FOOD ACCESS IN WILMINGTON, DELAWARE:
A SPATIAL ANALYSIS

by
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A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Master of Arts in Urban Affairs and Public Policy

Summer 2015

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ACKNOWLEDGMENTS

This thesis project turned out to be far more exciting than I ever anticipated, especially given its potential implications for healthy food initiatives, which I’ll soon be working on. I am fortunate to have had a fantastic committee that was willing to cultivate my interests and assist my development. I would like to extend my sincere thanks to Drs. Allison Karpyn, Kelebogile Setiloane, and Harvey White.

I wish to express my gratitude to the School of Public Policy & Administration and the Center for Community Research and Service for the opportunity, particularly Dr. Danilo Yanich and Diana Simmons for their genuine support and concern over the past two years. Whether invaluable lessons outside of the classroom or levity to lighten the mood, encouragement from Dr. Yanich was both needed and welcomed. Diana’s employment responsibilities involve administrative tasks, but I am most grateful for the support she provided that was not part of her job description; it was priceless.

Finally, I must acknowledge those most dear to my heart. Thank you to my family for being my biggest fan. Without the encouragement of my husband, Chris Moss, my mother, Judy Maybon, and my niece, Bianca Porter, I would not have completed the program.
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Health implications associated with food access are of grave importance, as the state of one’s well-being has layered components – mental physical, social, intellectual, and environmental, of which nutrition is entangled. Research regarding food access, or lack thereof, suggests the lived-environment influences consumption. Limited availability can translate to poor dietary intake and subsequent risk of disease, chronic conditions, and morbidity. Discussion of food deserts often involve urban areas where people, mainly minority and low-income, do not have affordable, healthy food access. A universal definition of food desert does not exist, but commonly implicated are economic and geographic barriers to healthy foods. Environmental conditions prevalent among food availability include socioeconomic factors -income, education, employment, and race- that impact weight and health. Increasingly, public, private, and not-for-profit organizations have turned their attention to the concerns of health inequality and nutrition-related chronic disease. The prevalence of obesity, particularly among low-income populations, is of global concern. This study provides a spatial examination of retail food access in Wilmington, Delaware, a predominantly African-American community, the majority of which is female-headed households living below the poverty level. This spatial examination describes how objects (retail food outlets) fit together in space (Wilmington, Delaware). It includes the association with socioeconomic factors that impact health within twenty-four (24) census tracts that comprise the City of Wilmington. The objective is to explore the extent to which food access affects minority population segments. Census tract data from American
Community Fact Finder (2013 ACS 5-yr estimate) is used for socioeconomic demographic and socioeconomic analysis. PolicyMap provided the spatial map output of retail food outlets, socioeconomic characteristics, and health outcomes – diabetes, stroke, hypertension, and obesity. Spatial analysis, as illustrated in this study of food access in Wilmington, Delaware is a useful tool in policy-making as it can offer visual images of specified characteristics to tell a story and assist with identifying target areas for health-related interventions.

The results of the study indicate that as the percentage of minority population increases, access and availability decreases. Moreover, as the concentration of African-American increases, access to full service supermarkets decreases.
The term health refers to one’s mental or physical well-being. It is a condition that does not occur in isolation, but rather is linked to one’s environment – where one is born, resides, and grows. The lived-experience is therefore a critical component of well-being and the community environment plays a compelling role. It [the community] -regardless of characteristics, impoverished or wealthy- offers both buffers that support the soundness of body and mind and present impediments to positive development. Food access and availability has dietary consequences, and socioeconomic factors within the environment are associated with diet, health, and weight.

Poor diet quality is common among communities with residents of low economic status, food insufficiency is positively associated with obesity, fruit and vegetable consumption has been shown to influence the risk of disease, and increased fruit and vegetable intake is more likely among people with higher education and socioeconomic status. Neighborhoods in Wilmington, Delaware, like many urban cities, are plagued by limited access to healthy food, neighborhood concentration (by race and income), and nutrition-related health challenges associated with said characteristics.
As a former community development professional I facilitated and supervised single-family mortgage transactions for many customers, predominantly minority. The loan products used often subsidized the purchase of homes in targeted census tracts – mainly low-to moderate-income census tracts. I was pleased to assist customers with homeownership, but was not aware of the outcomes associated with neighborhood concentration. Since that awakening, my desire to explore the effects of policies designed to improve social welfare has continued to increase. Of particular interest are the unintended consequences of these policies that can impact one’s quality of life and subsequent life course trajectory.

Growing up in Chicago and being a resident of Atlanta have allowed me to both experience and witness disparities that exist among communities. Some areas are saturated with fast food restaurants, convenience stores, package/liquor stores, and currency exchanges, while others offer sprinklings of the aforementioned. Being a female woman of color I was often expected to cook and consume traditional soul-food items. My “blackness” was frequently questioned because my diet did not consist of fried foods and overcooked vegetables. Being pre-disposed to hypertension I made a conscious decision to consume nutrient dense foods and engage in physical exercise in an effort to reduce the risk of nutrition-related disease prevalent among minorities. Although easy for me, such determinations are complicated for others, as personal preferences, community provisions, and economic debilitations may prove daunting. Such acknowledgments serve as the impetus for my interest in the intersection between individual behavior and the lived-environment.
Chapter 1 introduces the research project and its foundation in human development, underscoring the importance of nutrition and its impact on health. It discusses how the macro level influence of one’s lived-environment is offered as a critical component of individual (micro level) behavior, lifestyle, and subsequent health. Health determinants among vulnerable populations are underscored, as urban environments are often characterized by neighborhood concentration – via income, race, and other socioeconomic factors. Geospatial analysis is offered as a useful tool in revealing characteristics of otherwise invisible geographic patterns. Such information can assist policy decisions, or simply allow for understanding people and places. Chapter 1 also introduces the research question. The theme is health and is intended to highlight persistent health outcomes associated with nutrition as well as the importance of food access and health equity.

Chapter 2 includes a review of literature to understand the health implications associated with nutrition and well-being. The role of nutrition on related health outcomes are discussed as well as social health determinants, including the built environment. Food access is viewed from an ecological lens to understand the links between individuals and their lived-environment.

Chapter 3 considers the methodology. After reading chapter 3, readers should understand the study design and data collection method utilized to appraise the degree to which food access disproportionately affects minority population segments in Wilmington, Delaware.
Chapter 4 presents the research findings. It offers visual images on the location of retail food outlets in Wilmington, Delaware in relation to race, socioeconomics, and nutrition-related health outcomes. In doing so, this chapter exposes the prevalence of corners stores and nutrition-related chronic disease within minority communities.

Chapter 5 is the concluding chapter. It offers insight on the role policy can play in re-shaping the environmental context of the study population. It will also reiterate key findings that have appeared throughout the previous chapters and conclude with recommendations for future research.
Chapter 1
INTRODUCTION AND BACKGROUND

Introduction

Nutrition is a variable associated with mental (Prado & Dewey, 2014) and physical well-being (Ogden et al., 2014), which poses a key influence on health outcomes. Good nutrition can protect against the risk of disease and illness, promote cognitive performance and memory recall, and facilitate mobility. Conversely, poor nutrition can lead to obesity, cardiovascular disease, other chronic illnesses, and morbidity (Sturm & An, 2014). It is also associated with mental health, behavioral outcomes, and other nutrient-related outcomes.

Nutrition intake and its consequences are often seen as an individual’s responsibility, suggesting agency over one’s consumption choice. However, a 2001 report by the U.S. Surgeon General called for community responsibility in the approach to health promotion and obesity prevention (Karpyn et al., 2012), (Odoms-Young et al., 2012), thus acknowledging the importance of an environmental context in the health of vulnerable communities. As this report makes clear, good nutrition is a long-standing topic of concern for persons of low socioeconomic status (SES), particularly in urban areas.
Fresh foods are usually very limited in these urban areas. Grocery stores are often scarce, corner stores are common, and fast food outlets are prevalent (Block, 2006). Minimal food access to nutritious food can influence individual behavior and increase the risk of obesity (Block, 2006). Socioeconomic and environmental factors play a vital role in lifestyle and health (Powell et al., 2007). An examination of neighborhood conditions such as food access can evidence the extent to which individual choice and health are associated with one’s lived environment.

This paper explores food access, health disparities, and health-related socioeconomic factors through a multidisciplinary lens of human development. An ecological perspective is used to help understand the inseparable linkage of individual lives at all stages and structural mechanisms in their communities.

**Research Goal**

The goal of this study is to gain an understanding of the retail food environment in Wilmington, Delaware and its association with socioeconomic factors linked with health outcomes. More specifically, the desire is to understand food availability in Wilmington. The guiding research question asks to what extent a lack of food access disproportionately affects minority communities. Consideration is given to the following questions in an effort to connect the critical nature of food access - socially, economically, and physically:

- How does nutrition impact health outcomes?
- What socioeconomic factors affect health and weight?
What are the health implications of environment on life course of vulnerable populations?
The Human Development context is a useful approach for exploring these questions.

The Human Development Context and Rationale

This research is approached from a human development perspective to magnify the importance of one’s social experience and the potential impact later in life. Given the author’s interest in health determinants, it was deemed essential to utilize an ecological approach for not only understanding human health, but also as consideration for ways in which healthy behavior can be optimized to reduce the cost of nutrition-related chronic health conditions. An ecological examination of food access is used to explore the intersection between an individual’s behavior and their environment at various levels. The notion of an ecological approach to food access, individual behavior, and nutrition-related health outcomes would acknowledge the entangled connection between individual behavior and structural influences.

Urie Bronfenbrenner’s theory of ecological systems (EST) describes the environment as a “nested arrangement of structures, each contained within the next” (Neal, 2013), thus underscoring the influence of established systems on behavior that cannot be isolated. Individual behavior is often viewed as the sole influence of one’s choice. Instead, consideration of other factors (e.g. family, community, school, society, etc.) should be accounted as worthy contributors. EST proposes that individuals exist within various settings, often portrayed as rings – micro, meso, exo,
and macro, where behavior at each level is influenced by others, both within and across (Mc Guckin & Minton, 2014), (Duerden & Witt, 2010).

Figure 1: Urie Bronfenbrenner - Ecological Systems Theory

Structures in the microsystem involve daily interactions; family, teachers, friends, and neighbors constitute direct environmental agents in which a “pattern of activities, roles, and interpersonal relations are experienced” (Neal, 2013). Because of the proximate contact these dyadic relationships are thought to be impactful. Nutrition habits and dietary intake are established at this level. Interactions between students and teachers (micro-level agents) occur within the meso-system; the experience with teachers may trickle down to student networks. For example, a teacher’s nutrition curriculum educates students. In turn students request different meal options at home.

The exosystem addresses the indirect influence of broader social systems on behavior and development. The decisions of local government to approve food outlets within communities have consequence on the nutrition options from which families choose. Macrosystems finalize the environmental influence on development and
behavior. They provide broad cultural and ideological patterns such as regional or global policies that have residual repercussions over time (Lakic, 2012). National agendas such as Michelle Obama’s Let’s Move! campaign seeks to encourage healthful outcomes for America’s youth at each underlying structural level. The chronosystem developed later by Bronfenbrenner, address lifespan effects. Temporal components of human development occurring between the individual and the environment are evidenced (Mc Guckin & Minton, 2014).

Attention is drawn to the value of an EST approach, which often includes interventions to address social concerns. Using this approach to frame an analysis can help clarify understanding of individual behavior and serve as the foundational tool in which policies are amended to promote healthful behavior. Moreover, levels of interaction between individuals and their environment are intertwined, embedded, and often unseen. EST can provide insight into how the environment influences health outcomes for individuals and communities.

**Background**

**Health**

Health outcomes are determined by a myriad of factors. Social determinants constitute one set of factors believed to influence health. The study of these determinants is a complex field that addresses health implications associated with one’s living and working environments, along with lifestyle consequences. Another set of health related factors is identified by the Centers for Disease Control (CDC). According to the CDC, five categories contribute to an individual’s health and well-
being: genetics, individual behavior, social environment, physical environment, and health services. Findings by The World Health Organization (WHO) suggest similar determinants of health, particularly among the poor and disadvantaged. In 2003, WHO published *The Solid Facts* (2nd edition), an information resource guide to promote awareness and inform policy, highlighting specific conditions among the poor and disadvantaged associated with health disparities. Economic, social, and environmental factors are described as critical health determinants in the information resource guide.

Diet is another area that impacts the health of a population, contributing to obesity and other chronic health problems (Briefel & Johnson, 2004). It is believed that poor nutrition, emanating from dietary behaviors, is the central cause of overweight and obesity among today’s youth (Jamelske et al., 2008). Obese individuals are at higher risk of premature death, chronic disease, reduced quality of life and social stigma than normal weight individuals (Niggel et al., 2013).

Food access is becoming one of the most prevalent discussions surrounding diet, nutrition and health. Embedded in the current discussion of food access is concern for outcomes associated with neighborhood concentration which may occur by race, socioeconomic status, or other demographic characteristics disproportionately affecting some population segments more than others – often impoverished and persons of color (Rossen & Schoendorf, 2012). Moreover, location matters. Research has evidenced associations between poor health and limited food access (Karpyn et al., 2012), inverse relationships between healthy food options and minority neighborhoods (Odoms-Young et al., 2012), race and food availability (Galvez et al., 2008)
Many studies address food price as a barrier to diet. Findings suggest that there are costs, both positive and negative, associated with the space occupied by all population segments. Some neighborhoods promote healthy lifestyle, offering quality education systems, pedestrian friendly walk-space, public transportation, recreation amenities, and bountiful food options, including grocers and restaurants. Other neighborhoods are characterized by failing schools, minimal sidewalks, limited transit, unkempt public parks, and limited food options, which often include an over-saturation of fast food outlets. Essentially, social advantage, or lack thereof, is a predictor of one’s health.

The social economic status reflected in the above discussion can be achieved or ascribed. Singh-Manoux and Marmot (2005) argues that social class influences behavior – health-related and psycho-social. Achieved status, an earned social position that reflects individual choice and effort, is merited. On the other hand, ascribed status is an unmerited social position that is involuntarily assigned. Race, gender, and parental SES cannot be controlled, rather are assigned at birth. One’s seat of position in life is often defined by the group in which they are born. From there, norms, attitudes, and values are shaped and often remain unless altered. The process of socialization primes individuals to expected roles later in life. As a result, habits and life chances are a byproduct of social, cultural, environmental, and individual influences. Such odds provide added privilege for those with resources and increased obstacles for those without - both resilience and risk (Masten, 2014). Resilience refers to good/positive outcomes after the risk of threat or harm, which can produce negative
effects. Given that beliefs and behavior are embedded and passed down, socialization has intergenerational effects and significant health consequences.

In the context of nutrition and health, the individual, community and the environment, rather than an individual’s failure to choose nutrient-dense foods and resist sedentary behavior shape consumption patterns. In fact, environmental factors have been found to be of greater influence than genetics (van den Berg et al., 2013) in the development of food preference for long-term weight. Spatial analyses can offer an understanding of food access and the factors that impact weight and health. The intent of this study is to discover the extent to which environment and socioeconomic factors negatively impact the health potential of minority populations in Wilmington. It is timely because the State of Delaware is embarking on initiatives to combat sedentary behavior, poor diet, and obesity – contributors of chronic disease and premature death in Delaware. Moreover, obesity has become a major federal, state, and local issue that requires immediate attention.

**Obesity**

Obesity in the U.S. is an epidemic. Childhood obesity is of major concern, as obese children are likely to become obese adults (Ogden et al., 2012), thus the importance of early intervention. In 2007-2008, nearly 17% of U.S. children and youth were obese, having a body mass index (BMI) greater than or equal to the 95th percentile for age and gender categories. A 2009-2010 study yielded the same results (Ogden et al., 2012). The prevalence of obesity for the same time period was nearly 36
percent among adults – 35.5 percent among adult men and 35.8 among adult women (Fitzgerald, 2013).

Adult obesity is defined as body mass index greater than 30. Obesity is associated with hypertension, diabetes, and cardiovascular disease. The prevalence of obesity is also associated with lower education level, lower income, and unemployment status and is highest in African-Americans and Hispanics. The state of Delaware’s obesity challenge is significantly greater than the national average, particularly in the City of Wilmington.

**Delaware**

According to the Delaware Healthy Eating and Active Living (Delaware HEAL) report, produced by Delaware Health & Social Services, obesity in Delaware has steadily increased for adults – doubling from 14 to 28 percent between 1990 and 2008. (See Figure 2.)

![Obesity Doubled Among Delaware Adults: 1990-2008](image)

**Figure 2: Adult Obesity Rates in Delaware (1990-2008)**
Thirty-six percent of the state’s adult population is overweight and nearly two-thirds are overweight or obese. The young are equally prone to be obese. Thirty-seven percent of Delawarean children (ages 2-17) were overweight or obese in 2006, with no significant change in 2008. BMI calculations for the state’s adult population support the need for concern. In an analysis of BMI and obesity costs in Delaware commissioned by the Trust for America’s Health (TFAH) and the Robert Wood Johnson Foundation (RWJF), the rate of adult obesity in Delaware nearly tripled over sixteen years; from 15.2% in 1995 to 28.8% in 2011, and is projected to reach 64.7% by 2030. The highest rates of obesity for the State are in the City of Wilmington. (See Figure 3.)

The same report, Delaware HEAL, shows that obesity rates in Wilmington is much higher than federal and state levels. The average percentage of obesity among adults (18+ years of age) was highest in Wilmington than statewide. For instance, in 2006-2007, the City’s percentage for obesity was almost 31 percent, which is nearly 5 percentage points higher than the State’s rate of 26.4. Research findings suggest links between obesity and a variety of chronic diseases and mortality. (See Figure 3.)
Obesity-related health problems include diabetes, cancers, heart disease, stroke, hypertension, and arthritis. In fact, obesity and Type 2 diabetes frequently occur together in patients and are major causes of morbidity and mortality (Gupta, 2014). According to a 2012 TFAH report, the number of obesity-related health cases totaled over 500,000 in 2010, with hypertension being the most prevalent incidence (see Table 1).

Table 1: Cases of Top Obesity-Related Health Problems in Delaware (2010)

<table>
<thead>
<tr>
<th>Obesity-Related Health Problems in Delaware</th>
<th>2010 Cases Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 2 Diabetes</td>
<td>79,275</td>
</tr>
<tr>
<td>Obesity-Related Cancers <em>all ages, all genders, adjusted for self-reporting bias</em></td>
<td>14,714</td>
</tr>
<tr>
<td>Coronary Heart Disease &amp; Stroke</td>
<td>57,340</td>
</tr>
<tr>
<td>Hypertension</td>
<td>187,986</td>
</tr>
<tr>
<td>Arthritis</td>
<td>184,829</td>
</tr>
</tbody>
</table>

At the current rate, medical costs associated with obesity-related illnesses could be astronomical. According to TFAH (2012), Delaware would save $700 million of obesity-related health dollars in ten years if the average BMI of its residents
reduced by 5 percent, the equivalent of 10 pounds for a six-foot tall person weighing 200 pounds. Traditionally, efforts to address obesity were targeted at individual behavior. Recent contemporary thought suggests a more comprehensive effort is needed.

Former Surgeon General David Satcher helped shift the obesity awareness dialogue. His report titled “A Call to Action to Prevent and Decrease Overweight and Obesity” inspired a new concept -the importance of private industry in health promotion- which increased efforts to bring healthy foods into communities (Karpyn et al., 2012). The document suggested that immediate action would improve the quality of life, increase the years of healthy life in the United States, and decrease health disparities. The action plan, called for in the report provided the CARE approach – Communication, Action, Research and Evaluation among settings: Media and Communications, Health Care, Worksites, Families and Communities, and Schools to target overweight and obesity. Delaware is one of the states attempting to embrace the recommendations in the Satcher report.

Statewide initiatives have engaged partnerships to promote healthy eating and active living among its residents. Delaware Healthy Eating Active Living Partnership (Delaware HEAL) is a 5-year (2010-2014) comprehensive plan with collaborative initiatives designed to achieve statewide long-term health goals aimed at improving the health of Delawareans. It utilizes a socio-ecological model to promote positive individual behavior as well as healthful policy changes. It includes environmental and policy strategies to understand how one’s surroundings promote or prohibit physical
activity and healthy eating in recognition of multi-level (individual, interpersonal, organizational, community, and society) interaction (Delaware Health and Social Services, 2009).

Individual beliefs and behaviors regarding daily nutrition consumption and physical activity do not occur in isolation, neither are modifications toward wholesome choices. Interpersonal groups and organizations such as clubs and schools may serve as reinforcement towards healthful ideals. Initiatives such as Delaware HEAL provide an example of policy tools being utilized to assess and amend the community environment and offer access and availability to positive nutrition and recreational outlets. When viewing individuals and community collectively, a reciprocal society is portrayed – one in which all participants are aware of health promotion and are equipped with various tools to minimize the risk of nutrition-related disease and have access to healthful lifestyle options (Delaware Health and Social Services, 2009).

Delaware health issues and concerns are exemplified in the City of Wilmington. This includes the prevalence of nutrition-related diseases. As the State’s largest city, it is a major contributor to Delaware’s health challenges. In a recent state level analysis, the National Center for Chronic Disease Prevention and Health Promotion (n.d.) provided a geospatial display of retail food environments to identify food access, or lack thereof via census tract. The City of Wilmington was identified as having zero healthy food retailers, which includes supermarkets, larger grocers, produce stores, or supercenters. These data also suggest that census tracts in the city
contain more convenience stores and fast food restaurants than healthy food retailers. Smaller stores and non-chain supermarkets are less likely to stock healthful foods than larger sized stores and supermarkets (Powell et al., 2007). And minority, low-income communities have up to four times as many smaller grocery stores as non-minority, wealthier communities (Moore & Roux, 2006).

Census data from 2010 records estimates the population for the City of Wilmington at 70,851, of which 58% of the population is African-American and nearly 33% is White, and 12% is Hispanic. Females comprise the majority at 52.5 percent of the total population, while males constitute 47.5 percent of the total population. The median household income is $38,386 and 23 percent of the population lives below poverty level. These data are compelling reasons for selecting Wilmington as the focus of this study.
Chapter 2

LITERATURE REVIEW

The body of literature that underpins this research can be categorized into three main areas: childhood nutrition, adult nutrition, and food access. Cross cutting each of these areas are discussions of diseases and health outcomes associated with food consumption. Comorbidity and mortality are also often a part of these discussions. As discussed in Chapter 1, obesity and its consequences are linked to diseases and health outcomes.

Obesity is the leading cause of preventable death in America (Schaub & Marian, 2011). As pointed out in the literature, obesity tracks from childhood into adulthood, of which nutrition and dietary intake are the major causes. Chronic disease accounts for 40 percent of the ten preeminent causes of death in the United States and dietary intake is a major risk factor; African-American, other minority and low income communities are impacted the most (Zenk et al., 2005). Particular concern is also expressed in the literature over the availability and provision of nutrient dense food to children of low SES, as the poor are at a higher risk of obesity than the rich (Bhattacharya et al., 2006; Wijnen et al., 2009).

Obesity-related physical conditions are also given considerable attention. This includes risk of cardio-vascular disease, Type 2 diabetes, sleep apnea, and colon cancer (Shomaker et al., 2012). Findings surrounding obesity and overweight also
reveal psychosocial problems such as prejudice, discrimination, bullying, self-esteem, depression, and eating disorders (Wijnen et al., 2009).

The following review of the literature is from a human development context. This is significant because it embraces healthy nutrition as a tool, which promotes survival and functional equilibrium throughout life. This is particularly germane in children.

**Nutrition & Children**

The literature related to nutrition and children can be categorized into three components: well-being, mental health, and performance. Children’s well-being is the most frequently discussed aspect of this component of the literature.

**Well-being**

One of the major conclusions from the literature on children’s well-being is that poor nutrition is the primary cause in the incidence of overweight and obesity. That is, nutrition influences weight gain and weight gain increases body mass index (BMI) – an obesity indicator. As with adults, the CDC uses BMI to measure overweight and obesity among children and adolescents (aged 2-19); it is calculated using a child’s weight and height. The child’s weight status is then determined using an age/sex percentile categories.

Overweight children, childhood obesity, and obesity-related disease are of worldwide concern, as obese children tend to become obese adults. Childhood obesity is not limited to the United States; an increased incidence of obesity has been seen in China and England as well (Li & Hooker, 2010). Although obesity is of global
concern, greater rates are observed in the United States. This is believed to be related to the high fat content of the food children consume in America.

Research on child nutrition has found that the customary diets of American children is considered high in fat, saturated fat and cholesterol, a pattern linked to obesity, cardio vascular disease, and cancer (Zhang et al., 2005). In 2011-2012, 32% of youth were either overweight or obese, and 17% of youths were obese (Ogden et al., 2014). For the same year no difference was observed in obesity prevalence by gender; however, differences were detected by race. The prevalence of obesity was lower among non-Hispanic Asian youth (8.6%) than among White non-Hispanic youth (14.1%), non-Hispanic black (20.2%), or Hispanic youth (22.4%) (Ogden et al., 2014). Between 2003 to 2004 and 2011 to 2012, obesity prevalence decreased among higher SES youth but increased among lower SES youth. Early intervention was found to be critical, as overweight and obesity induces risk factors, such as sedentary behavior and hypertension (Mozaffarian et al., 2015).

Mental Health

Findings by Tomlinson and colleagues (2009) suggest that dietary intake may be a significant contributor to mental health among children. As they point out, poor nutrition can result in delayed body growth and can effect cognitive and behavioral developments which are immediate and long term. Similarly, as Burkhalter and Hillman (2011) point out in their work, nutrition can impact both the development and health of brain structure and its function. In a review of literature regarding the relationship of energy consumption and its impact on cognition and scholastic
performance, they recount a previous study by Freeman and colleagues which examined the effects of nutrition on cognitive performance among 3 and 4-year old children in Guatemala. In an assessment of language, memory, and perception, their results revealed associations between increased protein energy consumption and improved cognitive performance. Their study also demonstrated higher cognitive performance in children whose mother consumed protein energy supplements during pregnancy and lactation, suggesting that pregnancy and early life are critical periods of development in which the biggest effects take place during shorter time periods.

Cohen and colleagues (2002) report that psychological distress, defined as symptoms of mild depression and anxiety is associated with unhealthful dietary behavior including weight control and binge eating. Research has also discerned an association between prematurity and low birth weight with high rates of adolescent depression, suggesting poor maternal nutrition as a contributor to both low birth weight and prematurity. Direct causation is not yet proven (Tomlinson et al., 2009).

Tomlinson and colleagues recount research which suggests that high maternal fish intake is associated with higher verbal IQs within children 7 years in age, as oily fish is high in essential in Omega-3 fatty acids, crucial nutrients for health. The intake of Omega-3 fatty acids is negatively correlated with severe depression. Human and animal studies have found that protein-calorie deficiency is associated with cognitive function deficits (Liu et al., 2003).

The literature suggests that children’s mental and physical behavior is affected by nutrition and dietary intake. According to Stevenson (2010), diet quality can impact
social behavior, including mood, conduct, and attention. Attention deficit hyperactivity disorder (ADHD) is considered the most common child psychiatric condition in the U.S., affecting 3-5% or as many as two million children (Bussing et al., 1998). Poor concentration affects learning which impairs a child’s ability to function successfully in school or within social settings. Diet is probably not the sole force behind the multiple behavioral and cognitive symptoms of ADHD, but a study of children treated with Omega-3 fatty acids and other essential fatty acids such as evening primrose oil, which contains essential fatty acids, showed improvements in attention and behavior (Turner, 2014).

Tomlinson and colleagues (2009) also report reduced symptoms of hyperactivity among children who ate a selected range of natural foods. This suggests a strong correlation between diet and performance.

**Academic Performance**

Findings from a variety of studies evidence the link between nutrition and academic performance. This is important because, as research by Florence and his colleagues (Florence et al., 2008) shows, academic performance of children is associated with future educational attainment and health. This includes a strong correlation between education level and income status, which affects quality of life. Academic performance is a common measure of competencies and inadequate nutrition can place students at risk of failure. In this regard, a growing number of studies aim to increase student performance through improved nutrition (Barrigas & Fragoso, 2012; Florence et al., 2008; Kleinman et al., 2002). In an examination of
associations between overall diet quality and academic performance, Florence and colleagues (2008) reported the findings from a 2003 literacy study of Canadian students which found positive correlations between decreased overall diet quality and poor performance, whereas students with increased fruit and vegetable consumption were less likely to fail.

Studies on the timing of meals have also revealed impacts on student academic performance. In a study to assess the relationship between breakfast consumption and academic performance, Kleinman and colleagues (2002) found that participation in a school breakfast was associated with significant improvements in academic performance. Skipping breakfast impairs attention and memory; breakfast cereal can reduce attention deficit and prevent some conditions of memory deficit (Wesnes et al., 2003); it was also found to be associated with poor memory, test performance and learning (Muthayya et al., 2007). Muthayya and Sumithra confirm the decline of cognitive functions through the morning in their research, suggesting the time of food consumption is “an important determinant of cognitive functions in school children” (p. 149). Moreover, as with other areas of food and nutrition the timing of meals has been shown to affect cognition.

As revealed in the literature above, children’s well-being, mental health, and performance are strongly related to diet and nutrition. These relationships have life course impacts. That is, dietary habits developed early in life often persist into adulthood, which has major health and other socioeconomic implications.
Nutrition & Adults

The literature on nutrition and adults indicate that dietary habits have a significant influence on health, mortality, and the overall quality of life, particularly for residents in minority and under-served communities. In a report of preliminary U.S. mortality and life expectancy for 2010, the Division of Vital Statistics (2012) reports that three of the fifteen leading causes of death were nutrition related. Two studies, one led by Mozaffarian (2015), the other by Odoms-Young (2012), found negligible diet quality to be the leading risk factor for death and disability in the United States. Both studies also found insufficient intake of fruits, whole grains, vegetables, and excess sodium intake to be main contributors. In a report on cardiovascular disease (CVD) and sodium intake, Mozaffarian and colleagues (2015) noted that sodium intake accounted for 1 in 8 CVD deaths before 70 years of age; globally an estimated 1.65 million deaths are related to CVD (Mozaffarian et al., 2015). In an examination of CV health metrics, Yang and colleagues (2012) found a lower risk of total and CVD mortality, yet CVD remains the leading cause of death in the United States; CVD is associated with nutrition (Yang et al., 2012), but is not the sole cause.

As reflected in life course theory, the prevalence of childhood obesity tends to manifest itself in adults as well. This is particularly evidenced in minority populations. As literature suggests, suboptimal diet quality and its related disease risk are associated with race and ethnicity, and is evidenced among subgroups. Dubowitz (2008) found that obesity rates are rising faster in adult African-American and
Hispanic than in White populations. According to Lincoln (2014), African-Americans are 51% more likely to be obese compared to non-Hispanic Whites. This disparity is also widespread among gender subgroups; approximately 50% of African-American women are obese compared to 33% of White women (Kirby et al., 2012). Individual factors such as SES have also been found to co-exist with racial-ethnic disparities. For instance, Dubowitz and colleagues (2008) found that neighborhood SES was positively associated with fruit and vegetable intake. Moreover, after controlling for SES, race emanates as a prevailing factor in health disparities, and is linked to global nutrition-related diseases and a range of negative nutritional associated behaviors (Bahr, 2007).

**Food Deserts**

The environmental context of nutrition-related outcomes has contributed to the dialogue regarding so called food deserts, health disparities, and social equity. Permeating the literature on nutrition and health are issues of access and availability, which relates to food deserts. As Zenk and colleagues (2005) point out, resources and risks are spatially and socially organized. She further notes African-Americans disproportionately occupy areas that are economically disadvantaged.

Important to this discussion are the various definitions of a food desert. The term “food desert” was initially used in Europe to describe excluded areas where people experience physical and economic barriers to healthy food access and remains undefined beyond its initial conception (Shaw, 2006). The term has been further operationalized to include factors associated with health and diet, such as economic,
psychological, sociological, and geographical (Shaw, 2006) for research purposes. A common thread of the definition of a food desert in the literature describes urban- and rural-locations with limited access to and availability of healthy and affordable foods. Given the geographic context of food deserts, it is conceivable to express spatial disparities in connection to nutrition-related health outcomes. Studies support concern for spatial equity, as African-American neighborhoods generally have fewer supermarkets, more convenience and liquor stores, and fewer fresh fruit and vegetable options (Odoms-Young et al., 2012). Another finding of the literature is that African-American neighborhoods (regardless of income) are less likely to have access to a supermarket relative to higher-income and White neighborhoods (Ghosh-Dastidar et al., 2014) and supermarket presence within an environment has been shown to impact the quality of health (Zenk et al., 2005). When comparing supermarket food offerings to that of neighborhood grocery and convenience stores, a San Francisco study found that supermarkets offered twice the average number of healthy foods compared to neighborhood grocery stores and four times the average number than convenience stores (Morland, et al., 2002).

While availability is a concern, research suggests that price is also an important factor in consumption choice, environment, and obesity. Price-related studies in the United States (Alkon et al., 2013) and many African countries (Ghosh-Dastidar et al., 2014) found price to be a primary barrier to accessing healthy food. The availability of supermarket chains in low-income areas, or lack thereof, is cause for concern as
supermarkets offer food at lower prices and provide higher quality food in comparison to smaller grocery stores (Powell et al., 2007).

**Summary**

The above survey of the literature reveals that nutrition is a critical component of well-being with mental, physical, emotional, cognitive, and social effects for the young and adult population. A major trend explores nutrition-related diseases that continue to be a leading cause of death among Americans and is associated with dietary intake. Suboptimal quality food has been found to be a factor that contributes to overweight and obesity, which tracks into adulthood. Studies on food access and availability suggest a positive association between obesity and fewer grocery stores. Similarly, health and well-being were shown to be outcomes of nutrition and are influenced by socioeconomic factors such as race/ethnicity, education, employment, and income. Moreover, as research reveals, poor diet quality is associated with low economic status, food insecurity with obesity, fruit and vegetable consumption with SES status and education, as well as cancer and heart disease.

The literature on food deserts is expansive and addresses the impact of health of children and adults. It also highlights the impact on children’s mental behavior and performance and a variety of other related concerns at both the global and national level. However, spatial analysis of food deserts are rare and none available for Wilmington. Findings from the literature were used to discern appropriate variables of analysis of food deserts in the City of Wilmington. The identified variables include: race/ethnicity; income, education, and health outcomes. Using these variables and the
methodology described below, this thesis will provide an analysis of food access in Wilmington, Delaware. The focus is on low income and minority communities.
Chapter 3

METHODOLOGY

Geospatial analysis serves as a visual tool for information analysis. Geographic Information System (GIS) is a mapping tool increasingly being used in public health and public policy research to examine spatial patterns and the distributions of targeted outcomes. This study uses a web-based GIS application to investigate the extent to which food access disproportionately affects minority populations in Wilmington, Delaware.

Supermarkets, grocery and corner/convenience stores were geocoded to create an electronic map of exposure to retail food outlets. Supermarkets and small grocery stores were identified through a Google search. The Food Trust, a Philadelphia based not-for-profit community organization, dedicated to affordable food, nutrition access, and health information, provided a list of corner stores in Wilmington in conjunction with their Healthy Corner Store Initiative. At least one half of the retail food locations were visually verified, others were verified via phone. A list of all supermarket and small grocery/corner store locations with a Wilmington address can be found in the appendix.

The level of analysis for this study is the census tract, a relatively permanent subdivision of a geographic county-region. Census tracts were established by the United States Census Bureau to analyze populations, often between 2,500 and 8,000 in
relation to demographic characteristics and economic status. The analysis was limited
to twenty-four census tracts which comprise the City of Wilmington, Delaware (See
Figure 4). At times, this spatial configuration is referred to in this analysis as the
“focus area” of the study. An enlarged view of all maps is provided in the appendix.

Figure 4: Wilmington, Delaware - Census Tracts

This study examines the availability of two types of food stores -supermarket and
corner stores- and associations with neighborhood characteristics on SES, race, and
ethnicity. The North American Industry Classification System (NAICS) codes identify
supermarkets and grocery (except convenience) stores together (445110), describing
them as industries engaged in retailing of canned and frozen foods, fresh fruits and
vegetables, fresh and prepared meats, and fish and poultry. Whereas convenience
stores retail a limited line of goods that include milk, bread, soda, and snacks
(445120). This study grouped grocery and convenience stores together, as most stores
listed as grocery (by name) had characteristics of a convenience store. Data points
with a Wilmington Delaware address totaled 79 – 62 corner and small grocery and 17
supermarkets. Using data points, demographic information, and PolicyMap software, an analysis was made of census tracts in Wilmington, Delaware to determine access and availability to retail food establishments. The analysis was undertaken with seven phases of maps.

Phase I: Initially maps were created to depict the locations of supermarkets across Wilmington. Phase II: The locations of corner stores were mapped. Phase III: Corner store and Supermarket locations were combined onto the same map. Phase IV: The locations of both supermarkets and corner stores were overlaid with data on the density of African-American, White and Hispanic residents again, by census tracts. Phase V: Store locations (both supermarket and corner stores) were mapped alongside the average per capita income for each census tract. Phase VI: The percentage of residents with a high school diploma and a bachelor’s degree were mapped. In an effort to conform to literature, education attainment is provided given its association with health. Phase VII: The proportion of residents diagnosed with diabetes, hypertension and stroke was compared to the location of corner stores and supermarkets. In conjunction with the literature review, nutrition-related diseases are measures of health.

The density of racial and ethnic groups is depicted on the maps using a graduated color whereby density of the predominance of the race/ethnic group increases as the color darkens. Per capita income displays reported twelve month income, also graduated by color whereby the density represents increased earnings.
Higher levels of education attainment are represented by colors density and the same applies to health measures. For each there are 4 possible color gradients, and these gradients correspond to quartiles determined based on national population. Table 2 depicts the relative breakdown of racial/ethnic composition alongside the relative shading provided in phase IV-VII maps.

Table 2: Race and Income cut points

<table>
<thead>
<tr>
<th>Racial/Ethnic Subgroup</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; quartile (lightest shade)</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; quartile</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; quartile</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; quartile (darkest shade)</th>
</tr>
</thead>
<tbody>
<tr>
<td>African-American</td>
<td>0%-0.81%</td>
<td>0.82%-3.98%</td>
<td>3.99% - 14.94%</td>
<td>14.95-100%</td>
</tr>
<tr>
<td>White</td>
<td>0%-61.79%</td>
<td>61.80%-82.07%</td>
<td>82.08%-92.83%</td>
<td>92.84%-100%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0%-2.18%</td>
<td>2.19%-6.52%</td>
<td>6.53%-19.62%</td>
<td>19.63%-100%</td>
</tr>
<tr>
<td>Income</td>
<td>$16.00-$18,702</td>
<td>$18,703-$24,721</td>
<td>$24,722-$33,064</td>
<td>$33,065-$253,439</td>
</tr>
</tbody>
</table>

The web-based GIS application described above is used in this research study to investigate the extent to which food access disproportionately affects minority populations in Wilmington, Delaware. It facilitates a spatial analysis on the location of supermarkets and small grocery/corner stores and their association with socioeconomic variables such as race, income, academic performance, education attainment, and health outcomes. This analysis was employed using census tract data.
Chapter 4

RESULTS

The results of this research study of food access in the City of Wilmington correspond with findings in much of the literature on health and nutrition reviewed in Chapter 2, with one notable exception - hypertension. Location, income, and race are highly associated with food access and availability in the City. The lack of affordable nutritious food is also associated with negative health outcomes in the City of Wilmington. Specific details of the research results are presented in this chapter.

Of the 17 supermarkets with a Wilmington address, Figure 5 shows that 71% (n=12) of supermarkets are located in the greater Wilmington-area suburbs, which are predominantly White, while 29% (n=5) are located in areas with significant concentrations of minority residents. Supermarkets are depicted with green circles.

Figure 5: Geocoded supermarkets in Wilmington, DE
In contrast to supermarkets, the majority of small grocery/corner stores are located in minority communities. Eighty-five percent (n=53) of all small grocery/corner stores are located within the urban center of Wilmington. Only 15% (n=9) are located in the outlying Wilmington-area. Small grocery/corner stores are depicted with yellow stars.

Figure 6: Geocoded small grocery/corner stores in Wilmington, DE

Figure 7 provides a combined visual of both supermarkets and small grocery/corner store locations.

Figure 7: Geocoded supermarkets and small grocery/corner stores in Wilmington, DE
With shades of purple, Figure 8 depicts the density of African-American residents in each census tract - the darker the shade, the higher the density. An overlay of food locations reveals that corner stores predominate in sections of the city where the density of African-American residents is the highest, while supermarkets are located in areas where the density of African-

Figure 8: Supermarkets and small grocery/corner stores and African-American (race)

Figure 9 reveals the extreme opposite of the previous figure. Whites are highly concentrated in Tract 13 – areas of minimal African-American residents. Although there is no supermarket located within the census tract, residents have access to a food retail location in the adjoining tract.

Figure 9: Supermarkets and small grocery/corner stores and White (race)
While Hispanics in Wilmington appear to have greater food access and availability than African-Americans, Figure 10 reveals that their circumstances are still below that of the majority population. Many Hispanics in the City live in areas that border majority communities, and consequently have greater food access than African-Americans.

Figure 10: Supermarkets and small grocery/corner stores and Hispanic (ethnicity)

Income in Wilmington appears to be closely connected to food retail access and availability. Census tracts with large concentrations of Whites have an average per capita income of at least $86,000. In contrast, census tracts with significant concentrations of African-American have an average per capita income of just over $15,000.

Figure 11: Supermarkets and small grocery/corner stores and Per Capita Income
Supermarkets and small grocery/corner stores in Figure 12 appear to be loosely associated with education. Within the targeted area, residents with a high school diploma are located in census tracts that offer supermarkets access as well as areas that do not.

Figure 12: Supermarkets and small grocery/corner stores and High School

Figure 13 represents college degree attainment in relation to retail food locations. While high school education was more spread out, college degree attainment is heavily concentrated outside of the target area. Moreover, there is a higher concentration of small grocery/corner stores in areas with lower education.

Figure 13: Supermarkets and small grocery/corner stores and bachelor's degree
Relative to diabetes, Figure 14 reveals that all segments of the population have significant incidence of this disease. Its prevalence however, is greater among African-Americans. The incidence for Whites is between 11.6-13.6% and 13.61-38.23% for African-Americans.

Figure 14: Supermarkets and small grocery/corner stores and diabetes

In contrast to the literature, there is no significant difference in incidences of hypertension. Up to 78% of residents in both targeted and non-targeted areas are subject to high incidence of hypertension. In essence, findings suggest food access and availability is not significantly related to hypertension in Wilmington.

Figure 15: Supermarkets and small grocery/corner stores and hypertension
The spatial analysis of targeted areas in the City of Wilmington reveals significant associations between food access and availability and the health and well-being of residents who live in minority communities. Low-income, chronic diseases, and low education attainment are spatially correlated with the prevalence of small grocery/corner stores. The analysis suggests that low-income and minority residents have very limited access to affordable nutritious food from supermarkets. The small grocery/corner stores located in the targeted areas typically sell less healthy food options, which have health and economic consequences.

Similar to the incidence of hypertension, Figure 16 shows both targets and non-targeted areas are subject to a high incidence of stroke; however, in this case, minorities within the targeted area have an even higher risk of experiencing this illness.

Figure 16: Supermarkets and small grocery/corner stores and stroke

**Summary of Findings**

The spatial analysis of targeted areas in the City of Wilmington reveals significant associations between food access and availability and the health and well-being of residents who live in minority communities. Low-income, chronic diseases, and low education attainment are spatially correlated with the prevalence of small grocery/corner stores. The analysis suggests that low-income and minority residents have very limited access to affordable nutritious food from supermarkets. The small grocery/corner stores located in the targeted areas typically sell less healthy food options, which have health and economic consequences.
Chapter 5

DISCUSSION

Our approach, while unable to make statistical inferences or indicate the causation of findings does reveal intriguing and potentially powerful connections between the locations of supermarkets, corner stores and the racial and ethnic, health and income characteristics of residents in Wilmington, Delaware. Our findings are consistent with research conducted by Morland, Powell, Zenk, Dubawitz, Karpyn and others in other areas of the United States which have identified large sections of urban (and rural) areas where food access is a challenge for the most low-resourced, vulnerable populations.

As efforts to improve health, and reduce disease and its associated health care costs increase, increased attention to the root causes of disparities in health, especially those where reasonable action can be taken need serious consideration. Our work is focused on the location of food outlets in the City of Wilmington and finds that the areas with the highest density of lower-income, less healthy and minority residents are least likely to have easy access to affordable nutritious food and are more likely to have access to smaller corner stores that typically sell less healthful options. Efforts such as the nascent effort undertaken by The Food Trust and its partners in Wilmington to improve the quality of corner store product offerings, expanding stores
to include a variety of healthier whole grain, low-fat dairy and produce option are highly relevant for the city and should be considered for ongoing support.

Further efforts to incorporate more food retail outlets in the city center are needed. To date no Healthy Food Finance Initiative (HFFI) funds have been received by organizations operating in Delaware, and efforts to understand, apply and receive these important resources dedicated to improving healthy food access for all Americans should be considered and supported by local policy-makers and community food advocates alike. Providing access to healthy food lays a foundation for improved health, jobs and neighborhood revitalization that benefits not just the most vulnerable, but creates an economic stimulus able to be felt state-wide.

This study contributes to a growing body of knowledge that uses spatial analysis as a tool for accessing the role of the environment in health determinants. Spatial analysis also offers a visual tool that policy makers can use to examine areas for targeted interventions. To my knowledge it is the first spatial analysis of food access and availability in Wilmington, Delaware. The study confirms previous research regarding urgency of health disparities – social, economic, and spatial.

Given that ecologic models often include interventions, Wilmington, Delaware could serve as the target of a longitudinal study to examine the long-term effects of a targeted intervention to provide healthy food to minority populations segments in the City.
REFERENCES


Block, D. (2006). What fills the gaps in food deserts? Mapping independent groceries, food stamp card utilization and chain fast-food restaurants in the Chicago area. *Appetite, 47*(3), 386. doi: [http://dx.doi.org.ezproxy.gsu.edu/10.1016/j.appet.2006.08.012](http://dx.doi.org.ezproxy.gsu.edu/10.1016/j.appet.2006.08.012)


### Appendix A

**LIST OF SUPERMARKET and SMALL GROCERY/CORNER STORES IN WILMINGTON, DE**

<table>
<thead>
<tr>
<th>Store Name</th>
<th>Street Address</th>
<th>City</th>
<th>Zip Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adams Market</td>
<td>836 W 7th St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Ray's Market</td>
<td>307 N King St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Bennie's Big Scoop</td>
<td>800 N Church St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Bill's Meat Center</td>
<td>940 N Pine St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>New Brown Bag Deli Inc.</td>
<td>301 E 9th St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Taffi Food Mart</td>
<td>701 E 4th St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Walnut Street Deli</td>
<td>11th and Walnut St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Windsor Market</td>
<td>500 N Walnut St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Woody's Deli</td>
<td>857 Kirkwood St # A</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Peoples Market</td>
<td>700 N Washington St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Convenient Food Mart</td>
<td>201 W 9th St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Produce On 9th Street</td>
<td>314 W 9th St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>A1 Grocery</td>
<td>215 W 4th St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Abarrotes Guerrero, Bus Stop Market</td>
<td>1 South Jackson St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Buck Stop Market</td>
<td>725 N King St</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Kwik Stop Mini Market</td>
<td>5 W 4th Street</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>Ray's Deli</td>
<td>1200 Northeast Blvd</td>
<td>Wilmington</td>
<td>19801</td>
</tr>
<tr>
<td>201 Concord Food Market Inc</td>
<td>201 Concord Ave</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>701 Mart</td>
<td>701 Concord Ave</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>City Market Deli &amp; Grocery</td>
<td>2402 N Market St</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>Eddie's Market</td>
<td>700 E 22nd St</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>Grab N Go</td>
<td>3804 N Market St</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>Market Street Market</td>
<td>2715 N Market St</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>Printz Market</td>
<td>2715 Governor Printz Blvd</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>Rash Food Market</td>
<td>3001 N Market St</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>Shiva Market &amp; Grocery Store</td>
<td>1218 Vandever Ave</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>Sharman Mini Market</td>
<td>2215 N Washington St.</td>
<td>Wilmington</td>
<td>19802</td>
</tr>
<tr>
<td>Business Name</td>
<td>Address</td>
<td>City</td>
<td>Zip Code</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>--------------------------</td>
<td>------------</td>
<td>----------</td>
</tr>
<tr>
<td>El Cibaeño</td>
<td>822 Maryland Ave</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Maryland Avenue Sub Shop and Deli</td>
<td>623 Maryland Ave</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>A One Market</td>
<td>418 N Scott St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Chestnut Market</td>
<td>1301 Chestnut St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Chow's Farms</td>
<td>1211 Kirkwood Hwy</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Estevez Grocery</td>
<td>1023 W 5th St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Franklin Quality Food</td>
<td>128 N Franklin St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>J &amp; R Supermarket</td>
<td>1516 W 4th St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Jalisco Mexican Grocery Store</td>
<td>1722 W Gilpin Dr</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>La Flor</td>
<td>1100 W 2nd St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Lancaster Market</td>
<td>101 N Clayton St</td>
<td>Wilmington</td>
<td>19805</td>
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<tr>
<td>Lesly Grocery</td>
<td>1640 W 2nd St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Lucky Spot Market</td>
<td>1101 W 2nd St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Papa's Food Market</td>
<td>1910 W 6th St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Quisquella Deli &amp; Grocery</td>
<td>1201 W 4th St</td>
<td>Wilmington</td>
<td>19805</td>
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<tr>
<td>Rodriguez Food Market</td>
<td>1322 W 4th St</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Sansone's Fish Market</td>
<td>7th and Lincoln Sts</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
<tr>
<td>Union Market</td>
<td>724 N. Union St.</td>
<td>Wilmington</td>
<td>19805</td>
</tr>
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<td>Yummy Bites</td>
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APPENDIX B

LIST OF MAPS
Wilmington DE Supermarkets & Small Grocery/Corner Stores Est. % African American between 2009-2013

Estimated percent of all people who were African American between 2009-2013.

Supervision and consultation provided by: W. Scott Cameron, Ph.D., PolicyMap.

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Wilmington DE Supermarkets & Corner Stores Est % adults ever diagnosed with a stroke in 2013

Estimated percent of adults ever diagnosed with a stroke in 2013.

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Source: CDC BRFSS  
Polycmap

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