable consumption (Rose and Richards, 2004; Zenk et al., 2005) and decreased BMI, obesity, and numbers of people who are overweight (Rundle et al., 2009; Morland, Wing, and Roux, 2002). Citing their finding that fruits and vegetables are 50% less available in cities than in suburbs and that chain stores have higher quality produce and lower prices, Chung and Myers (1999) recommended supporting the development of chain supermarkets in urban areas. Based on the findings that urban African American women with higher incomes shopped at supermarkets and also had higher intakes of fruits and vegetables, Zenk et al. (2005) concluded that poor access to supermarkets in African American neighborhoods could have negative effects on residents’ fruit and vegetable intakes.

Guy (2004) concluded that relying on small stores to increase supply of and access to healthy, high quality produce might not be the best strategy in the short term. Instead, policy makers should focus on ways to increase access to supermarkets. In addition, Guy (2004) recommends offsetting some costs for chain supermarkets in urban areas, since costs are higher to develop in urban areas due to additional costs associated with crime, theft, extra security, and taxes. Guy (2004) also recommends, for the purposes of neighborhood acceptance and improvement, that chain supermarkets allow joint ownership or franchise management by residents and food retail establishment owners. According to the author, this would alleviate tensions that could arise from competition created by inner-city development in areas where a large, chain supermarket might cause the demise of small, independently owned grocers.

Bodor, Rose, Farley et al. (2009) found that supermarkets had much more shelf space dedicated to fresh fruits and vegetables than small grocery stores, and that people who owned a car were more likely to shop at supermarkets. In addition, the authors found that those who owned a car ate more servings of fresh produce daily than those who did not. Bodor, Rose, Farley et al. (2009) concluded that increased access to grocery stores could increase fruit and vegetable consumption among those individuals residing in urban environments with limited access to such stores.

In order to convince large supermarkets to establish themselves in low income, urban areas, consideration and compensation should be given. For examples, since it is known that supermarkets avoid urban areas because of extra costs, these costs should be offset. Local officials should find solutions to alleviate these costs, such as giving grants for construction and sufficient outdoor lighting, providing extra security, and tax breaks or tax incentives for establishing themselves in urban areas. In addition, in order to increase neighborhood acceptance

and to minimize the negative effect a large supermarket might have on owners of small ‘mom and pop’ stores, local officials should mediate agreements between the supermarket owners and locals to ensure employment of locals at the supermarket. This way, owners and workers will not be unemployed because of the new supermarket.

#### **4.3.1.2 Support for Small Stores**

Supermarkets are strongly associated with available, affordable healthy foods (Bodor, Rose, Farley et al, 2009; Guy, 2004; Chung and Myers, 1999; Rose and Richards, 2004; Zenk et al, 2005). However, it can be argued that building large urban supermarkets is not the only way to improve urban food environments (Moore and Diez Roux, 2006). It is suggested that there are many positive consequences of small neighborhood stores. These include neighborhood walkability, improved street life and increased social interactions between neighbors (Moore and Diez Roux 2006). In order to reap the total benefits of small neighborhood stores that are already in existence, it may be helpful for policy makers to work with small stores to increase the number of high quality, healthy foods offered to promote healthy eating (Whitacre, Tsai, and Mulligan 2009). In addition, Whitacre, Tsai, and Mulligan (2009) suggests strategic urban planning when considering locations of small food stores and farmers markets, citing an example of a very successful market placed near Women, Infants, and Children (WIC) offices in urban areas (Whitacre, Tsai, and Mulligan, 2009).

In 2000, Reisig and Hobbiss identified two major factors in food poverty: general poverty and the structure of the food system, which currently favors corporations and large financial returns. Therefore, in order to alleviate food poverty, either income or food can be redistributed, or both. Support should be given to local food producers and processors, community cafes, co-ops, small food retailers, local store branches, and school cafeterias to favor fresh, local produce

to sell to locals. This will stimulate a healthy food economy, both in terms of a stable, sustainable, and local food system and a system that provides healthy foods and creates jobs and training for locals (Reisig and Hobbiss, 2000).

Support for small food stores can be given in the form of grants or very low-interest loans in order for small food stores to procure the equipment necessary to hold and distribute fresh fruits and vegetables and other healthy foods. Lack of coolers and air conditioning are is one major reason small food stores cannot carry fresh produce. In addition, providing small stores with extra security systems, or the monetary funds to purchase these systems, to reduce theft would be a helpful way to reduce costs. Finally, subsidizing the cost of produce and other healthy foods will ensure that these foods are sold and are not lost to spoilage, in addition to ensuring affordability of these foods to local residents.

#### **4.3.2 Price Manipulation**

Not only is it intuitive that foods, including fruits and vegetables, are purchased and consumed more when they are cheaper, there is now evidence to substantiate this intuition (Powell, Zhao, and Wang, 2002). Based on national data, the authors found adolescents and adults of low to middle socioeconomic status to be highly sensitive to the price of fruits and vegetables. In other words, this study found that people who have low income and low education levels are highly price sensitive when it comes to purchasing fruits and vegetables. Therefore, the authors suggest subsidies or decreased taxes on production, sale, and purchase of fruits and vegetables in order to make healthy choices affordable. Whitacre, Tsai, and Mulligan (2009) support price manipulation not only to decrease the cost of fresh produce, but also to increase the price of unhealthy foods (which could, theoretically, subsidize the cost of fresh produce).

### 4.3.3 Food Environment

Many researchers believe that an effective way to improve the eating patterns of urban populations is to change the foods that are offered within that environment (Spence, Cutumisu, Edwards, et al., 2009; Moore and Diez Roux, 2006; Farley, Rice, Bodor, Cohen, Bluthenthal, and Rose, 2009). Therefore, another policy option is to support healthy eating in food deserts by improving the food retail environment via zoning by-laws (Spence, Cutumisu, Edwards, et al., 2009). By-laws are local, specialized laws. These types of laws could essentially disallow a certain proportion of unhealthy foods to be sold within a certain area. By creating definitions of healthy and unhealthy food mixes, local authorities could mandate a certain mix of foods within a certain environment. While Moore and Diez Roux (2006) cite the need to determine the minimum level of food availability that would ensure a healthy diet with urban areas, it may still be helpful to provide incentives to stores that sell healthier foods, based on a minimum shelf space ratio of healthy foods to a maximum of unhealthy foods (Farley, Rice, Bodor, et al., 2009). Increasing the number of stores in an area with a healthy food mix has powerful potential to enhance the diet of a food desert population, where a healthy food mix is the ratio of a minimum level of healthy food to a maximum level of unhealthy food. (Farley, Rice, Bodor, et al., 2009).

Many researchers have concluded that policy should play a major role in alleviating food desert conditions in urban areas. Some of the researchers mentioned above believe that food retail should be enhanced and supported in urban food desert areas. This includes either the establishment of large supermarkets or enhancing the abilities of small food stores to carry fresh foods. Some researchers support manipulating food prices to both favor the purchasing of healthy foods and discourage the purchasing of unhealthy foods. Other researchers believe that changing the food environment by regulating how much of which products can be sold in a given

area would be highly effective. In this way, there will be more healthy foods available than unhealthy foods, increasing the likelihood that healthy foods will be chosen for consumption.

Table 2 is a summary of the studies reviewed in this paper and their findings regarding how healthy food consumption is affected by the availability of healthy foods, cost of healthy foods, race, distance to healthy food sources, and income.

**Table 2 Summary of Results**

AUTHOR	YEAR	LOCATION	AVAILABILITY	(-)* COST	RACE (W>B)**	(-)* DISTANCE	INCOME
Ard	2007	Alabama	-	-	-		
Baker	2006	Missouri			+	+	+
Bodor	2008	Louisiana	+	+	+	+	+
Cummins	2005	England	-	-		-	
Chung	1999	Minnesota	+	+	+	+	+
Dixon	2007	Australia	+	+			
Donkin	1999	England	+	+		+	
Farley	2009	California	+	+		+	
Glanz	2005	US	+	+	+	+	+
Guy	2004	England	+	+		+	
Hendrickson	2006	Minnesota	+	+		+	+
Hosler	2008	New York	+	+	+	+	
Jago	2007	Texas	+			+	
Larsen	2009	Canada	+	+	+	+	+
Moore	2006	New York	+	+	+	+	+
Moore	2008	New York	+	+	+	+	+
Morland	2002	US	+	+		+	
Morland	2006	US	+			+	
Powell	2009	US	+	+	+	+	+
Raja	2008	New York	+	+	+	+	
Rose	2009	Louisiana	+		+	+	
Rundle	2009	New York	+			+	
Spense	2009	Canada	+			+	
Story	2008	US	+	+	+	+	+
Winkler	2006	Australia	-	-			
Wrigley	2003	England	+	+	+	+	+
Zenk	2005	Detroit	+				+

**Factors that affect the consumption of healthy foods. \*Indicates an inverse relationship. \*\* Indicates the assumption that Caucasuion/white consumption of healthy foods is greater than that of African American/Black. + Indicates that an association was found. – Indicates that no association was found.**



## 5.0 DISCUSSION

The effects of urban food desert conditions are wide and far-reaching. Low-income minorities, who tend to be the population within urban food deserts, are the most affected. Having restricted access to healthy foods that can help prevent disease and abundant access to unhealthy foods that can cause disease puts this population at the greatest health risk.

In urban areas, those who have the best access to the healthiest foods tend to have healthier diets, and those who have the greatest access to unhealthy foods tend to have the poorest diets (Baker, Schootman, Barnidge, et al., 2006; Bodor, Rose, Farley, et al., 2008; Hendrickson, Smith, and Eikenberry, 2006). In addition, those with greater access to healthy foods have lower BMIs and decreased risk of obesity compared to those who have less access to healthy foods (Rundle et al., 2009). Rates of obesity and cardiovascular disease have been attributed to low availability of healthy foods in low income, minority populations (Kanjilal, Gregg, Cheng, Zhang, Nelson, Mensah, et al., 2006; Mensah, Mokdad, Ford, Greenlund, and Croft, 2005).

Two well-conducted intervention studies concluded that introducing a large healthy food retailer into a food desert could drastically change issues of access and availability in urban areas (Larsen and Gilliland, 2008; Wrigley, 2003). These authors argue that simply introducing a large, centrally located food retailer can alleviate food desert conditions. Another intervention study did not corroborate these findings. However, this study differs greatly from the other two

(Cummins, Petticrew, Sparks, et al., 2008). The conditions of the food environment were not discussed in great detail: however, the authors admitted that the area could not be defined as a food desert. Rather, this study was conducted in an area the authors described as ‘deprived.’ In addition, this study is not comparable to the others because of the very low initial response rate. Since only 15% of the study population responded, the results are not representative of the population in the area and also cannot be generalized to other populations or compared to other studies with higher response rates. These findings suggest that areas that are deprived but not classified as food deserts may not respond to an intervention in the same way a food desert would (Cummins, Petticrew, Sparks, et al., 2008; Winkler, Turrell, Paterson, 2006).

Many of the studies reviewed for this paper discussed policy-level action in order to alleviate food desert conditions. A popular suggestion was to support food retailers, such as large chain supermarkets, to increase access to affordable, high-quality fruits and vegetables (Chung and Myers, 1999; Bodor, Rose, Farley, et al., 2008; Guy, 2004; Zenk et al., 2005). Supporting existing small stores in urban areas to address issues of cost, quality, and access was another option (Moore and Diez Roux, 2006; Reisig and Hobbiss, 2000; Whitacre, Tsai, and Mulligan, 2009). In essence, all of the above research supports creating and sustaining food retail infrastructure in urban food desert neighborhoods to solve food insecurity issues. These approaches provide opportunities to support the economic development of disadvantaged neighborhoods, which can yield ancillary benefits that have been mentioned, but are not the focus of this paper.

A relatively new approach is the idea of price manipulation to increase the consumption of healthy foods and decrease consumption of unhealthy foods (Powell, Zhao, and Wang, 2002; Whitacre, Tsai, and Mulligan, 2009). The research conducted by Powell, Zhao and Wang (2002)

is unique and profound; this research explains food consumption in terms of economic decisions based on the idea of price elasticity (meaning how likely a person is to purchase something when the price changes). These authors found people of low to middle socioeconomic status are highly sensitive to prices when purchasing fruits and vegetables. This means that low income disadvantaged urban populations are more likely to buy fruits and vegetables when prices are low and unlikely to buy them when prices are high. This is strong evidence that decreasing the prices of fresh produce may increase its consumption. Whitacre, Tsai, and Mulligan (2009) take this idea one step further and suggest increasing the cost of unhealthy foods to help subsidize the cost of healthy foods and also to discourage the excess consumption of unhealthy foods (though the assumption that people will consume fewer unhealthy foods if they are more expensive is not based on price sensitivity of unhealthy foods).

Farley et al. (2009), Moore, Diez Roux, Nettleton, et al. (2008), and Spence, Cutumisu, Edwards, et al. (2009) support using policy to create healthy food environments by controlling which and how much of certain foods are available in certain areas. Creating local, amendable laws that dictate the allowed ratio of healthy to unhealthy foods available is a viable policy option that has the potential to greatly improve the dietary habits of nearby residents.

Donkin, Dowler, Stevenson, and Turner (2000) describe a method of mapping an area based on cost, quality, and availability of food within an area (which, when conducted in London, found a much greater availability of unhealthy than healthy foods). This method, which can be modified as necessary to include variety of foods available, should be the starting point of food retail interventions. This detailed map would ensure accurate evaluation of an intervention, as well as an excellent way to prioritize areas of greatest need within an urban setting.

In addition, such a map would allow the opportunity to develop ‘zones’ for the creation of policy, as described by Spence, Cutumiso, Edwards, et al. (2009), to dictate how much healthy and unhealthy food should be available in an area. Predictably, the problem of defining ‘unhealthy’ foods and ‘healthy’ foods has long posed a problem to legislators. One approach could be to begin with simple definitions regarding processing, packaging, additives, and produce (from local farming efforts), allowing for later revisions.

Improving the food environment, discussed previously in relation to Figure 1, includes the food offered in school to children, teachers, principals, and others. Though not extensively addressed in the literature, building partnerships between inner-city schools and local farmers/farmers markets has the potential to greatly improve the diets of high-risk children and should be given very serious consideration. Partnerships such as these could have very little cost associated with them, yet still yield substantial benefits for the community

Based on the literature reviewed here, increasing access to affordable, fresh, healthy foods in urban areas is likely to increase the consumption of fresh, healthy foods. The ideas generated by the research could be used together in a mass effort to improve the diets of low income, urban populations. For example, a local, policy-level effort (neighborhood, city, or county-wide) to build new food retailers in conjunction with efforts to support existing food retailers has the potential to significantly improve healthy food access. In addition, monitoring and regulating the foods that are offered by using GIS mapping technology and a healthy food mix minimum would ensure that residents have access to foods that are indeed healthy, of high quality, and affordable. In this way, it is possible to improve the food environments of urban areas effectively.

The body of literature on the topic of food access in urban areas lacks information regarding resources necessary to improve food environment conditions. The cost of building a new supermarket in an urban food desert environment is not readily available, nor is the cost of improving a small food store so it can hold and sell fresh produce. Obtaining these data would allow a cost-benefit analysis to be conducted regarding which approaches are best in terms of both cost and effectiveness. In addition, this information would allow different neighborhoods or cities to make decisions about their food environment that are individualized to their specific situation, making any effort more likely to succeed.

Also lacking in this body of literature are standardized measurement tools. Many researchers used the GIS mapping system as a tool to determine food availability and access in a neighborhood, however no study defined the term neighborhood. In addition, no two studies used the same 'distance to food retailer' as a measurement of availability. One study used a one-block radius from a residence to food retailer as a measure of availability, while another used one kilometer, and still another used 3 blocks. In addition, there is no standard tool to measure food intake, which is typically self-report and therefore inaccurate, or quality of food (some studies used the presence of brown spots on fresh fruits or vegetables, but did not address under-ripe produce or other types of spoilage). The absence of standardized measurement tools limits the ability of the findings from these studies to translate into policy action. Policy makers will need these studies to correspond to one another. Since it is agreed that policy action is needed standardized measurement tools are also needed. In addition, a widely accepted definition of food desert that differentiates a food desert from a 'highly deprived area' is required.

## **6.0 RECOMMENDATIONS AND CONCLUSION**

This review demonstrates the importance of urban food availability for diet and health outcomes and the disparities present among minorities and low SES populations. If we are ever to reach the Healthy People 2010 goal of eliminating health disparities, we must begin with food access and availability. Urban minority populations should be the first priority, based on research that finds these populations to be the most disadvantaged in terms of access and availability of healthy foods (Hosler, Rajulu, Ronsani, et al., 2008).

Because of the significant public health effects of healthy food access in urban populations, public health policy must be part of the solution. Combining strategies suggested in the literature would facilitate the development of a fast and effective strategy to alleviate food insecurity for vulnerable populations. Since improving food access by supporting the current food retail infrastructure in urban areas would yield the fastest results, this should be immediately addressed. Tax breaks could be given to stores willing to increase their healthy food mix. Though a minimum healthy food mix ratio is yet to be determined, significantly improving the ratio of healthy food to unhealthy food in favor of fresh produce and other healthy foods, such as whole grains and minimally processed foods, is a good first step. Other incentives such as low-interest loans or grants could be given to these stores in order for them to purchase the necessary equipment and make the necessary changes to accommodate fresh produce and other healthy foods.

For now, unless the community feels strongly, it appears that valuable time and resources could be better used elsewhere, rather than investing in the development of urban supermarkets, due to a number of factors. For example, sufficient space for large stores is might be difficult to find in urban areas. Since the literature has found the shelf-space ratio of healthy foods to unhealthy foods to be a predictor of healthy food consumption, regardless of supermarket access, small food stores could improve the urban food environment. Therefore, the resources necessary to attract and maintain large chain supermarkets into urban areas might be more effectively used to create a healthy food environment by supporting current small neighborhood stores, developing farmers markets, and developing partnerships between retailers and schools with farmers.

This paper is a literature review of mostly cross-sectional studies (indeed, this is the bulk of the research available for review) and therefore has limitations. The data upon which this review and its recommendations are based cannot prove that food environments cause people to eat in a certain way, only that environments are associated with diet. Therefore, it is also recommended that more data be amassed. More research into food mix ratios and healthy eating patterns will ultimately enable scientists and policy makers to establish a minimum healthy to unhealthy food-mix ratio in a defined area. This will allow more effective, evidence-based laws to be created regarding the ratio of healthy foods and unhealthy foods that is allowed to be sold in a certain area. Conducting high-quality intervention studies here in the United States will give more information on the effectiveness of developing new food retailers in food deserts. Currently, only the three previously discussed intervention studies prove that healthy food access dictates healthy food consumption, since most of the literature contains cross-sectional studies. More research is needed in order to determine if food insecurity causes insufficient and non-

nutritious diets and justify a strategic course of action. Though more information is needed, without intervention urban populations will continue down a path of worsening health outcomes and greater disparities between white and minority populations.

Because the definition of food desert has yet to be solidified and widely accepted, this author proposes the use of ‘empowerment zones’ as identified by the US Department of Housing and Urban Development (HUD) as a starting point for interventions. Empowerment zones are urban areas that are in need of resources in order to be sustaining and self-sufficient economies. Part of the criteria for becoming an empowerment zone (EZ), renewal community (RC), or enterprise community (EC), which all have similar definitions but different funding sources, is lacking healthy food resources (<http://www.hud.gov/offices/cpd/economicdevelopment/programs/index.cfm>). Because of this requirement, this author suggests using urban EZ/RC/ECs as a starting point for interventions. Centrally locating intervention retailers within EZ/RC/ECs, or supporting existing small food retailers that are centrally located within EZ/RC/ECs, may be a way to differentiate between ‘food desert’ communities and ‘deprived’ communities.

More research is necessary in order to make decisions that will benefit urban food desert neighborhoods across the United States. Intervention studies involving small food stores and large supermarkets alike are needed. Improving many small stores in a neighborhood may have an effect on the residents’ diet and health similar to having access to a supermarket, but we do not have evidence to support this theory yet. Resources that go into improving small food stores and establishing supermarkets in food desert areas should be carefully recorded for the purpose of comparison. Such resources could include grants, low-interest loans, tax breaks or tax incentives, donations, or anything else that is instrumental for increased development of the retailer. Benefits, including improved dietary patterns, improved mental health, and decreased



cost of food should also be carefully recorded for comparison. These data will allow a cost-benefit analysis to be performed, which might be the best tool to determine the most appropriate course of action.

In the meantime, action must be taken. Though it is possible to compare pre-intervention conditions and post-intervention conditions based on existing data, there have not been intervention studies of this type in the US. In order to obtain the most accurate information, these studies should be conducted here in the US over a similar time frame, under demographically similar conditions so data are easy to compare and results are reliable and valid. In this way we could determine the best course of action to alleviate food desert conditions. The United States could finally change the nature of health disparities within our nation and make a giant leap towards achieving both of the Healthy People 2010 Goals of increasing years of healthy life and eliminating health disparities.

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