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Hunger and Violence: An Ecological Examination in Fulton County Atlanta, Georgia

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Hunger and Violence: An Ecological Examination in Fulton County Atlanta, Georgia

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Abstract

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By

Ashley N. Ototo

Background. Atlanta, Georgia has experienced rapid growth in both spatial capacity and population over the past several decades and has become one of the largest commercial and industrial regions in the southeast (Lo, 2002). With the growing population also came a rise in food deserts (FD). In addition, crime increased within the city and continues to be a public health issue not only in Georgia but globally.

Methods. To understand the relationship between food deserts and violence, an ecological study was done in Atlanta, Fulton County, Georgia. Data were obtained from the United States Department of Agriculture Food Access Research Atlas (USDA) and the Atlanta Police Department (PD). Spatial analysis was done using Anselin Moran's I to determine spatial autocorrelation for crime, grouping crime into clusters of above average (high-high) values, below average (low-low) values, high values surrounded by low (high-low) values, and low-values surrounded by high (low-high) values of crime. Furthermore, regression analysis was conducted to investigate if being exposed to areas classified as FD was associated with higher rates of crime. Data included all crimes reported within Fulton County in areas under Atlanta PD jurisdiction.

Results. In Atlanta, Fulton County, Georgia, within the Atlanta PD jurisdiction there is a significant relationship between living in FD and violent crimes with demonstrated significance when controlling for no vehicle and low access to supermarket or healthy food. The odds of high-high (HH) clusters of crime in FD census tracts are 1.89 times greater than low-low (LL) clusters of crime in non-FD census tracts ([OR] 1.89; 1.60,2.23]). The odds of HH tracts is 2.13 times greater than HL, LH, and LL census tracts ([OR] 2.13; 2.01,2.26]). When adjusting for no vehicle, no access at ½ mile had a protective effect.

Discussion. The findings of this study provide context for FD and number of violent crimes in Atlanta, Fulton County, Georgia. The study further stratifies the data into clusters, demonstrating a significant relationship between living in a FD and number of violent crimes compared to living in non-FD areas. It describes the complex interactions between multiple factors and the multilevel nuances pertaining to these factors. The findings of this study serve as a foundation for future interdisciplinary research and influence additional research at the neighborhood and individual levels to advance food access and potential interventions for violent crimes within this area.

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This project is dedicated to the people of Fulton County Atlanta, Georgia who are currently facing and fighting systemic and oppressive barriers, who lack access to healthy food but manage to make it to the next day, those who have been exposed to violence as well as those who have been perpetrators of violence due to their unfortunate circumstances. Thank you for trying your best!

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Table of Contents

Table of Tables and Figures

Acronym List

BLT	Behavioral Learning Theory
CLT	Cognitive Learning Theory
CVE	Community Violence Exposure
FD	Food Deserts
IPV	Intimate Partner Violence
PD	Police Department
SLT	Social Learning Theory
USDA	United States Department of Agriculture
WHO	World Health Organization
WRVH	World Report on Violence and Health
NVDRS	National Violent Death Reporting System

Chapter I. Introduction

Food insecurity and violence are two public health discussions that have gained wide-spread attention. Specifically, food deserts, critical problems emerge when considering how low-income neighborhoods lack grocers. Food deserts have been a global health concern affecting urban communities (Smith, 2013). Market studies have shown the difficulties owners would experience in regard to reaching an acceptable return on investment in low-income neighborhoods (Popejoy, 2013). Conversations have risen about the role violence plays in neighborhoods due to inaccessibility of resources, one being food. In one study, a critical aspect of the role violence played in an African community was the "lack of systematic understanding of the relationship(s) between local food resources and violence against civilians." (Koren, 2017). Although context in nature may differ, there is a desire to understand the relationship between community violence and food deserts.

Problem Statement

According to data from USDA's Economic Research Service, 22.3% of the Atlanta Metropolitan Statistical Area's population lives in census tracts that are low income and have low access to a supermarket, supercenter or large grocery store (Iqbal, 2018). Furthermore, Atlanta has a crime rate of 58 per one thousand residents, having one of the highest crime rates in America compared to all communities of all sizes - from the smallest towns to the very largest cities (Neighborhood Scout). One's chance of becoming a victim of either violent or property crime here is 1 in 17. Within Georgia, more than 93% of the communities have a lower crime rate than Atlanta (Neighborhood Scout).

Purpose Statement

Exploring the relationship between FD and violent crimes using both quantitative and spatial methods provides crucial context for the type of relationship. Detailed information regarding this relationship may guide future interventions such as programs and policy to target these specific issues.

Research Objective

Using data from the USDA, this study identifies food desert and non-food desert areas in Fulton county in Atlanta, Georgia. Based on this the study has the follow aims:

1. Investigate the association between food desert areas and rates of community violence
2. Determine whether any other socioeconomic factors such as SES and access to transportation affect this association
3. Identify areas where there is clustering of violence within food deserts.

It is the belief that communities classified as food deserts would demonstrate a relationship with community violence.

Significance Statement

The research question addresses both the populations affected by FD and how violence within those communities play a critical role in health outcomes. There is extensive research on both food insecurity, specifically related to food deserts as well as community crime/violence, but not much has been done solely to determine the relationship/association between the two. In mixed methods research done by Chilton, quantitative research revealed a correlation between mental health issues among mothers on program assistance and food insecurity (2014).

Qualitative research revealed childhood trauma and life-changing violence are linked to severe food insecurity (Chilton, 2014).

With this study, potential interventions can be discussed to determine feasible and sustainable means to decrease potential violent acts within the community by focusing on access to food. Both food deserts and violence are two important public health issues affecting low-income and poverty-stricken communities that continue to drive less than desired health outcomes in these communities.

Chapter 2. Literature Review

The link between food insecurity and violence has received little attention (Conroy, 2010). Decades of research has demonstrated that markers of poverty such as income, employment, education and violence are linked to each other (Conroy, 2019). In 2002, a study presented to the US Department of Justice found that women in relationships that are located in socio-economically disadvantaged communities were at higher risk of experiencing violence from their male partners (Benson, 2002). The relationship between community context and intimate violence is not the result of compositional differences in neighborhood populations but rather represents a contextual effect (Benson, 2002). Different forms of economic distress are related to the likelihood of violence against women in intimate relationships, and the correlation of race and ethnicity with intimate violence is confounded with differences in the community context (Benson, 2002). There is some evidence that food insecurity and violence are positively associated. According to the Centers for Disease Control (CDC), women who reported being food insecure in the past 12 months experienced higher levels of rape and physical violence than women who reported being food secure (Breiding, 2014). Another recent study that focused on food insecurity and violence in a prospective cohort of women at risk for or living with HIV in the United States concluded that food insecurity was strongly associated with violence, and women exposed to persistent food insecurity were even more likely to experience violence (Conroy, 2019).

Of the small number of studies on the association, most consist of cross-sectional studies with people receiving public assistance, small community-based samples, or people outside of the US. There is an urgent need for larger-scale studies that examine the association between

persistent exposure to food insecurity, more specifically food deserts, and violence as an outcome in the United States.

I. Food Access

The United States Department of Agriculture (USDA) estimated that in 2018, 11.1 percent of U.S. households were food insecure at some point in time, meaning they were unable to obtain enough food for an active and healthy life (Coleman-Jensen, 2019). The USDA defines food insecurity as "a household-level economic and social condition of limited or uncertain access to adequate food" (USDA, 2019). Recently, considerable resources and research have been directed towards improving diet in low-income communities by exposing contributing factors that affect access to healthy foods but also increasing neighborhood access to fruits, vegetables, and other healthy foods (Mayer, 2014). Research has shown that low-income neighborhoods offered greater access to sources that promoted unhealthy eating (Hilmers, 2012) and how racial disparities play a role in access to health food (Franco, 2008; Powell, 2007). Low-income and predominantly African American neighborhoods (regardless of income) are less likely to have access to a supermarket relative to higher-income and white neighborhoods (Baker, 2006; Zenk, 2005; Ghosh-Dastidar, 2014).Traditionally, food insecurity has been addressed through government funded food assistance programs: The Supplemental Nutrition Assistance Program (SNAP, formally known as food stamps) and the Special Supplemental nutrition program for Women, Infants, and Children (WIC). Additionally, other resources include non-profit assistance. However, although programs aim to increase food access and reduce food insecurity, families may continue to be unable to purchase food due to other contributing factors such as economic instability and poverty.

a. Food Deserts

The phrase “food desert” was first used in the early 1990s and defined as poor access to an affordable and healthy diet. (WHO, 2002; Walker, 2010). Since that time the phrase has been used differently. Today, food desert (FD) is defined as a census tract with both low access to a supermarket or large grocery store (at least one-third of tract residents live more than 1 mile away or 10 miles away in the case of rural areas) and low income (poverty rate greater than or equal to 20% or median family income at 80% or lower of the area median family income) by the US Department of Agriculture. An estimated 23.5 million people live in a FD across the US (Schultz, 2018). Governmental programs and food policies are currently focused on addressing FD areas by increasing funding for healthy food options and access. However, the direct linkage between FD and certain health outcomes remain understudied (Schultz, 2018). Food deserts have been linked to diseases such as cardiovascular disease (CVD), obesity, and diabetes and mental health, including depression but not much research has demonstrated the link to violence (Mayer, 2014; Kelli, 2017).

Food deserts have been a growing concern in urban communities, affecting areas with a large proportion of residents living in poverty (Mayer, 2014). Research demonstrates that some low-income African American neighborhoods throughout the US experience limited access to foods more than any other community (Story, 2008). According to research by the USDA, food desert tracts have different ethnic and racial compositions compared to all other tracts. Food desert tracts have a greater concentration of all minorities – 53 percent greater in urban and 65 percent greater in rural food desert tracts compared to non-food desert tracts in 2005-2009 (USDA, 2019). In addition, residents of food desert tracts have lower levels of education than their counterparts in non-food desert tracts (USDA, 2019). Furthermore, economic disparities between food desert tracts and other tracts is prevalent and noted in differences in median family

income, unemployment rates, and the proportion of households receiving public assistance. Further impact extends to access to private vehicles which plays a large role in determining the ease of obtaining healthy and affordable food.

Many urban neighborhoods and rural communities throughout the United States continue to have limited access to wholesome quality, affordable and nutritious foods (Smith, 2013). Barriers to access to healthy foods can stem from a lack of financial resources, a lack of supermarkets within close proximity to their homes, and limitations in accessing personal transportation and public transit. For the purpose of this study, the USDA food desert definition will be used.

II. Violence

No country or community is untouched by violence (WHO, 2002). Motivations of violence are rooted in a web of complex systems. Violence is defined by the World Health Organization in the World Report on Violence and Health (WRVH) as "the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation" (WHO, 2002). According to the WRVH, the typology of violence is divided into three categories based on who commits the violent act: self-directed violence, interpersonal violence, and collective violence (WHO, 2002). For this study, the focus is on interpersonal violence which is further divided into two subcategories: family and interpersonal violence and community violence. Community violence is defined as violence between individuals who are unrelated, and who may or may not know each other, taking place outside of the home (WHO, 2002). Types of community violence include youth

violence, random acts of violence, rape or sexual assault, and violence in institutional settings such as schools, workplaces, prisons, and nursing homes (WHO, 2002).

a. Social Learning Theory

Violence has plagued many low-income, minority, and impoverished communities, some stemming from scarcity of resources. According to the National Violent Death Reporting System (NVDRS) in the United States, more than seven people per hour die a violent death. More than 19,5000 people were victims of homicide and over 47,000 people died by suicide in 2017 alone (CDC). Violence is recognized as a significant public health problem (Lambert, 2005). Research suggests that community violence exposure (CVE) can influence an individual's attitude and beliefs about violence. This finding is consistent with the social learning theory which suggests that violent behavior can be learned through observation, retention, reproduction, and motivation, and the more often it is reinforced the more likely it is to occur (Motely, 2017).

Social learning theory (SLT) combines cognitive learning theory (CLT) what asserts that that learning is influenced by psychological factors, and behavioral learning theory (BLT), which assumes that learning is based on responses to environmental stimuli (Fryling, 2011). Early studies examined the role of modeling of aggression (Bandura & Ross, 1963) and moral judgment (Bandura & McDonald, 1963) providing a foundation upon which the social cognitive theory was built (Fryling, 2011). SLT has been adapted by psychologists globally but more popular in Western cultures. It is applied to many practices in order to understand perpetuating and cyclical violent behaviors. Today this is still widely practiced but research predominantly focuses on exposures of violence within these communities and treatment and prevention is focused on perpetrators of violence. Although the gap between addressed treatment and

prevention is closing, it still continues to exist when considering perpetrators and victims of violence (Cooley-Strickland, 2009).

III. Violence as an Outcome

CVE is a common and persistent public health issue in many inner-city neighborhoods (Buka, 2001; Stein 2003). Neighborhood environmental characteristics and socioeconomic status (SES) have been linked to health outcomes such as cardiovascular disease, mental health, diabetes and other chronic diseases (Schultz, 2018; Shim, 2019; Sumner, 2015). These unfavorable environmental attributes also appear to impact lifestyle behaviors such as obesity, tobacco use, physical inactivity, and violence. It has long been suspected that the adverse effects of these environments are driven by low access to resources including low access to healthy food for neighborhood residents.

a. Trends in Violence

It is widely accepted that racial/ethnic minority neighborhoods are disproportionately affected by violence. Rates of violence vary by age group, geographic location, sex, race, and ethnicity (Sumner, 2015). For example, in the United States, homicide is the leading cause of death for non-Hispanic blacks, ages 1 through 44, and driven by males age 15-34 years (Sumner, 2015; CDC, 2020). Homicide rates have varied over the past 50 years – rising and falling in trend based on historical events (Sumner, 2015). In the early 1960s, the homicide rate in the United States increased steadily from about 4 to 5 deaths per 100 000 persons to a peak of 10.7 deaths per 100 000 in 1980 (CDC, 2020). Homicide rates remained noticeably elevated through the mid-1990s (Sumner, 2015). Rates of aggravated assault were 86 per 100 000 in 1960, peaked at 442 per 100 000 in 1992, and decreased to 242 per 100 000 in 2012 (Sumner, 2015). The

increase in homicides from the late 1960s to the 1990s has been attributed to factors such as the rising number of youth among the population resulting from the post–World War II baby boom; the growing spread of multiple drugs of abuse; the increase of more powerful firearms; and rapid changes in family structures, cultural norms, and societal dynamics (Blumstein, 2000). Compared to other high-income countries, the United States still exceeds in homicide rates, regardless of the continued decline since the 1990s (Sumner, 2015). The World Health Organization's Global Status Report on Violence Prevention places the 2012 US homicide rate at 5.4 per 100 000, whereas the rate for Canada was 1.8; for the United Kingdom, 1.5; and for Australia, 1.1 per 100 000 (WHO, 2014). For many forms of nonfatal violence—including child maltreatment, youth violence, intimate partner violence (IPV), sexual violence, and elder abuse—progress has also been made, but the burden remains high (Sumner, 2015). For example, from 1992 to 2012, official reports by child protective service agencies of substantiated sexual abuse declined by 62%, physical abuse by 54%, and neglect by 14%; however, an estimated 12.5% of US children still experience confirmed child maltreatment by age 18 years (Wildeman, 2014; Finkelhor, 2013). Furthermore, a recent analysis of national crime survey data indicates that from 1995 to 2010, rates of rape or sexual assault among females decreased 58% from 5.0 episodes to 2.1 episodes per 1000 population; however, nearly 1 in 5 women (19.3%) have experienced rape (completed or attempted unwanted penetration) at some point in their life and experience the sequelae of such violence (Planty, 2013; Breiding, 2011).

b. Prevention and Injury Control

Violence prevention programs are often developed to target specific forms of violence (eg, IPV, youth violence, child maltreatment) rather than violence overall (Sumner, 2015). Evidence for policy- and community-level approaches point to income-strengthening approaches

(eg, subsidies or cash transfers), urban upgrading (eg, improved transportation, lighting, buildings, green space), economic development strategies (eg, business improvement districts), and residential mobility programs that enable families living in disadvantaged environments to resettle in more advantaged neighborhoods (Anderson, 2002; Cancian, 2013; MacDonald, 2010; Sumner, 2015). Increasing family income through subsidies or cash transfers, for example, has been shown to reduce child abuse and neglect, youth violence, and partner violence (Costello, 2003; Knox, 2000; Cancian, 2013).

c. Violence as a Disease

These disparities are believed to be associated with factors including racial segregation, poverty and neighborhood deprivation of resources (Walker, 2010). More recent studies make the argument that violence is a contagious disease – spreading from person to person (Slutkin, 2012). It is further explained that violence is largely exhibited in those who have both perpetrated and experienced violence. By looking at violence as a disease instead of a risk factor or exposure, there will be a better understanding of the role access to resources, specifically food.

A physician named Gary Slutkin discusses in his book Contagion of Violence, the connection between violence and disease (Slutkin, 2012). He elaborates on diseases in their early coming. Often the emergence of new diseases yields criticism and skepticism due to a lack of understanding. In turn, these diseases are arguably treated outside of the infectious disease realm. Diseases such as leprosy, typhoid, and etc. were subject to stigma and people with the disease were treated as the cause of their disease – often misdiagnosed and mistreated because of fear of the unknown. Today, violence is still a social construct that is not understood enough or arguably unknown in its entirety. This leads to a lack of proper diagnoses which often lead to ineffective and counterproductive treatment and control strategies. As studies have progressed, violence can

now be better understood scientifically, and as a result, new strategy to reduce and eliminate violence can be introduced.

Slutkin makes the comparison of infectious diseases and violence by first highlight the characteristics of infectious diseases in population settings – clustering, spread, and transmission. Clustering, or grouping, is the characteristic of epidemic disease. Clustering is often seen and more apparent in areas with violence. Spread, specifically in epidemics, varies in presentation It may occur as waves and can occur at a rapid or slow pace in dramatic fashion depending on the nature of the epidemic. Infectious diseases are normally spread rapidly. Historically, this has been true with epidemics such as the Spanish flu, and more recently Ebola and the Zika virus epidemic. "The same rapid spread has been seen in violence outbreaks such as wars, riots, or genocide (p. 6)." Examples of slow spread are diseases such as tuberculosis or AIDS, characterized with longer incubation periods, and showing spread over decades. Slutkin argues the spread of violence in cities mimics that of these slow spread diseases showing gradual increases over decades.

Transmission of an infectious disease is the passage of an infection from one organism to another. Classic cases of infectious disease are transmitted by agents such viruses or bacteria. Violence in turn is transmitted from human to human. Essentially, it is expected once the disease has been transmitted, the person exposed to the disease will exhibit characteristics of the disease. Many research studies have demonstrated this phenomenon: people who are exposed to violence – either by observing, witnessing, or experiencing violence themselves – are more likely to become what is a perpetrator of violence (Slutkin, 2012; Roberts et al., 2010). Infectious diseases have many transmission routes, usually through direct or indirect contact. Slutkin mentions the different pathways' pathogens are able to enter the body – respiratory tract, gut, skin, or other

routes – causing dysfunction or dysregulation of one or more organs. When talking about transmission of violence, two pathways possible pathways mediated by the brain are 1) visual observation and 2) direct victimization which too cause dysfunction and dysregulation of future behaviors (Slutkin, 2012).

IV. Conclusion

Though majority of research has focused on FD and violence independently, there is research that address the factors associated with FD and violence and their indirect relationship at various sociological and ecological levels. Although there is research on the complexities and nuances of violence, there still continues to be a lack of understanding violence in totality. There continues to be insufficient data on the role violence plays as a disease. Examining both FD and violence at a community level will provide a better understanding of the spatial orientation of violence and if trends are sufficient with classified FD areas. The purpose of this thesis is to explore the relationship between FD and violence.

Chapter III. Methods

Study Population

Population data, including age, race, ethnicity, and residence in group quarters, are from the 2010 Census of the Population and downloaded at the census-block level before being allocated to ½-kilometer-square grid cells. Urban or rural designation was also provided by the 2010 Census at the block level. Data on income, vehicle availability, and SNAP participation are from the 2010-14 American Community Survey and were downloaded at the block-group level (income and vehicle availability) and tract level (SNAP participation) for assignment to ½-kilometer-square grid cells. The study focused on the city of Atlanta census tracts located within Fulton County, Georgia.

Crime data were collected by the Atlanta Police Department (PD) which included information for each police zone within the city of Atlanta (including Dekalb County) from 2009-2018. Data used for the analysis included the 122 census tracts within Fulton County located in the city of Atlanta. Reported crimes in 2015 were used for the analysis.

Environmental Characteristics

An ecological analysis of data collected from city of Atlanta, Fulton County, Georgia in 2015 was conducted, and examines the intersection of violence and food deserts. Fulton County consists of 204 census tracts. The study looked at crimes occurring in census tracts within Atlanta PD jurisdiction in Fulton County (n=122) classified as either food desert or non-food desert**.**

Variables. To classify census tracts as food deserts, I used the Food Access Research Atlas. The Atlas provides data collected by USDA based on low-income and low food access census tracts. A low-income census-tract is defined as an area with a poverty rate of 20 percent or greater, median family income is less than or equal to 80 percent of the State-wide median family income, or located in a metropolitan area and has a median family income less than or equal to 80 percent of the metropolitan area's median family income (USDA). A low-food access census tract is defined as being 1 mile from a supermarket, supercenter, or large grocery store (USDA). A census tract is considered to have low access if a share of individuals in the tract is far from a supermarket (USDA). FD is measured as census tracts that are both low income and low access (USDA). For the analysis, each census tract is either classified as a food desert or non-food desert based on access and income.

In the analysis, crime is measured as the number of crimes reported by Atlanta PD per census tract. The potential confounders no vehicle with ½ mile access and 1 mile access, were continuous variables from the 2015 USDA data used in the analysis. African American is defined as the percent of people who identify as African American per census tract. Median family income is defined as the income level at which half of all households have lower incomes and half have higher incomes per census tract.

Analysis

Spatial Analysis. ArcMap 10.7 was used to perform spatial analysis. Atlanta PD crime data were represented using the point feature class and aggregated into a polygon feature class using the Production Points to Line or Polygon tool. Within ArcMap, attribute tables were accessed to match census tract numbers from food access data to raw crime data via table join feature. Raw

crime data was exported into new shape file and then imported for analysis. A spatial join was performed with crime shapefile and FD shapefile by census tract.

Once the crime points were converted into polygons; aggregation was performed to assess the number of crimes within each census tract (covered by the Atlanta PD). Anselin Local Moran's I was conducted to assess spatial autocorrelation of crime frequency among the census tracts. "Spatial autocorrelation usually describes the correlation among values of a given variable in dependence on the relative locations between the spatial units (Getis, 2007)." "If 'neighbors' or clusters tend to have similar values, one generally speaks of a positive spatial autocorrelation, while one speaks of a negative spatial autocorrelation if they tend to have dissimilar values (Schmal, 2017)." Tracts were classified into statistically significant clusters of positive and negative spatial association. Clusters with an above average value of crime are in a location surrounded by neighboring above average values of crime (high-high) or a below average value of crime is surrounded by neighboring below average values (low-low), spatial autocorrelation is positive. In contrast, when a high (above average) value is surrounded by primarily low values (high-low) and vice versa (low-high), clusters are considered outliers and spatial correlation is negative. All analyses were performed at the census tract level.

Statistical Analysis. The number and proportion of census tracts that are classified as food deserts and the proportion of violent and property crime per census tract were computed. Continuous variables are presented as means ± standard deviation (SD) or proportions. Crime was further stratified to types of crime within census tracts classified as FD and non-FD (Table 2). Univariate group differences were compared using the chi-square test for categorical variables.

A logistic regression was conducted to explore the association between FD and crime. The relative odds of reported crime per census tract associated with tracts classified as food deserts was estimated. Logistic regression was conducted to determine the adjusted association between food deserts and the clusters of reported crimes at the census tract level after adjusting for no vehicle with low access ½ to 1 mile. Assumptions of logistic regression were expected to be met. Census tracts were not independent from one another. While there was collinearity between FD and no vehicle and no access, it was not expected to rise to a level that precluded further analysis. Final sample size was 122 census tracts. P values <0.05 were considered significant. Analyses were performed using SAS 9.4.

Chapter IV. Results

Food Desert Characteristics

Baseline ecological characteristics of the sample of census tracts (n=122) are presented in Table 1. The sample was 35.01% white, 52.02% African American, 5.49% Hispanic, and 7.48 other. The mean number of children under the age of 17 years and seniors age 65 years and older per census tract were 694.65 ± 501.10 and 347.95 ± 293.63 respectively. Adults ages 17-64 years were included in the sample population but data by census tract was not available. Socioeconomic assessment revealed that the poverty rate was 27.73%. Median family income was 69,973.65 ± 59,397.45 (Table 1).

The distribution of FD in the Atlanta metro area according to the USDA Food Access Research Atlas is shown in Figure 1. Population living in FD areas (pop census n=187,741, 43.95%) were predominantly African American (26.39% vs 25.63%) with higher median family income compared to those who were not living in a FD, Table 1. Despite higher median incomes, poverty rates were higher in FD (25.84% vs 17.67%).

Overall, 38.52% of census tracts within the city of Atlanta in Fulton County were FD (n= 47). Of the total number of housing units (n=186,748), 40.85% (n=76,279) were in FD. Of the 17.34% of housing units with SNAP benefits, 45.70% of them resided in FD. The population was further classified on the basis of residing in neighborhoods and its access to healthy food and vehicle access (Table 1). 16.93% of housing units per census tracts had no vehicle. Of the 16.93%, 20.31% of the population had no vehicle and low access to supermarkets and healthy food at 1 mile. 92.68% of the 20.31% were in FD census tracts as opposed to 7.32% in non-FD census tracts.

Types of Crime

Table 2 shows the number of crime and types of crimes reported within food and non-food desert census tracts. Figure 2a shows the distribution of crimes within the Atlanta PD jurisdiction in Fulton County. In 2015, Atlanta PD reported 30,089 crimes. The mean number of crimes reported per census tract within Atlanta PD jurisdiction is 234.02 ± 165.96 (CI, 204.27, 263.76). Table 2 shows larceny (n=16,642, 55.31%) as the highest reported crime. 33.86% of reported crimes occurred in FD census tracts (Table 2). Specifically, non-vehicle, larceny crime is significantly higher in non-FD census tracts (n=5,113, 16.99%) compared to FD census tracts (n=1,937, 6.44%). In addition, home invasions (robbery) was 40.11% of total robberies in FD census tracts compared to 59.89% in non-FD census tracts. Violent crimes consisted of 14.64% of total crimes, 34.76% occurring in FD. Homicide (n=2, 100%) reported the largest proportion of violent crimes in FD (Table 2).

The crime data were further classified into clusters on the basis of high values of crime and the correlation to surrounding census tracts. The sample consisted of multiple clusters (n=31) shown in Figure 2. The proportion of HH (45.16%) was greater than the proportion of LL (22.58%). There were 14 total HH clusters, 8 of which were classified as FD and 6 as non-FD; 7 total LL clusters, 4 classified as FD clusters and 3 non-FD; 3 HL clusters, 3 classified as FD and 0 non-FD; 7 LH clusters, 1 classified as a FD and 6 non-FD.

High-High Clusters of Crime versus Low-Low Clusters

Clusters of crime were significantly different between FD and non-FD census tracts. The logistic regression model showed that FD tracts were more likely to experience high clusters of crime (HH) than non-FD tracts and that HH clusters were more frequent than low clusters (LL).

The odds of being a HH census tracts is 1.89 times more likely than LL in FD compared to non-FD census tracts (95% CI: 1.60, 2.23). Comparing HH census tracts to LL, HH is 1.01 less crime adjusting for no vehicle and no access within ½ and 1mile. The odds of HH census tracts is 0.36 (95% CI 0.29, 0.43) times the odds of LL census tracts, adjusting for no vehicle and no access within ½ and 1 mile. Table 3 shows no vehicle with no access ½ mile has a protective effect (OR, 0.986).

High-High Clusters of Crime versus High-Low, Low-High, and Low-Low Clusters

Comparing clusters of crime, high cluster census tracts (HH) are less compared to all other cluster tracts (HL, LH, and LL tracts). The odds of HH clusters in FD is 2.13 times greater than HL, LH, and LL in FD census tracts (95% CI: 2.01,2.26). The odds of HH in FD census tracts is 1.31 (95% CI 1.21, 1.42) times the odds of HL, LH, and LL in FD census tracts, adjusting for no vehicle and no access within ½ and 1mile. Table 3 shows no vehicle with no access ½ mile has a protective effect (OR, 0.994).

Overall, HH clusters have significantly lower odds of occurring in a FD compared to LL clusters but greater odds of occurring in a FD compared to all clusters grouped together.

Table 1. Ecological Characteristics of Fulton County within Atlanta Police Department Jurisdiction in Atlanta, Georgia at Census-tract Level by Food Desert Status

	Total	Food Desert	Non-Food Desert
Sample (n)	122	47	75
Population, 2010 (n)	427,208	187,741	239,467
Children (<17)	694.65 ± 501.10	970.93 ± 590.83	521.52 ± 338.64
Seniors (≥65)	347.95 ± 293.63	453.36 ± 352.79	281.89 ± 228.32
Ethnicity/Race (%)			
White	35.01	17.27	17.74
African American	52.02	26.39	25.63
Hispanic	5.49	2.42	3.07
Other	7.48	2.46	5.02
Median Family Income $	69,973.65 ± 59,397.45	77,564.30 ± 68,729.59	65,216.48 ± 52,739.65
Poverty Rate Share (%)	27.73 ± 17.72	25.84 ± 17.67	28.91 ± 17.76
Housing Units (n)	186,748	76,279	110,469
SNAP Benefits per Housing Unit (%)	17.34	45.70	54.30
Vehicle Accessibility per Housing Unit (%)			
No Vehicle	16.93	38.16	61.84
No vehicle with low access at ½ mile	58.14	73.98	26.02
No vehicle with low access at 1 mile	20.31	92.68	7.32

Data represent ecological characteristics of food deserts in Fulton County within Atlanta PD jurisdiction in Atlanta, Georgia at the census-tract level. Data are secondary data from the United States Department of Agriculture Food Access Research Atlas. Adults ages 17-64 was not available but were included for this study.

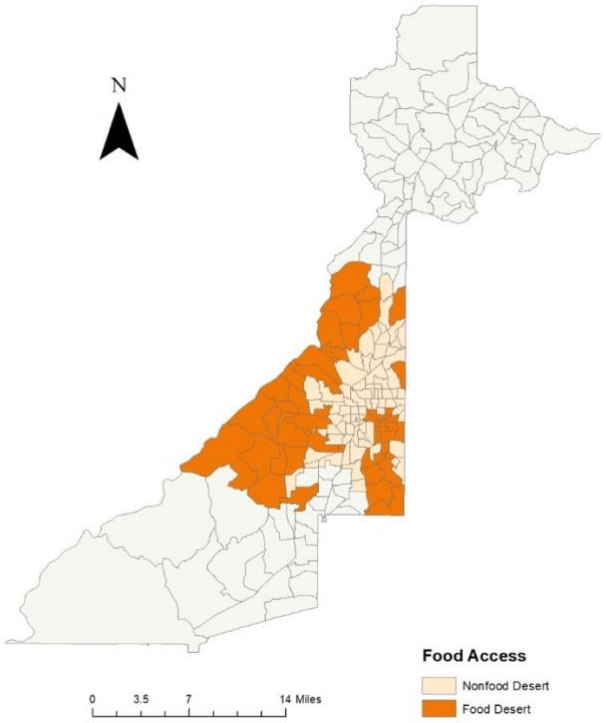

Figure 1. Distribution of food deserts.

Table 2. Estimated number of crimes according by type of crime reported.

	Total		Food Desert		Non-Food Desert	
	No.	**%**	**No.**	**%**	**No.**	**%**
Crime	30089	100.00	10187	33.86	19902	66.14
Aggravated Assault	2,157	7.17	777	2.58	1380	4.59
Auto Theft	4,250	14.12	1630	5.42	2620	8.71
Burglary – Non-Residence	868	2.88	267	0.89	601	2.00
Burglary - Residence	3,923	13.04	1456	4.84	2467	8.20
Homicide	87	0.29	26	0.09	61	0.20
Larceny – Non-Vehicle	7,050	23.43	1937	6.44	5113	16.99
Larceny – From Vehicle	9,593	31.88	3366	11.19	6227	20.70
Manslaughter	2	0.01	2	0.01	0	0
Robbery – Commercial	235	0.78	66	0.22	169	0.56
Robbery – Pedestrian	1,737	5.77	585	1.94	1152	3.83
Robbery – Residence	187	0.62	75	0.25	112	0.37

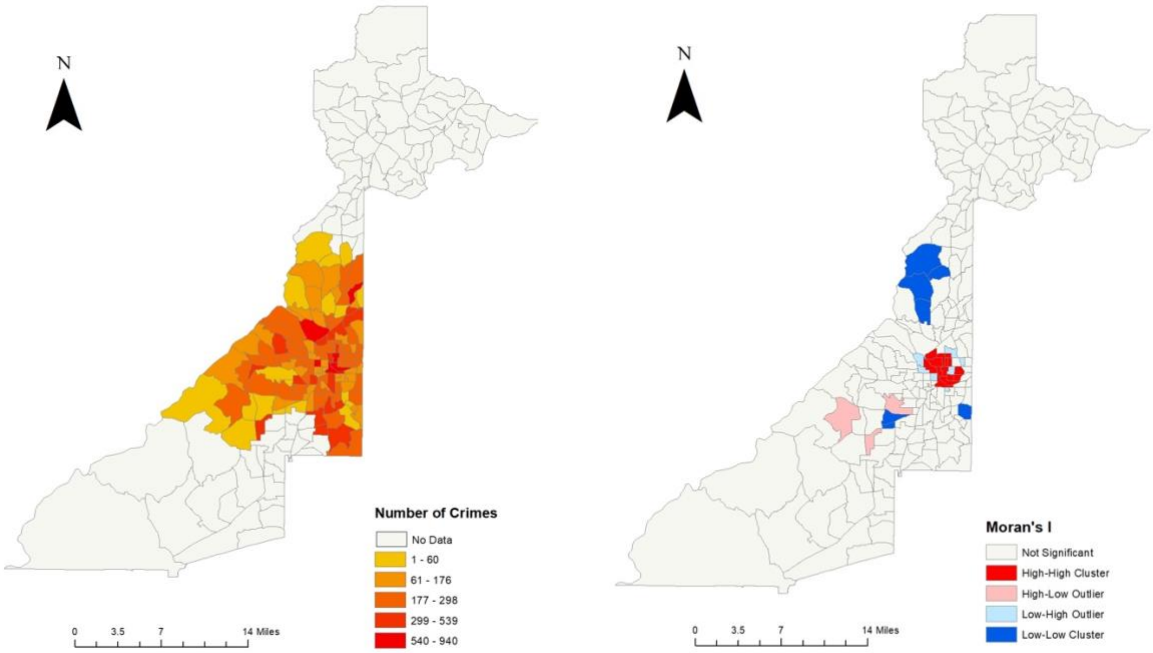

Figure 2. (a) Number of crimes in Fulton County within Atlanta PD jurisdiction in Atlanta, Georgia within 2010 census tract boundaries and (b) measures of spatial autocorrelation (Moran's I).

Table 3. Associations, Adjusted Odds Ratios (AOR) and 95% Confidence Intervals (CI) for associations between FD with no vehicle and no access ½ to 1 mile and non-FD and violent and property crime clusters (n=122).

	High-High (n=14) vs. All Clusters (n=31)						**High-High (n= 14) vs. Low-Low (n=7)**					
	OR	95% CI		AOR	95% CI		OR	95% CI		AOR	95% CI	
FD	2.129	2.005	2.261	1.310	1.208	1.421	1.890	1.604	2.227	0.363	0.291	0.453
No Vehicle												
No access ½ mile				0.994	0.994	0.995				0.986	0.984	0.987
No access 1 mile				1.010	1.009	1.010				1.401	1.036	1.056

All values are number (%). OR, Odds ratio. AOR, Adjusted odds ratio. CI, Confidence interval. NA, Not applicable.
*Significant association (P<0.05).

Chapter V. Discussion

Within the city of Atlanta, Fulton County, GA 38.5% of census tracts were classified as food deserts. Approximately 1/3 of all crimes occurred in FD. We found that high clusters of crime mostly occurred in FD tracts. Using census tract data from the city of Atlanta, in Fulton County, Georgia, we identified a significant ecological association between FD and crime. Low-income, poverty, and lack of transportation have been linked to both FD and crime in previous studies demonstrating a positive relationship between food insecurity and violence even after adjusting for socio-economic status (Conroy, 2019; Motley, 2017; Walker, 2010). There are several explanations for our findings. First, FD exposure can incite crime due to lack of having sufficient access to food. Access puts people at an increased risk for food insecurity and for crime (Mayer, 2014). Markers such as poverty and low-income may serve as a trigger for various types of crimes (Conroy, 2019). Second FD are connected with many socioeconomic factors which may make it difficult for the population to change or leave their environment.

Food Deserts. The present study is the first to report the relationship between living in FD (defined as both low income and low access to healthy food areas by the USDA) census tracts and crime. Previous studies have focused on select neighborhood characteristics and socioeconomic status. (Kelli et al., 2017; Robert, 1998). Other studies have focused on chronic health diseases such as cardiovascular disease (CVD) and mental health issues (Kelli, et al., 2017; Laurenzi, 2020). For example, areas with poor food quality, low access to healthy foods, or more fast food restaurants are associated with obesity and diabetes. Another, recent study demonstrated the association between food insecurity, maternal mental health, and domestic violence (Laurenzi, 2020).

Food Access. There is controversy regarding crime rates and food access (Conroy, 2019). In this study, it was found that FD census tracts had higher proportion of housing units with no vehicle access and low access within ½ and 1 mile. Living with no vehicle and access within ½ and 1 mile within FD census tracts comprised 38.16%. Therefore, food access alone, measured by proximity to supermarkets, may be the contributor to increased crime and the relative cost of higher quality food rather than access may not be a major barrier to healthy lifestyle and choices (Walker, 2010).

Crime and Clusters. There is geographical variation in the distribution of low values of crime clusters and high values surrounded by low value outlier clusters within Fulton County, Atlanta, Georgia. Low value clusters surrounded by high values and high value clusters surrounded by other high value clusters demonstrate less variation. High-high clusters were more frequent and concentrated within metro Atlanta census tracts. 57% of high-high clusters (n=14) were identified in FD census tracts and consisted of 45.14% of all clusters.

This is the one of the few studies to examine the relationship between FD and violence. In agreement with the hypothesis, there is a relationship between FD and violence. Although FD made up 38.5% of census tracts, they had higher average of both children under the age of 17 and seniors age 65 and older in addition to higher population of African Americans compared to non-FD. This may be especially relevant as previous studies and research have reiterated age, ethnicity, and socioeconomic status are predictors of FD.

Limitations and Strengths

This study has several strengths. It investigates the relationship between FD and violence in a populous region. The study overall provides a better understanding to population health and encourages further research on the association of FD and violence. Limitations include its ecological nature. This study is a valid method for showing dose-response relationships, and at a minimum, provides solid foundation on which continued research and investigation can take build on (Hart, 2011). It is important to understand that conclusions cannot be drawn about individuals based on the analyses of population data. This is otherwise known as the ecological fallacy.

Second, data are secondary data, originally not collected to address the hypothesis of this research study (Cheng, 2014). This can lead to missing variables of interest to the study and/or lack of data collection for subgroups (Cheng, 2014). Violence data are often underreported and not a representation of all crimes. Most city neighborhood crime data are incomplete and inaccurate because crimes are reported by individual law enforcement agencies rather than by city. Crime risk assessment across the nation is further hindered because the majority of law enforcement agencies in the United States do not geocode the specific locations of reported crimes, making it difficult to ascertain the locations, zip codes and neighborhoods where most crimes occur in America today (Neighborhood Scout). In addition, data was not collected by the researchers therefore, there is potential for inability to identify study-specific nuances or glitches in the data collection process that may be vital to the interpretation of specific variables in the dataset. In the case of large-scale data provided by government agencies, users may miss important details (Cheng, 2014).

Third, within this particular study, Atlanta has greater density population in food deserts compared to nonfood deserts which may account for various results such as higher median

family income in census tracts considered FD which by definition include low-income. Understanding gentrification and how the populous lines have shifted since the 2010 census to 2015 data used in the analysis is important in understanding the results. Communities are changing rapidly in Atlanta, calling into question the appropriateness of utilizing data collected in 2015 but based on a 2010 census. It is possible that 2015 FD data based on 2010 census population may not be attributable to the 2015 crime data collected by Atlanta PD. With populations continuing to grow and migrate, it is important to understand that demographics change which can cause misinterpretation of results.

Lastly this study focuses on FD as the exposure and violence as the outcome. The study was done using data at a point in time rather than over a period of time. Analysis may not provide enough information to understand potential reverse causality. In addition, structural and injury prevention interventions can be limited and/or ineffective.

Conclusions

The findings of this study provide context for the relationship of FD and violence. The spatial data collected in this study can be used to better understand areas in Fulton County that experience low food access and low income as well as clusters of violence and how they overlap. This section will explain how the findings presented in this study can be used to further investigate and develop community-level public health programs that address both of these issues in Atlanta, Georgia.

The results from this study should be followed by more in-depth research at a more micro level to better understand complexities between and among groups of people or communities. Both food access and violence are systemic issues need continuous research for various

interdisciplinary perspectives. To address impact of both public health issues, it is critical to utilize a community needs assessment and community-based participatory action and qualitative research to understand community history, needs, and desires. Such research can further inform policy that will affect community needs.

This study is just a small step in addressing food access and violence but is a starting point for future research that will ultimately generate impact.

Chapter VI. Implications and Recommendations

Few quantitative studies have suggested that violence may be associated with very low food security (Chilton, 2014). Even fewer studies have suggested that exposure to food insecurity may lead to violence (Conroy, 2019). There is a need for continued exploration into the prevalence of exposure to food insecurity and how it is linked to violence. The findings of this study could serve as the foundation of future research that addresses each key result in the context of Atlanta, other cities and counties in GA, or the country. Given the objectives of this research, the limited information of the study population and generalized results, further investigation into FD and violence at the individual level of Atlanta is necessary. Interdisciplinary backgrounds such as sociology, anthropology, economics, medicine, social work, and psychologists would be useful to analyze this study in order to provide multiple perspectives on intervention design to address study issues.

The implications of these findings are that in urban areas, FD exposure and violent and property crime appear to be associated with access to healthy food. The results from this study suggest that it is ineffective to apply these findings at the individual level and require various interventions. Instead, the results are a generalization of the population. Both food access and violence are multilayered and nuanced, affected by multiple socioeconomic factors such as low-income, poverty, education level, transportation, and victimization of violence. Various structural interventions may improve access to and availability of food as well as prevent violence. Targeted food assistance – food banks and pantries – and supplemental nutritional assistance programs are options to address food insecurity (Ivers, 2011; Conroy, 2019; Smith, 2013). To address violence, Multi-level programs that focus on combining structural interventions and violence prevention programs may be useful to address violence.

Further studies should explore additional factors that can provide a better understanding of the relationship between FD and violence. The results from such studies may inform practitioners and policy makers on resources to assist in reducing the impact of violence within FD areas. In addition, studies can further investigate locations of crime and crime over periods of time. Overall, given the limited studies found on the association between food access and violence, the relationship between FD and crime deserves more attention in research.

In order to move forward with food security and violence research, high rates in crime and violence result in increased utilization of hospital resources including the Emergency Department. Health-care providers and practitioners should screen for both food security and violence simultaneously. Referrals to domestic violence resources should result in further referrals to food assistance programs. Food assistance programs should screen more in-depth about community involvement. Second, community wide interventions to address community violence, domestic violence, child abuse, and intimate partner violence could readily incorporate a community food security approach that seeks to improve access to food and ensures families can readily access federal nutrition programs. This study will influence additional studies that look at individual health outcomes more closely.

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