Accessible Rations: Food Environment and Race – The Case of Forsyth County, North Carolina

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Received November 1, 2019
Accepted for publication January 21, 2020
Published February 1, 2020

Abstract

This study assesses the spatial physical surroundings of the food environment of Forsyth County, which includes the city of Winston-Salem, North Carolina. This descriptive analysis expands upon the understanding of relationships between food environment, neighborhood racial composition, poverty level, and associated disparities. We used United States Census block group data to measure how the average distance to a grocery store varies by race and poverty level. The study builds on existing literature to propose a framework useful for understanding food environments and determinants of food insecurity among African Americans in smaller urban areas and regions such as Central North Carolina. Explicitly, the findings suggest that high poverty and predominantly black neighborhoods are food environments that are saturated by easily accessible unhealthy foods.

Keywords: Food Environment, Racial Segregation, Disparities

Publication Type: Original research article

Preferred Citation: Towns, Tangela and Richard G. Moye. 2020. "Accessible Rations: Food Environment and Race – The Case of Forsyth County, North Carolina." *Sociation*, 19(1), 1-14.

Introduction

Access to affordable, quality, nutritious, and adequate food (in accords to one's culture and dietary standards) is a consequence of social and economic status and yields increased prevalence of food insecurity in spaces that are segregated racially and economically (Odoms- Young and Bruce, 2018). The concept of food insecurity encompasses social, economic, institutional, structural, and environmental factors within a community that affect the quantity and quality of available food and its affordability (or price) relative to the financial resources available to acquire it (Cohen, 2002). A food environment consists of the physical presence of food that affects a person's diet, a person's proximity to food store locations, the distribution of food stores, food service, income, poverty, and any physical entity by which food may be obtained; or a connected system that allows access to food (CDC, 2016; Dharmasena et al., 2016). The literature of food desert focuses on the smaller selections of food in urban areas (MacNell et al., 2017). This paper focuses on the concept of food environment while paying attention to proximity to food store locations, poverty, and physical entity variations between neighborhoods.

The USDA (US Department of Agriculture) data from 2018 showed that food insecurity was prevalent in 11.1% of American households (Coleman-Jensen et al., 2019). Over the course of nearly twenty years, the food insecurity proliferation has worsened as a social problem experienced by many Americans. Collectively, there are about twelve states that have food insecure prevalence rates that are higher than the national average; North Carolina is one of them (Feeding America, 2017; Coleman-Jensen et al., 2019).

Data suggests that Forsyth County's food insecurity rate is 15.5%; the insecurity varies by geographical area, race, family structure, socioeconomic background, and age (Feeding America, 2017). Most of the counties surrounding Forsyth County are more rural and have lower food insecurity rates comparatively (Feeding America, 2017). Our descriptive analysis includes U.S. Census block group data to measure the food environment in Forsyth County by how the average distance to a grocery store and other food sources such as food pantries varies by race and poverty level.

Race, Food Insecurity, and the Underserved

Existing food desert literature frames food access through understanding, defining, and measuring the quantity of food stores in a designated spatial area (Reese, 2017). Food Insecurity literature often supports that communities are often organized by affordability, social class and are often racially divided (Horowitz et al., 2004; Mello et al., 2010). Often, a community's resources reflect that of the class affiliation of its residents. Thus, lower income communities have higher potential to be underserved. Similarly, the proportion of minorities that experience poverty is higher when compared to whites. For instance, U. S. Census data reports (in the general population) 20.8 percent of African Americans were living in poverty in 2018 while 8.1 percent of whites experienced poverty in 2018 (Semega et al., 2018). Although whites accounted for 60.2 percent of the total population, they represent 41.2 percent of people in poverty (Semega et al., 2018).

A predictor of food insecurity is economic hardship (Haering & Syed, 2009). Economic hardship is frequently reflected and exercised through shopping behaviors, physical environment, social environment, and the use of resources around the city. Literature illustrates that racial and ethnic minorities (as race is often a predictor of food insecurity) are more likely to experience food insecurity when compared to whites (Mello et al. 2010). Specifically, the USDA reports that just under a quarter of the African American population (21.2 percent) experience food insecurity; this is nearly twice the national prevalence rate (11.1 percent) (Coleman-Jensen et al., 2019) and this percentage parallels the percentage of impoverished African Americans. Similarly, the prevalence of food insecurity for Latino households is about 16.2 percent (Coleman- Jensen et al., 2019). Less than 10 percent of white households report food insecurity (Coleman-Jensen et al., 2019).

A Story Of Food Environment: Segregated, Impoverished, And Hungry

Given that neighborhoods are stratified economically and racially, one might also expect that access to food outlets such as grocery stores, supermarkets may also be unequal. Dean and Sharkey report that food environments frame the availability of food resources (2011). The scholars suggest that food store types constrain food choice and food environments are often structural barriers via spatial accessibility which encompass distance and transportation to food outlets (Dean and Sharkey, 2011). There are also notable spatial differences when comparing rural and urban food resources (Dean and Sharkey, 2011). In a study of Black and Latino urban food desert residents, the authors report that the majority of residents live over a mile from a larger supermarket and half of the residents did not own personal transportation (MacNell et al., 2017).

Due to a history of institutionalized racism, cities and metropolitan areas across the U.S. are highly segregated along racial lines (Massey and Denton 1988; Charles 2003; Logan and Stults 2011). Residential segregation leads to inequality in access to consumer resources (Pager and Shepherd 2008). As a result, residents of black neighborhoods have less access to a variety of goods, including healthy foods (Larson et al). Reese (2018) noted how residents in a hyper-segregated community in Washington, D.C. used community gardens as a form of self-reliance due to the complete lack of grocery stores in their neighborhoods. The garden however is not large enough to supply the entire community and yield enough produce year round to make up for the lack of a local grocery store. Reese's (2018) qualitative study also noted the despair experienced by Black communities. Much of this despair, driven by structural and spatial inequality, is observed by the abundance of smaller selections of food resources such as the dollar store chains of which do not offer fresh food options (ILSR, 2018).

While other researchers have documented racial disparities in access to quality food, the existing body of research has thus far focused on large metropolitan cities (Ball et al., 2009; Franco et al., 2008; Galvez et al., 2008; Mendez et al., 2016). Franco et al (2008) examined access to healthy foods in Baltimore, MD and Galvez et al (2008) found that blacks were less likely than whites to be able to walk to healthy food options in the Harlem neighborhood of New York City, NY. There is reason to suspect the patterns may be different in Forsyth County and other southern cities with populations under 1,000,000. Population density is lower, and more importantly, the level of segregation is lower: the index of dissimilarity is 81 in

New York City, 68 in Baltimore, and 50.1 in Winston Salem (Logan and Stults 2011).

Racial residential segregation is often associated with higher levels of poverty and poorer quality food environments in predominantly Black and Latino neighborhoods (Bower et al., 2014). The concept of food desert alone implies accessible small food outlets in urban minority neighborhoods. These small food outlets may be more effective in minority neighborhoods when compared to supermarkets, yet the quality of the foods offered by these food environments are in question (Raja et al., 2008). Accessibility to healthy foods is determined by geographic determinants such as number of stores, types of stores, size of the stores, distance of food stores to the neighborhoods as well as socioeconomic deprivation (Sharkey and Horel, 2008). There are socio-cultural processes that demand certain store types in high poverty, minority neighborhoods: interviews with storeowners and managers revealed that businesses in high minority neighborhoods perceive that the cost and utility of healthy foods would be less attractive to their customers than frozen convenience foods (Gravlee et al., 2014). More recent literature reports supermarkets in racially diverse North Carolina neighborhoods regularly stocking culturally appropriate African American foods (MacNell et al., 2017).

The specific interaction of neighborhood segregation, stratification, and food security are often specific to the city's make-up. Although predictors of food insecurity and food environment frameworks are outlined in the literature, the understanding of demographics are essential in telling the story of the food environment; these findings can be generalized across counties.

Forsyth County (Winston- Salem), NC Characteristics

This study focuses on Forsyth County. Forsyth County includes the city of Winston-Salem as well as nearby towns such as Clemmons, Kernersville, Walkertown, and Lewisville. Forsyth County is 413 square miles (U.S. Census Bureau, 2016). The county population is 379,099(U.S. Census Bureau, 2018). The median income is $48,369 (U.S. Census Bureau, 2018). This county has an unemployment rate of 3.8 percent and approximately 16.6 percent are living in poverty (U.S. Census Bureau, 2018). Racial demographics suggest the population is majority white (U.S. Census Bureau, 2018). The county houses two major Universities (Wake Forest University and Winston-Salem State University); two colleges (Salem College and Forsyth Technical Community College); and major businesses and business headquarters (e.g. Hanesbrands Inc., Krispy Kreme donuts, Novant Healthcare, Reynolds Tobacco, and BB&T Banking Company) among other institutions, industries, and businesses. Forsyth County's economic hardship and food insecurity are both reported as high in comparison to comparable counties. Therefore, Forsyth County has the ingredients for a high prevalence of food insecurity. Table 1 illustrates the national demographics to that of Forsyth County's demographics for comparison measure.

Table 1: 2018 Demographics of Winston-Salem, NC v. National Demographics

		Forsyth County Percent	National Percent
Race			
	White	66.7	60.2
	Black	27.5	12.3
	Latino	13.0	18.3
Unemployment		6.8	3.9
Poverty		16.6	13.1

Source: U.S. Census Bureau, July 2018; Census Quick Facts, 2018; Bureau of Labor Statistics July 2018

Theoretical Framework: The Ecological Model

According to the Ecological Model, food environment can be perceived as a consequence of structural, socio-communal and economic constraints; these include structural factors such as proximity to neighborhood food options, community factors including access to and affordability of healthy foods, and walkability or travel to healthy food choices (McLeroy et al., 1988). Traditionally, this model focuses on influences and interrelations of factors (such as behavior or relationships among systems) tiered into levels of hierarchical interaction (i.e. micro-, meso-, exo-, and marco- levels) (McLeroy et al., 1988). Extant literature stemming from Berkes et al. (2003) illustrates the ecological model perspective as a process blending the interactions of ecology and social environments such that our food environment must meet the needs of a community to guarantee sustainability and access to the members of the community, begetting a social-ecological model.

Using the framework within this project allows for the analysis of the spatial access among physical and social food environments (Kaiser, 2011). We will use only two of the components of this framework to assess the structure of food environment in Forsyth County, NC. The socio-community component focuses on access to grocery stores, food pantries, and farmers markets via travel or walkability measured in miles. The socio- community component also connects the structure of socio-demographic characteristics of a neighborhood such as racial composition (Sharkey and Horel, 2008; Gravlee et al., 2014; Raja et al., 2008). The social-political factors that influence food decisions incorporate economic factors such as income that tend to act as a barrier to food purchases (Just 2007).

Understanding the complexity of food environments calls for an examination of the interaction of factors such as proximity to stores, poverty and race (among other variables) as correlational relationships (Dharmasena et al., 2016). Using the ecological model alongside a GIS methodology allows for the illustration of the spatial physical environment display of physical presence of food sources, proximity to grocery stores and food pantries, and a display of the social system that allows access to food.

Research Questions

1. Is the average distance to a grocery store higher for residents of predominantly black neighborhoods than for other residents of Forsyth County?
2. Is the average distance to a grocery store higher for residents in high poverty neighborhoods than for residents in average or low poverty neighborhoods?
3. Which kind of grocery store is most prevalent in high poverty and predominantly black neighborhoods?

Research Design

We obtained data from two separate sources and merged them to complete our analysis. We obtained block group level data from the census bureau's American community survey five-year sample (2007-2011). The data contains information about the population in each block group by race, ethnicity, and economic characteristics. We obtained information about the location and type of grocery stores from MapForsyth.org.

We test whether or not access to type of grocery store varies by neighborhood composition and neighborhood economic status. We follow Raja et al (2008) in using block groups rather than census tracts to represent neighborhoods in Forsyth County. The boundaries of census tracts are defined by the census bureau for the purpose of dividing populated regions into smaller units to ease data collection of the decennial census. However, the boundaries are drawn in a way that typically matches with residents' perceptions of their neighborhoods. Each census tract is further subdivided into typically three or four block groups. Block groups are considerably smaller and allow for a more accurate representation of how neighborhood demographics can be associated with location to amenities. In Forsyth County, the mean total population in each census tract is 3770 while the mean total population in each block group is 1430. Using block groups allows for a more thorough analysis of how neighborhood location may be related to food insecurity.

Types of Grocery Stores

To measure and describe the food environment, we obtained information on the location of grocery stores, food pantries, and farmer's markets from MapForsyth.org. These data were collected by both Forsyth County and the City of Winston-Salem agencies. The city and county data employs GeoData Explorer and Geographic Information Systems to integrate the data. The location information is in the same format as produced by ESRI community analyst. In our analysis, we chose to focus on grocery stores as the primary method of access to food for most households. The list produced by ESRI community analyst is a standard list and we choose to further focus on two important subareas: grocery stores with fresh fish, and general stores. The general store category includes dollar stores such as the "Dollar Tree" franchise and similar outlets which primarily sell processed, pre-packaged dry food, candies, and processed frozen microwaveable dinners in a plastic tray. These could be a particularly poor source of nutrition as they have high levels of sodium, high fat content, and are more calorie dense than freshly prepared foods (Walker et al., 2010).

The other subcategory we chose to focus on is 'Grocery Stores with Fresh Seafood'. Only select groups of grocery stores have fresh seafood to offer, and stores which sell fresh seafood are also likely to have a larger variety of fresh fruits and vegetables compared to stores which do not sell fresh seafood. Powell and associates suggests that supermarkets are larger and are more likely to have fresh meats (this may include fresh seafood) among other fresh foods offered (Powell et al., 2007). Overall, this is a proxy measure for access to a variety of fresh meats and produce. Stores included in this category typically

include higher-end grocery chains such as "Fresh Market," "Publix," and "Whole Foods" as well as some of the larger chain supermarkets.

Measurement of Food Environment

Our main variable of interest is the average distance to each type of store. We use ESRI's ArcMap program to calculate the distance in miles from the centroid of each block group to the closest grocery store of each type. We use t-tests to determine if there are any significant differences in distance to grocery stores by neighborhood demographics and by neighborhood poverty level. We also present maps to visually demonstrate the issues of food insecurity in Forsyth County. Maps were created using ArcMap.

Neighborhood racial composition and levels of poverty:

We follow Zenk et al (2005) by categorizing neighborhoods as either high poverty or low poverty based on the percentage of residents with incomes below the poverty level. Neighborhoods where at least one-third of households had incomes below the poverty line are considered to be high poverty neighborhoods. Quillian (1999) uses a similar threshold for defining high poverty. We also categorize neighborhoods by the percentage of black residents. Neighborhoods which were at least 70% black were considered to be predominantly black. Prior research on neighborhood segregation has defined an area of 70% or black as a predominantly black neighborhood (Moye & Thomas 2018). Black neighborhoods generally receive less consideration by the real estate industry as well as by retailers (Gotham 2000). Consistent with prior research on neighborhood segregation, both non-Hispanic blacks and Hispanic blacks were combined in the numerator when calculating the percentage of black residents (Moye 2014; Ellen 2000).

Female-Headed Households

The USDA reports that many food insecure individuals are poor, minorities, and are single parent households (Coleman-Jensen et al., 2010). When compared to dual earning households, single parent households have more financial responsibilities and may be more socioeconomically deprived; thus, the resources used on food may be limited. Nearly a third (35.3%) of households with children that are headed by single women are food insecure (Coleman-Jensen et al., 2015). Thus, we include female- headed households in our descriptive table to provide more context to the food environment in our study area.

Transportation:

In this project, we discuss structural barriers, socioeconomic deprivation, and accessibility. All are underlying factors of food insecurity and are also related to transportation (Zenk et al., 2005). Specifically, limited transportation is a structural barrier that results in limiting food access (Morland et al., 2002). Socioeconomic deprivation, or affordability of transportation, is also a barrier limiting food access. Having access to a vehicle in areas that are serviced by public transport systems may be unaffordable to many families and unattainable for residents living in areas that are not serviced by public transport (Wauchope and Ward, 2012). We use this variable as a proxy measure of access to food.

RESULTS

Descriptive Statistics

We have data for all 243 block groups of Forsyth County. The average block group includes 1,430.3 persons and 566.6 households. On average, each block group is only 0.43 miles away from the nearest grocery store, but there is a great deal of variation in distance across the county, as the maximum distance is 4.31 miles. Similarly, on average each block group is 1.32 miles away from the nearest general store and 1.19 miles away from a grocery store with fresh seafood, but the maximum distance to a grocery store with seafood is 6.80 miles, almost seven miles away.

In the average block group, 14.9 percent of households are households with children headed by a single mother. In terms of transportation, across the county in the average block group, only 8.5% of households do not have a vehicle, however there is one block group where 66% of households do not have a car. The average block group is 27.4% black, 58.6% white and 10.7% Latino. Together, those three racial-ethnic groups include 97% of the county population. Therefore, we do not report separately on Asians, American-Indians, or Pacific Islanders.

Out of 243 block groups in Forsyth County, there are a total of thirty-nine High Poverty block groups and twenty-four predominantly black block groups.

Table 2: Descriptive Statistics

	Minimum	Maximum	Mean	Std. Dev
Total Population[1]	369.0	3,175.0	1,430.3	571.0
Total Households[1]	24.0	1,290.0	566.6	231.7
Total Distance to All Grocery Stores (Miles)[2]	0.0	4.31	0.43	0.64
Distance to all General Stores (Miles)[2]	0.0	5.80	1.32	1.23
Total Distance to all Seafood Grocery Stores (Miles)[2]	0.0	6.80	1.19	1.06
Percent Female Headed Households[1]	0.0	100.0	14.6	12.8
Percentage of Housing Units with No Car Available[1]	0.0	66.0	8.5	11.5
Percent Below Poverty[1]	0.0	93.4	15.9	16.1
Percent Black including Hispanic Black[1]	0.0	100.0	27.4	26.4
Percent Non-Hispanic White[1]	0.0	100.0	58.6	31.2
Percent Latino (excluding Black Latinos)[1]	0.0	84.1	10.7	15.3

1 Source: US Census Bureau American Community Survey 2007-2011 5 year estimates
2 Source: Map Forsyth

Table 3: Household Type and Car Access by Poverty Status & Racial Diversity

		Percent of Housing Units with No Car**		Percent Female Headed Households**	
	N	**Mean**	**St. Dev**	**Mean**	**St. Dev**
High Poverty	39	25.36	16.58	24.76	14.11
Low Poverty	204	5.28	6.50	12.68	11.64
		***p<.001*		***p<.001*	

		Percent of Housing Units with No Car**		Percent Female Headed Households**	
	N	**Mean**	**St. Dev**	**Mean**	**St. Dev**
Black Neighborhoods	24	23.10	19.33	32.43	9.54
Majority White & Integrated Neighborhoods	219	6.91	9.07	12.67	11.60

*****p<.001 **p<.001***

Bivariate Analysis

Table 3 shows the results of an independent t-tests comparing access to cars and household type by poverty status and racial diversity. Residents of high poverty neighborhoods are much less likely to have a car, and twice as likely to be headed by a single woman. In addition, residents of Black neighborhoods are also much less likely to have a car and more likely to be headed by a single woman.

Table 4 shows the results of independent t-tests comparing the average distance in miles from each block group to the nearest grocery store of each type. There is no significant difference in the distance to a grocery store with fresh seafood. In both the high poverty neighborhoods and the low poverty neighborhoods, stores with fresh seafood are a little more than a mile away. However, there is a big difference in terms of distance to general stores. High poverty blocks are much closer to general stores, and low poverty neighborhoods are more than twice as far away. Low poverty neighborhoods are also further away from grocery stores of all types. For residents of low poverty neighborhoods, this additional distance may not be as important of a barrier because 95% of household in the low poverty neighborhoods have access to a car.

Table 5 shows the results of independent t-tests comparing the average distance to each type of grocery store by neighborhood racial composition. Black neighborhoods are further away from grocery stores with fresh seafood than white or integrated neighborhoods. Black neighborhoods are also much closer to general stores. People who live in a black neighborhood on average can travel less than half a mile to a general store, whereas people who live in white or integrated neighborhoods would have to travel three times as far. There is no significant difference in the distance to all grocery stores.

To provide a visual depiction of the distance to each neighborhood type, we have included maps with the location of each store in Forsyth County and have highlighted the Black neighborhoods and the High Poverty neighborhoods in separate maps. Figure 1 shows the location of the predominantly black neighborhoods and the location of different types of grocery stores. Grocery stores with fresh seafood, general stores, and other grocery stores (the 'other grocery stores' category are grocery stores which do not sell fresh seafood; these are typically smaller establishments than the grocery stores which do sell fresh seafood). Figure 2 shows the location of High Poverty neighborhoods and the location of different types of grocery stores. Although there is considerable overlap between the predominantly black block groups and the High Poverty block groups, poverty is more spread out over the county, and there are predominantly black block groups which are not also High poverty block groups. The maps show that while grocery stores generally tend to be centrally located within Forsyth County, the groceries with fresh seafood are concentrated in higher income, whiter neighborhoods, and the general stores are almost exclusively located in black neighborhoods (although not necessarily located in high poverty neighborhoods).

Figure 3 shows the location of grocery stores alongside the location of food pantries in Forsyth County juxtaposed against the location of the high poverty block groups. What is apparent from the map is that the food pantries are located where high poverty neighborhoods are located. Many of the food pantries are run by churches. The grocery stores, however, are located mostly on the western side of the county, away from the high poverty areas. Residents of high poverty neighborhoods, who are less likely to have access to an automobile, would have a difficult time getting to and from grocery stores. In the northern part of the county, there are high poverty block groups not close to either food pantries or grocery stores. In this way, the ecology of the food environment suggests it is more difficult for the typical impoverished resident to eat a fresh and healthy diet.

Table 4: Distance to Grocery Stores by Type & By Poverty Status

		Groceries with Fresh Seafood (n=19)		General Stores** (n=16)		All Grocery Stores** (n=81)	
	N	M	SD	M	SD	M	SD
High Poverty	39	1.14	0.73	0.58	0.50	0.27	0.29
Low Poverty	204	1.21	1.12	1.46	1.28	0.46	0.68

*p=.623 **p<.001 **p=.007*

Table 5: Distance to Grocery Stores by Type & by Racial Diversity

		Groceries with* Fresh Seafood (n=19)		General Stores** (n=16)		All Grocery Stores (n=81)	
	N	Mean	St. Dev	Mean	St. Dev	Mean	St. Dev
Black Neighborhoods	24	1.60	0.74	0.44	0.35	0.31	0.31
Majority White & Integrated Neighborhoods	219	1.15	1.09	1.41	1.26	0.44	0.66

*p=.012, **p<.001, p=.095, Two-Tailed Significance Tests

Figure 1: Location of Grocery Stores & Predominantly Black Neighborhoods

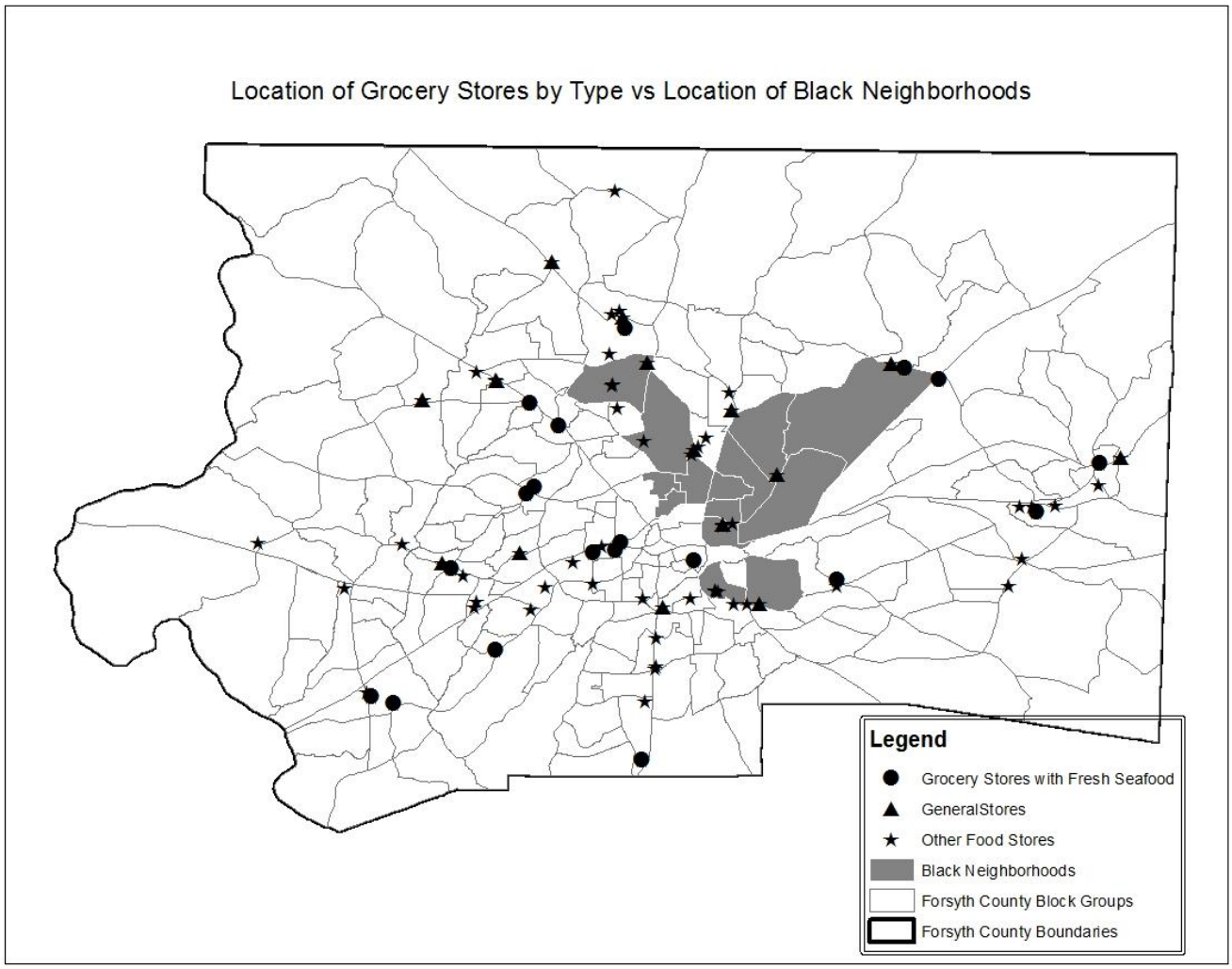


Figure 2: Location of High Poverty Neighborhoods & Location of Different Types of Grocery Stores.

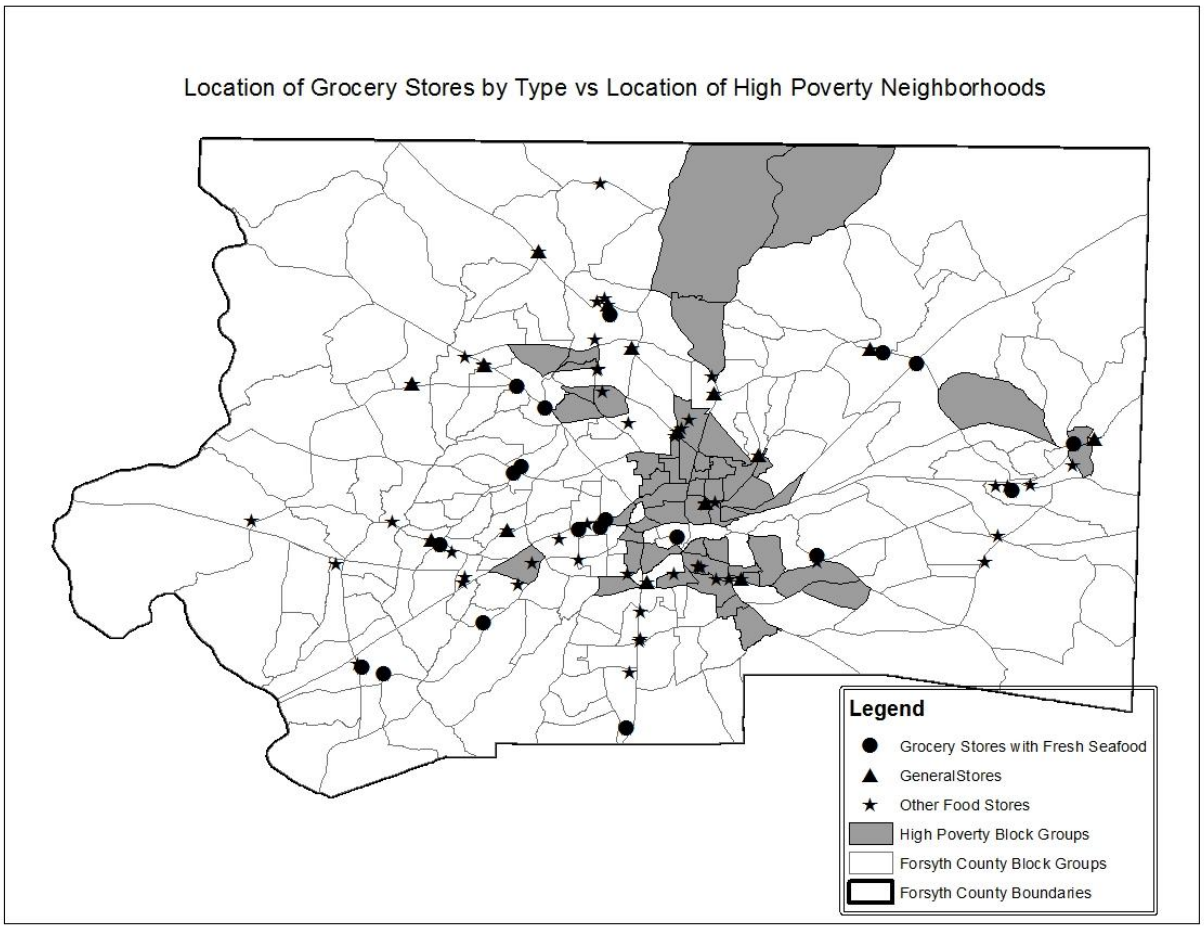
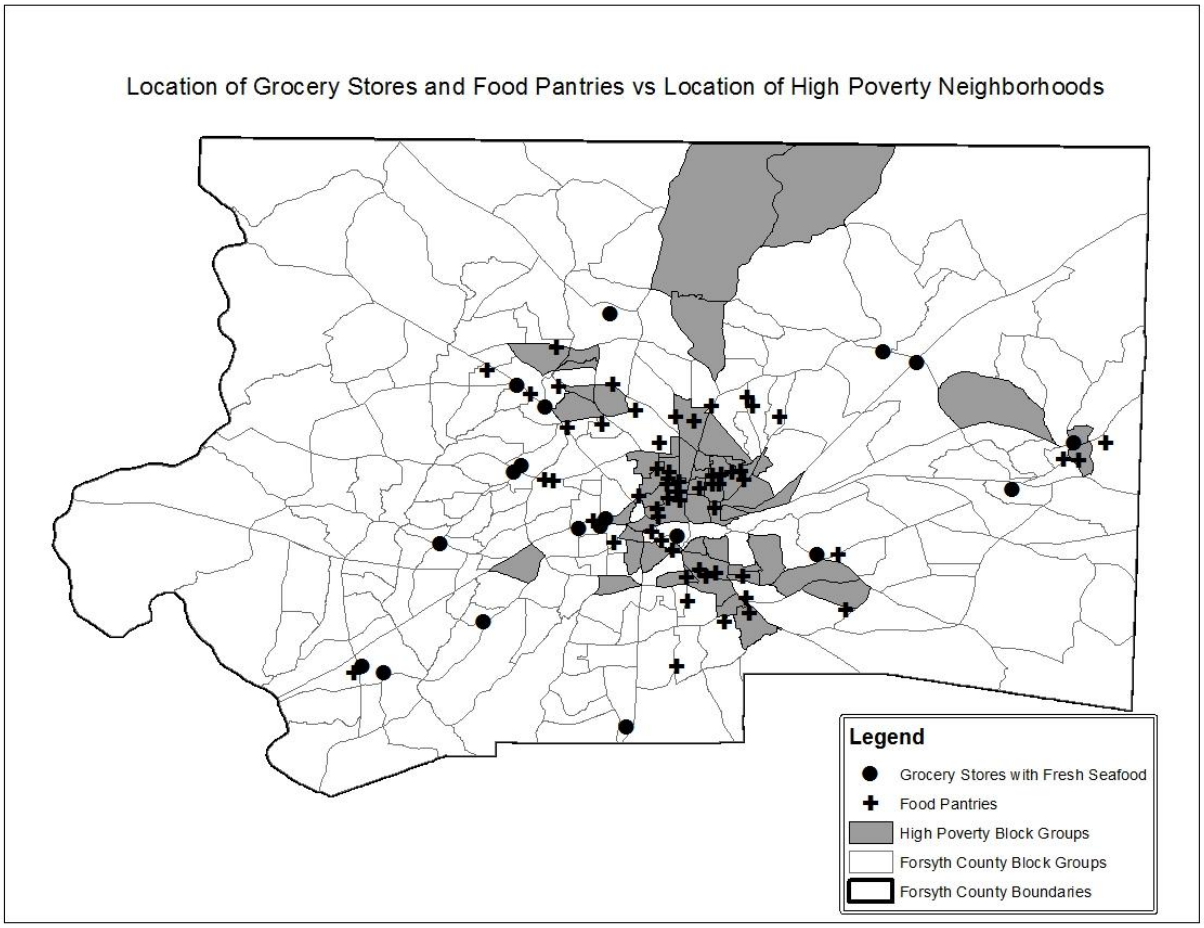


Figure 3: Location of Grocery Stores & Food Pantries vs Location of High Poverty Neighborhoods



Conclusion and Discussion

Our findings echo those of Raja et al (2008): although food outlets are available in and around poor neighborhoods and predominantly black neighborhoods, the kind of food outlets are not the same. We find that in poor neighborhoods and black neighborhoods, the average distance to grocery stores is higher when compared to low poverty and non-black neighborhoods. Access to low quality processed foods is abundant, but access to fresh fish and fresh vegetables is inadequate. In addition, residents of high poverty and predominantly black neighborhoods are less likely to have their own car and are more likely to shop at the stores that are in walking distance. This illustrates the prevalence of and the problem behind food swamps and food deserts (environments that are saturated by easily accessible unhealthy foods). The proliferation of dollar stores, although readily accessible to the Black neighborhoods, often reduce access to fresh foods while congesting retail space for grocers that may sale healthier options for low income communities (ILSR, 2018). The Institute for Local Self Reliance suggests that Dollar Stores are not necessarily a more affordable option for food (ILSR, 2018).

Theoretically, using the socio-community component of the Ecological Model, we contend that the access to food resources is limited in high poverty and predominately-black communities. Thus, this leads to increased levels of food insecurity.

The findings also illustrate the high poverty areas that are absent of grocery stores, general stores, and food pantries. This finding contrasts results in the extant literature that suggests networks of small grocery stores in high poverty areas (Raja et al., 2008). However, Dean and Sharkey's comparison of food resources in rural and urban environments supports this spatial illustration of constraints and structural barriers (2012). Application of the social-political component of the ecological model illustrates economic barriers and supports poverty being a predictor of poor food environments.

Our findings strengthen the gap in the literature that provides an understanding on food environments and determinants of food insecurity within smaller urban areas and regions such as Central North Carolina. Food insecurity literature focusing on larger cities and North Carolina areas such as the Appalachian region (which is about 90 miles west of Central North Carolina) are more common. As the Winston-Salem (Forsyth County), NC area has an 15.5 percent food insecurity rate, it has been one of the highest-ranked food insecure cities in the nation (Feeding America, 2017; Berner, 2013;NCAFAFB, 2016); conducting research addressing cities with food insecurity above the national rate is imperative to implement improvement.

Overall, our results pair the interaction of ecology and social environments through food environment to help illustrate the relationship between racial and economic segregation and food insecurity, uniquely focused on a mid-sized urban city. The county remains segregated, partly due to residents' prejudiced attitudes towards blacks (Opoku-Dapaah 2007). When white buyers and real estate actors choose to avoid black neighborhoods, the residents left in those neighborhoods have reduced purchasing power. Our results show that retailers, including grocery stores also avoid black neighborhoods. Thus, segregation has made it more difficult for residents in black neighborhoods to access quality, affordable fresh food. High levels of racial and economic segregation are associated with high levels of food insecurity. Despite America being a country with an abundance of food, access to quality food is unequal and many residents of poor or racially segregated neighborhoods do not have access to fresh food. Partly, as a result of this, they are at a higher risk for chronic conditions such as diabetes, hypertension, and heart disease.

Implications

Forsyth County, NC has several organizations and initiatives that work towards lowering the food insecurity rate. State organizations such as the North Carolina Alliance for Health has implemented a "Healthy Corner Store Initiative" that support smaller convenience stores in their sale of healthy foods (North Carolina Alliance for Health, 2015). Additionally, other organizations such as the Forsyth Community Food Consortium promotes equity by existence of a resource center that focuses on a food policy council, collaboration of community members, and project facilitation (Forsyth Community Food Consortium, 2016).

Our findings illuminates areas of the county that would benefit from assistance from the aforementioned organizations and initiatives in efforts to improve the food environment. Provision of resources within the underserved areas of Winston-Salem, NC while limiting the gates of access, marketing, economic, political, and structural gates that act as barriers to food are communal efforts. Existing research cautions the addition of large supermarkets within underserved neighborhoods as a resolve for food insecurity (Raja et al., 2008); smaller grocers maybe more appropriate. We challenge local communities and policy makers to use research in efforts to improve equity.

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