2020-12-10

The Intersection of Food Deserts and Food Assistance Deserts in El Paso County, Texas

Jacob Joseph Aun
University of Texas at El Paso

THE INTERSECTION OF FOOD DESERTS AND FOOD ASSISTANCE DESERTS IN EL PASO COUNTY, TEXAS

JACOB JOSEPH AUN

Master's Program in Sociology

APPROVED:

Jayajit Chakraborty, Ph.D., Chair

Cristina Morales, Ph.D.

Gregory Schober, Ph.D.

Stephen L. Crites, Jr., Ph.D.
Dean of the Graduate School

THE INTERSECTION OF FOOD DESERTS AND FOOD ASSISTANCE DESERTS IN EL PASO COUNTY, TEXAS

by

JACOB J. AUN, B.A

THESIS

Presented to the Faculty of the Graduate School of

The University of Texas at El Paso

in Partial Fulfillment

of the Requirements

for the Degree of

MASTER OF ARTS

Department of Sociology and Anthropology

THE UNIVERSITY OF TEXAS AT EL PASO

December 2022

Acknowledgements

I would like to thank my thesis advisor, Dr. Jayajit Chakraborty, Professor in the Department of Sociology and Anthropology at UTEP. He has been instrumental in guiding me through my graduate career and has given me the opportunity to work on various projects as his mentee. I would not be in the position I am in currently without the honest, thoughtful, and dedicated communication that he has given me throughout our time together. Additionally, I would also like to thank Dr. Gregory Schober, Assistant Professor in the Department of Rehabilitation Sciences, who has also been an integral part of my professional development. The passion he has for his work and the people he works with has been incredibly inspiring and is something I always find myself marveling at. I am also thankful for Dr. Cristina Morales, Professor in the Department of Sociology and Anthropology, for her help and guidance on this research. I am extremely appreciative of both my mom and dad for their continuous support throughout every facet of my life. The lessons they have taught me have molded me into who I am today. Lastly, I am grateful for the other extensions of my support system that includes my brothers, family, friends, and colleagues who have helped keep me grounded throughout this entire process.

Abstract

Although access to both supermarkets and food assistance sites are important for addressing food insecurity, previous studies have not examined how food deserts and food assistance deserts spatially coincide or analyzed their characteristics separately. This thesis sought to address this gap by identifying the locations and socio-demographic characteristics of neighborhoods classified on the basis of multiple food access categories in El Paso County, Texas: food deserts, food assistance deserts, and areas where both food deserts and food assistance deserts overlap. The goal was to determine if racial/ethnic minorities and other socially disadvantaged individuals are more likely to reside in neighborhoods associated with these food access categories. This study uses data from the 2019 American Community Survey, US Department of Agriculture's 2019 Food Research Atlas, and the Sun City Hunger Relief Coalition's 2019 Food Assistance Calendar. Statistical analyses are based on bivariate Z-tests of proportions that compare the socio-demographic characteristics of different food access categories to those outside these areas, as well as multivariate generalized estimating equations that account for spatial clustering to estimate the likelihood of a neighborhood being classified as one of the food access categories based on relevant socio-demographic factors.

Results from bivariate comparisons showed that racial/ethnic minorities and socially disadvantaged groups are more likely to reside in neighborhoods classified as food insecure. In food deserts and food assistance deserts, groups that are significantly overrepresented include Hispanic, less than high school educated, limited English proficient, and foreign born populations, and renters. In neighborhoods where food deserts and food assistance deserts overlap, there was a significant overrepresentation of all racial/ethnic minority groups, as well as less than high school educated, limited English proficient, and foreign born populations, as well

as renters. Additionally, multivariate modeling results revealed the strongest indicators of a neighborhood being classified as one of the food access categories. These comprised non-Hispanic Blacks, other non-Hispanic people of color, and renters for food deserts, and all racial/ethnic minority groups and those with limited English proficiency for food assistant deserts. In neighborhoods where food deserts and food assistance deserts overlap, the most significant indicators included other non-Hispanic people of color, limited English proficient, and unemployed populations, as well as renters. This thesis contributes to research on food security by identifying where food secure and food insecure neighborhoods are located within El Paso County, which socio-demographic groups are underrepresented in food insecure neighborhoods, and the most significant indicators of a neighborhood being classified as food insecure. More detailed analyses that focus on specific food insecure neighborhoods and their residents are necessary to understand the processes through which food deserts, food assistance deserts, and their areas of overlap are created and why specific socially disadvantaged groups reside in such areas.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Food security was first introduced as an issue that garnered public attention in the US during The Great Depression in the 1930s. At the time this term was conceived, Americans relied on communities, charities, and the federal government to provide food resources to the population (O'Brien et al., 2004). In the late 1960s, hunger itself became an issue that drew public attention because of new political interests and the television documentary, "Hunger in America," which aired in 1968 (Eisinger, 1998; National Research Council, 2006). Since then, many studies have been conducted by government agencies, academic researchers, nonprofit organizations, and advocacy groups to define and measure hunger in America (National Research Council, 2006). The definition of what constitutes hunger has varied widely and was often interchanged with the term malnutrition (National Research Council, 2006).

In 1990, there were major efforts by the US Department of Agriculture (USDA) and the National Research Council (NRC) to produce standardized definitions and measurements of hunger. This eventually evolved into what is currently known today as food security and food insecurity, and the definitions of these terms have remained practically unchanged since (National Research Council, 2006). Food security was defined as: "access by all people at all times to enough food for an active, healthy life, and includes, at a minimum: (a) the ready availability of nutritionally adequate and safe foods and (b) an assured ability to acquire acceptable foods in socially acceptable ways." (Anderson, 1990; pp 1575). Food insecurity was defined as: "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways." (Anderson, 1990; pp 1576).

When sources of affordable and nutritious food are not evenly distributed within a community or geographic region, unequal access to these resources creates neighborhoods where residents may struggle more than others to be food secure. This unequal distribution of appropriate food sites like supermarkets influences where and how far people are required to travel to meet their food needs. Additionally, the lack of food assistance sites to supplement vulnerable population's food needs also creates a void where people who may not have the income to meet these needs are placed at a disadvantage. Neighborhoods that are low-income and also lack access to affordable or nutritious food provide an important basis for studying and understanding food environments and food insecurity. The terms 'food deserts' and 'food assistance deserts' are often used to refer to these areas and for identifying where food insecure and low-income individuals in a given urban area may reside (Morton et al., 2006).

Deserts in the natural sciences are described as areas that are hot, dry, empty, or water barren and where it can be difficult for life to sustain itself (National Geographic, 2022). Food deserts and food assistance deserts can be thought of similarly as neighborhoods that are empty or food insecure, where it can also be difficult for a population to attain their adequate food needs (Raysoni, 2018). Food deserts are conceptually defined by the USDA as a census tract where a substantial number or share of residents do not have easy access to a supermarket or large grocery store and a large share of the population within the tract are low-income (USDA, 2015). Food assistance deserts are defined similarly as low-income neighborhoods that do not have easy access to a food assistance site such as a soup kitchen, food pantry, or religious organization that provides free food (Waity, 2016). Food deserts and food assistance deserts are linked to food insecurity because their lower proximity to food sources makes it difficult for socially vulnerable people to attain appropriate or enough food for a healthy diet (Giang et al.,

2008; Walker et al., 2010; Wolfson et al., 2019). These neighborhoods have often been abandoned due to the consolidation of the retail food industry in non-socially vulnerable areas (Rincón & Tiwari, 2020) or are outside the range of a food assistance site (Waity, 2016).

Previous studies addressing these topics have focused on identifying either food deserts (Dutko et al., 2012; Furey et al., 2001; Hendrickson et al., 2006; Jones et al., 2021; LeClair & Askin, 2014; Morton et al., 2005) or food assistance deserts (Curran & Armenia, 2021; Waity, 2016) separately. As a consequence, characteristics of neighborhoods where food deserts and food assistance deserts spatially coincide, or overlap has not been adequately examined in the research literature on food access or food insecurity. The total food environment cannot be accurately captured or understood unless both categories of deserts and areas of their overlap are identified. A systematic and comparative analysis of both food deserts and food assistance deserts in a given study area is necessary to provide a more comprehensive understanding of food environments because socioeconomically disadvantaged residents often rely on a multitude of different food sources to meet their food security (Curran & Armenia, 2021). Since access to both supermarkets and food assistance sites are important for addressing food insecurity, this thesis addresses the limitations of previous studies that have not examined how these two categories of food deserts spatially coincide or analyzed their socio-demographic characteristics separately.

This thesis sought to address this gap by investigating the following research questions, based on a case study conducted in El Paso County, Texas:

1. What are the locations and socio-demographic characteristics of food deserts in El Paso County? Are racial/ethnic minorities and other socially disadvantaged individuals more likely to reside in neighborhoods classified as food deserts?

2. What are the locations and socio-demographic characteristics of food assistance deserts in El Paso County? Are racial/ethnic minorities and other socially disadvantaged individuals more likely to reside in neighborhoods classified as food assistance deserts?
3. What are the locations where food deserts and food assistance deserts spatially coincide in El Paso County? Are racial/ethnic minorities, and other socially disadvantaged individuals more likely to reside in these neighborhoods at the intersection of food deserts and food assistance deserts?
4. Where are the locations of census tracts that are considered neither a food desert nor food assistance desert in El Paso County? Are non-Hispanic White and other socially advantaged individuals more likely to live in these neighborhoods that are neither food deserts nor food assistance deserts?

El Paso County, the study area for this thesis research, is the ninth largest county in Texas with a population of 836,062 (US Census Bureau, 2019). The population within the city limits of El Paso is 680,028 residents, making it the sixth largest city in Texas (Data Commons, 2020). This county is particularly suitable for addressing these research questions because of several reasons. First, it is a predominantly a community of color, with almost 81.5% of residents identifying as Hispanic. Texas as a whole has 39.7% of the population self-identify as Hispanic (US Census Quick Facts, 2019). People of color are more likely to struggle with food security needs (Morales et al. 2020) and El Paso presents a particularly relevant study area for identifying which other factors besides race/ethnicity play a role in determining unequal access to supermarkets or food assistance sites. Second, the median household income for El Paso County is $48,866, and the Texas median is $63,826 (US Census Quick Facts, 2020). Additionally, the poverty rate in El Paso County is 18.8%, compared to Texas poverty rate of

13.4% (US Census Quick Facts, 2020). This shows that El Paso County is more socioeconomically disadvantaged than other parts of the state and implies that El Paso County residents may be in need of greater assistance to meet their food needs. It is important that the most socially vulnerable populations are considered and planned for accordingly, and El Paso County serves as an interesting case for analyzing access to supermarkets and food assistance sites for census tracts within the county.

For this study, census tracts are used as the unit of analysis to represent neighborhoods because they are the smallest census unit for which relevant data required to answer the research questions are available. Demographic and socioeconomic characteristics of tracts are used to understand what social attributes are associated with living in a food desert, food assistance desert, areas where both of them spatially overlap, and areas where neither are present. The data used to conduct this study was obtained from multiple sources. For identifying food deserts based on tract boundaries, data from the 2019 Food Research Atlas created by the USDA is utilized. This Atlas provides multiple indicators of low supermarket accessibility and identifies tracts as 'low access' based on distances of 0.5 mile, one mile, 10 miles, and 20 miles away from a supermarket (USDA & Economic Research Service, 2019). Additionally, it defines low-income neighborhoods as census tracts where a substantial share of the tract's population has a median annual income below the federal poverty level (Jones et al., 2021; USDA, 2015, 2019; Wright, 2020). Food assistance deserts in El Paso are identified using proximity to site locations obtained from a spreadsheet created by the Sun City Hunger Relief Coalition that lists Emergency Food Sites within El Paso County. This dataset includes the street addresses of 80 local food pantries, soup kitchens, and religious organizations that distributed free food in 2019. The classification of food assistance deserts also utilizes the indicators of low-income census

tracts provided by the USDA Food Research Atlas. Data on socio-demographic characteristics of the residential population were downloaded from the 2019 US Census Bureau's American Community Survey (ACS) five-year estimates. This included variables for census tracts in El Paso County that describe race/ethnicity, educational attainment, language proficiency, nativity, employment status, homeownership, and occupancy status. These variables are useful for understanding the differences that exist between socio-demographic characteristics of people residing in a food desert, food assistance desert, at the intersection of both, or tracts that are neither a food desert nor food assistance desert, when compared to the rest of El Paso County.

Geographic Information System (GIS)-based spatial analytic approaches recommended in previous research was used to delineate food deserts and food assistance deserts based on census tract boundaries (Curran & Armenia, 2021; Furey et al., 2001; Hendrickson et al., 2006; Jones et al., 2021; LeClair & Askin, 2014; Morton et al., 2005; Waity, 2016), and identify tracts at the convergence of both food deserts and food assistance deserts. Both bivariate and multivariate statistical methods are used to estimate and compare socio-demographic characteristics of the population and housing units residing in food deserts, food assistance deserts, neighborhoods where they spatially coincide, and neighborhoods that are food secure with respect to census tracts located elsewhere in the county.

Chapter 2: Literature Review

This literature review examines the history of food access and food security, as well as published studies on food deserts and food assistance deserts in the US. The reviewed studies focus on various factors that influence food deserts and food assistance deserts that seek to understand: (1) potential barriers to food access; and (2) methodological approaches to identifying neighborhoods that can or cannot be considered a food desert and food assistance desert.

2.1: Barriers to Food Access

Income and barriers to food access change a person's cooking practices, frequency of eating, and consumption behaviors (Wolfson et al., 2016, Wolfson et al., 2019). Lower income individuals are more likely to have trouble gaining access to healthy and affordable ingredients such as produce, dairy, meat, and fish (Wolfson et al., 2016). Limited economic resources affect how often healthy meals are cooked in these households, and whether individuals are increasingly likely to obtain their food from frozen dinners, fast food, or cook using processed and non-nutritious ingredients (Ver Ploeg et al., 2015; Wolfson et al., 2019). The lack of supermarkets or food assistance sites negatively affects low-income residents' health and well-being by subjecting them to food sources that are more expensive and do not provide the same adequately nutritional value (Cummins & Macintyre, 2002; Giang et al. 2008; LeClair & Askan, 2014; Walker et al. 2010). This in turn affects their physical and mental health by causing anxiety and depression, lower self-esteem, higher rates of obesity, diabetes, and other dietary related issues (Leung et al., 2015; Morales et al., 2020)

Food deserts and food assistance deserts are created through the inability to access food or services that affects a resident's ability to attain their food needs. Neighborhood

characteristics and influential factors associated with food deserts and food assistance deserts that have been identified and discussed in previous studies include smaller population areas, higher numbers of residents with low income or education levels, lower levels of vehicle ownership, lower access to public transportation, higher poverty rates, higher unemployment rates, higher populations of color, higher rates of vacant housing, lack of time for grocery shopping, lack of high-quality food, and lack of culturally appropriate food (Dutko at al., 2012; Morales et al., 2020; Rose et al., 2010; Ver Ploeg et al., 2015).

2.2: Defining a Food Desert

The first recorded use of the term 'food desert' was in the early 1990s in Scotland by a resident of a public housing sector to describe poor access to a healthy and affordable diet (Beaulac et al., 2009; Cummins & Macintyre, 2002; Walker et al., 2010). The definition of a food desert has changed substantially over time. In a 2001 study, it was defined as areas where high competition from multiple large chain supermarkets created voids in the food environment (Furey et al., 2001). In a 2002 study, it was defined as "urban areas where residents cannot buy affordable and healthy food" (Cummings & Macintyre, 2002). It was subsequently altered and defined in 2006 as "urban areas with 10 or fewer stores and no stores with more than 20 employees" (Hendrickson et al., 2006). While there have been different definitions of what constitutes a food desert since the term was first used, the USDA definition tends to be the most widely accepted version: an area that does not have easy access to a supermarket or large grocery store. Additionally, the neighborhood's poverty rate must be 20% or greater; or the tract's median family income is less than or equal to 80% of the state-wide median family income; or the tract is in a metropolitan area and has a median family income less than or equal to 80% of the metropolitan area's median family income (Jones et al., 2021; USDA, 2015, 2019; Wright,

2020). In urban areas, the distance from a supermarket must exceed a one-mile range for 500 residents or 33% of neighborhood residents living in that census tract to be considered a food desert and be a low-income neighborhood. In rural areas, the only difference is that this distance must exceed 10 miles (USDA, 2015). It is estimated that over 6,500 census tracts in the United States meet these criteria, with 63% of the identified food deserts being in urban areas (Dutko et al., 2012; Jones et al., 2021).

There are a few different theories on how food deserts are developed. One theory is that during the 1970s, socioeconomically affluent White residents of urban areas began to move to the suburbs. This caused a shift in the socio-demographic characteristics of urban areas due to the in-migration of lower income people of color. Supermarket chains began to place stores outside of urban areas to accommodate suburban spaces, and the shift in median income was not enough to sustain stores in urban neighborhoods. This forced many stores to close due to the lack of income needed to support businesses (Alwitt & Donley, 1997; Bianchi et al., 1982; Nyden et al.,1998; Walker et al., 2010). For places with large communities of color, this looks different because race/ethnicity does not play as large of a role in this migration because there are fewer White residents to begin with. Instead, it becomes an issue regarding social class and separating high and low-income populations. The lack of grocery stores in low-income neighborhoods may be attributed to suburbanization. As a city or county continues to expand and develop outwards, more affluent groups of people move to these areas in search of new places to live. This creates a need to build stores in these newly developed affluent areas while the existing neighborhoods now contain smaller populations and have a much smaller buying power as compared to pre-suburbanization (Mead, 2008). Another theory is that the expansion of large chain grocery stores was detrimental to smaller neighborhood grocery stores. Smaller stores were being

outpriced, more varieties of product were available at larger stores, and hours of operation tended to be longer at supermarkets which made shopping more convenient (Alwitt & Donley, 1997; Guy et al., 2004). There are other additional factors that may have contributed to the rise in food deserts in urban areas such as inadequate space to build a supermarket or limited financial gain due to opportunity costs in these areas. (Alwitt & Donley, 1997; Walker et al., 2010).

It is important to note that food deserts are socially constructed and can be credited to pre-existing stereotypes in these areas that creates a lack of interest in building supermarkets in areas that are most in need of them. Some of these reasons include concerns about lower sales, high operating costs, low profit margins, and perceptions of higher crime (Rincón & Tiwari, 2020). When checked however, a lot of these areas have the potential to bring in profit but end up being serviced by convenience or dollar stores. Rincón and Tiwari (2020) conducted a study that compared food secure tracts in the northern part of Dallas County to the southern part of the County in response to large chain supermarkets deciding to build stores in already food rich areas in the northern part of the county. They identified that many of these preconceived stereotypes did not hold true when looking at several factors that included crime rate and median household income. Stores in the northern part of the county created unnecessary competition between the chain stores that already existed there. Comparing food insecure parts of the southern part of Dallas County to the food rich of the northern part allowed them to justify that creating supermarkets in food deserts is not only a benefit to the surrounding community, but is also a smart business investment to avoid unnecessary competition between chains (Rincón & Tiwari, 2020).

Food deserts across the US have also been identified as being more ethnically and racially diverse than non-food desert areas. They have a greater concentration of people of color such as

Hispanics, non-Hispanic Blacks, and other non-Hispanic groups of color (Dutko et al., 2012). This plays into the theory that was mentioned earlier on 'white flight' and suburbanization which pushes socioeconomically affluent residents from urban neighborhoods to suburban neighborhoods (Alwitt & Donley, 1997; Bianchi et al., 1982; Mead, 2008; Nyden et al., 1998; Walker et al., 2010). Because of these patterns, non-White neighborhoods tend to be at more of a risk of being classified as a food desert. While food deserts themselves may not be a direct cause of food insecurity, they are good indicators of where food insecurity is more likely (Morton et al., 2005).

2.3: Defining a Food Assistance Desert

Food assistance deserts is a term that was first used in a study on food assistance access in Indiana (Waity, 2016). It is spatially defined in a similar fashion to food deserts as an area that is one mile from a site that provides food assistance to local residents, as well as the same measures of low income outlined for food deserts (USDA, 2019, Waity, 2016). There are several types of food assistance programs utilized by the public that are either funded by community or neighborhood organizations, local/national governments, faith-based organizations, or nonprofits (Mikelbank, 2021). One type is food pantries, where individuals can receive free supplemental groceries that last several days. The other type of food assistance site is a soup kitchen where free prepared meals are provided that are meant to be eaten at the site or take away for later (Waity, 2016).

Food assistance sites are underused compared to government resources like the Supplemental Nutritional Assistance Program (SNAP), but many individuals rely on both resources to meet their food needs because one alone is often not enough to increase someone's food security (Curran & Armenia, 2021, Poppendieck, 1999). Government

support of SNAP has declined over the years, which has revived the need and demand for food assistance agencies (Waity, 2016).

Food assistance sites often struggle in reaching local residents who rely on them due to their location falling outside a reasonable walking distance. The value of food from food pantries is estimated to be around $40 every week, which if used weekly, comes out to around $2000 annually (Fong et al. 2016). Accessing food assistance sites becomes invaluable for those struggling to attain their food needs, but if not in close proximity, will make people less likely to utilize these resources. Supermarkets are a bit different because individuals who live in food deserts will still travel to them to meet their food needs. Food assistance sites, however, are limited in this regard and are more constrained than supermarkets in their ability to serve their target population for several reasons. One reason is that pantry users must be physically present at the location during the day and time when food is being distributed. This is different from SNAP, where the ability to buy food travels with someone if they have their SNAP card and go to a retailer that accepts that payment (Waity, 2016). The location of the site can also be another barrier in accessibility as it may be unappealing to travel due to safety concerns, transportation issues, or racial/ethnic composition (Fong, 2016, Kissane, 2010). While there are barriers to using food assistance sites, there are ways that they provide food relief in ways that SNAP cannot. For example, food assistance sites have far fewer restrictions than SNAP and provide immediate in-person assistance. This is unlike SNAP where there is a monthly limit that once reached, will not allow a person to buy food using these benefits until the following month (Waity, 2016). Ensuring that food assistance sites are located in areas of most need is crucial for providing services in assisting those who may have difficulty in attaining their food needs.

While limited research on emergency food assistance has focused on El Paso County, Texas, a recent study examined access to emergency food transfers (EFTs) for residents of this county during the COVID-19 pandemic (Chakraborty et al., 2022). The results revealed that the need for food assistance was greater in neighborhoods that were more socially vulnerable and were also closer to food distribution sites. Neighborhoods that had higher social vulnerability in terms of housing and transportation were less likely to utilize EFTs, partly because the longer distance from the food assistance sites was a barrier that made it more difficult for people in these neighborhoods to access those resources. This study emphasizes the necessity of identifying where food assistance deserts are located in El Paso County, since residents of these areas could benefit from the placement of a food assistance site in close proximity.

Food assistance deserts are important to consider in this study because of the service they provide to their surrounding communities for meeting their food needs. Lack of access, however, limits where, when, and who can receive these benefits (Curran & Armenia, 2021; Kissane, 2010; Waity, 2016). Residents of neighborhoods that are not within a reasonable distance from these sites are less likely to utilize them. While food assistance sites may not be able to provide the same quality and quantity as a supermarket, they are still important resources for addressing food insecurity. Similarly, to food deserts, food assistance deserts may not be a direct indicator of food insecurity, but knowledge of where they are found and the socio-demographic characteristics of people who live within them can provide valuable insights on places where food insecurity may be more prevalent (Morton et al., 2005). This information could then be used to provide support to these neighborhoods and their residents.

2.4: Summary

Food deserts and food assistance deserts represent areas that are likely to have lower levels of food access and contain people that are less socioeconomically affluent and more socially vulnerable. While these may be limited indicators of what constitutes food insecurity and access, they still provide an insight to understanding areas that have a greater difficulty than others in meeting their food needs (Morton et al., 2005). Finding areas where food deserts and food assistance deserts overlap is important for attaining a more comprehensive representation of the food environment in El Paso County. Since previous studies have chosen to focus only on food assistance deserts or food deserts, there is a growing need to document the similarities and differences between them, especially in terms of the social characteristics of people who reside there. Appropriate access to both food sites (such as a supermarket) and food assistance sites are necessary to ensure that food needs of local residents are met, because one of these alone may not be enough to support socially vulnerable populations.

Chapter 3: Data and Methods

This chapter describes the data sources, variables, and analytical approaches that were used to identify and analyze food deserts, food assistance deserts, neighborhoods at the intersection of both food deserts and food assistance deserts, and neighborhoods classified as neither a food desert nor food assistance desert. The study area of El Paso County, Texas, is introduced first, followed by a discussion of data sources, units of analysis, and variables for the study. The next section of this chapter describes the methodology used to classify census tracts in El Paso County as a food desert, food assistance desert, zone of overlap, or being neither a food desert nor food assistance desert. The final section outlines the statistical methodologies associated with the bivariate and multivariate analyses utilized for this study.

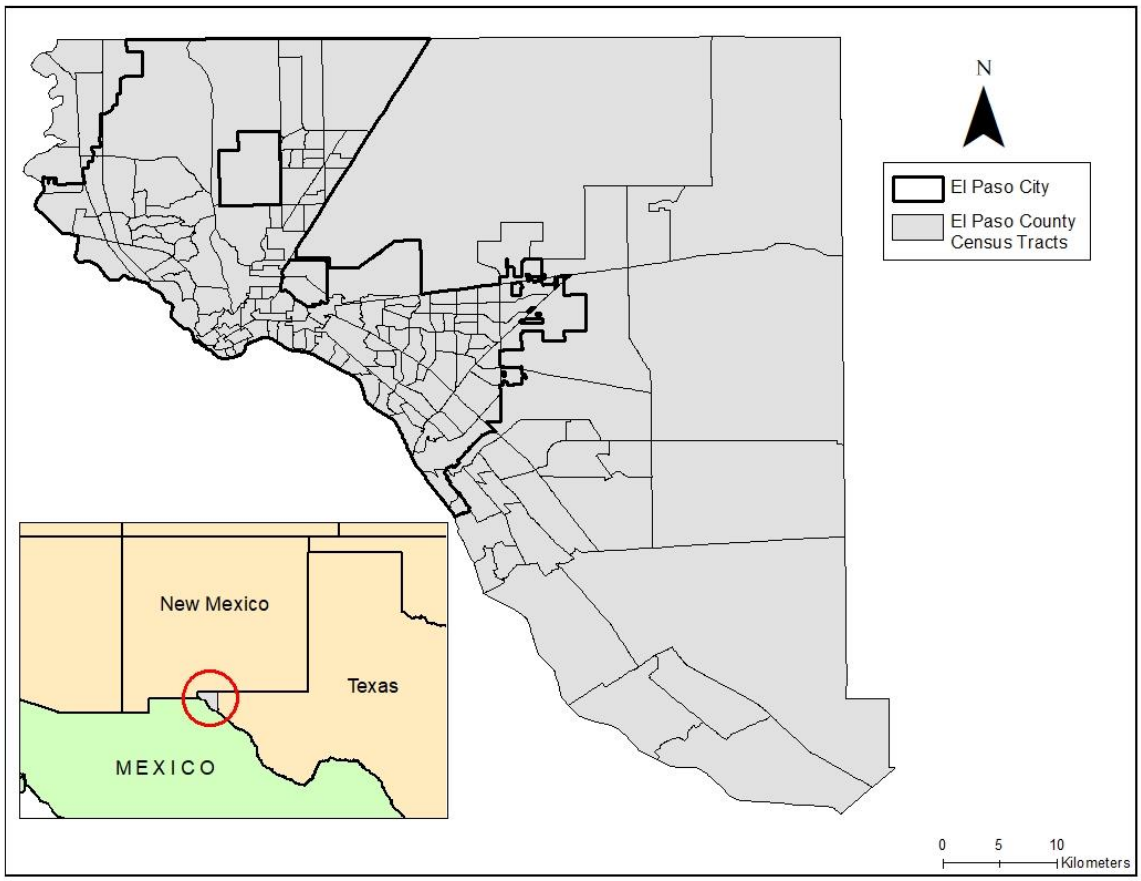

Figure 3.1: Study Area Location and Census Tracts in El Paso County, Texas.

3.1: Study Area: El Paso County, Texas

Figure 3.1 shows El Paso County, Texas, the study site for this thesis research. El Paso County is located along the US-Mexico border and is the westernmost county in the state of Texas. In 2019, this county had a total population of 836,062, making it the ninth largest county in Texas (Data Commons, 2020, US Census Bureau, 2019). The population within the city limits of El Paso is 680,028 residents, making it the sixth largest city in Texas (Data Commons, 2020). This is a predominantly Hispanic community, with 81.5% of county residents identifying as Hispanic, much higher than the Texas average of 39.7% (US Census Bureau, 2020a). The median household income for the county is $48,886 and is substantially lower than the median household income for Texas at $63,826 (US Census Bureau, 2020a). About 18.8% of the county population lives below the federal poverty level, which is higher than the Texas average of 13.4% (US Census Bureau, 2020a). Although there are 161 census tracts in El Paso County, 160 have a population greater that zero. The tract containing the El Paso International Airport with no population data was excluded from the statistical analysis.

El Paso County is a suitable area for this study because its median household income is considerably lower than the corresponding Texas average as well as the relatively higher percentage of racial/ethnic minorities who reside in the county. Consequently, El Paso residents are likely to be more vulnerable and placed in a position where their food needs are difficult to meet because of the combination of their lower socioeconomic and non-White status (Morales et al., 2020).

3.2: Unit of Analysis: Census Tract

Census tracts represent the most appropriate geographic unit for assessing food access disparities at the neighborhood level because of their size and number of people residing in them.

Census tracts were originally created in 1906 by Dr. Walter Laidlaw to understand population changes that were affecting places of religious worship and their congregations in New York (Watkins et al. 1956). While they were originally developed for identifying populations to better understand proper locations of churches, census tracts were referred to as 'sanitary areas' because of the health department's role in establishing their boundaries and their relevance for addressing public health Concerns (Krieger, 2006). By the 1930s, their use extended beyond the scope of health agencies with academic researchers commonly using these zones, and thus became known as census tracts (Krieger, 2006). As more cities began to define census tracts in their own regions, research on understanding phenomena within census tracts expanded to encompass issues such as health, fertility, marriage, social stratification, crime, employment, education, residential segregation, and urban ecology (Krieger, 2006; Skevky & Bell, 1955; Watkins et al., 1956). Although census tracts were initially delineated only for metropolitan areas of the US, their coverage was expanded in 2000 to include all counties in the entire US.

Census tracts currently represent subdivisions of a county that enclose a population of 1,500 to 8,000 people, with an average size of 4,000 people (US Census, 2020). They are often used as a proxy for residential neighborhoods because they provide a stable set of geographic units designed to be homogeneous with respect to demographic and socioeconomic characteristics of the population when they were first established (US Census, 2020b). These smaller geographic areas provide the means for understanding social phenomena that may be unique to a particular area within a larger geographic region. Census tracts allow researchers and policy makers to identify which areas fit their criteria at a more accurate and precise scale (Dutko et al., 2012).

For this thesis, census tracts are used to represent neighborhoods because they are the smallest census unit for which food access indicators from the 2019 USDA Food Research Atlas were available. Previous studies have also used census tracts to delineate food deserts, food assistance deserts, and non-desert tracts (Chakraborty et al. 2022, Furey et al. 2001; Guy et al. 2004; Hendrickson, 2006; Jones et al. 2021; LeClair & Askan, 2014; Waity, 2016). Census tracts in El Paso County and their distinctive social characteristics were used to understand which groups were overrepresented in a food desert, food assistance desert, the convergence of food deserts/food assistance deserts, and neighborhoods that are classified as neither a food desert nor food assistance desert, as well as the characteristics of the different food access categories.

3.3: Spatial Analysis for Identifying Food Deserts and Food Assistance Deserts

The first step of this study was to use geographic information system (GIS)-based spatial analysis to identify the geographic boundaries of food deserts, food assistance deserts, and their areas of overlap, on the basis of census tracts. Food deserts are spatially defined using data from the 2019 USDA Food Research Atlas as low-income tracts that have low-access to a supermarket. The Food Research Atlas defines food access as: "accessibility to sources of healthy food, as measured by distance to a store or by the number of stores in an area" (USDA, 2019). Low-income tracts are defined as those where "the tract's poverty rate is 20% or greater; or the tract's median family income is less than or equal to 80% of the State-wide median family income; or the tract is in a metropolitan area and has a median family income less than or equal to 80% of the metropolitan area's median family income" (USDA, 2019). Using the methodology implemented in previous studies, food deserts are identified in El Paso County as census tracts that fall outside a one-mile radius from the population-weighted center of the tract to the nearest supermarket and are also low-income based on the aforementioned definition

(Dutko et al. 2012; Furey et al. 2001; Guy et al. 2004; Hendrickson, 2006; Jones et al. 2021; LeClair & Askan, 2014; Raysoni. 2018).

Food assistance deserts in El Paso County are spatially defined using a similar methodology, based on a previous study of spatial inequalities associated with food assistance sites in Indiana (Waity, 2016). In this study, Waity utilized the USDA definition of food deserts (USDA, 2015), but used food assistance sites as the means of measurement instead of supermarkets. She also used the USDA approach to define low-income neighborhoods for identifying food assistance deserts (Waity, 2016). For this thesis, the USDA's Food Access Research Atlas measures for both accessibility and low-income are utilized. Additionally, tracts that fall outside the one-mile range from the tract's population weighted center were identified using street addresses of food assistance sites in El Paso County that were collected from the Sun City Hunger Coalition's 2019 calendar of 80 food assistance sites. This address information was used to geocode the locations of all food assistance sites within the county using the address-matching functionalities of *ArcGIS Desktop 10.8.1* software. Circular buffers of one-mile radii were then constructed around the census tract's population weighted center provided by the 2010 US Census. This approach aligns with Waity's (2016) methodology and other previous studies conducted on food deserts and provides a consistent spatial definition for both food deserts and food assistance deserts in this study.

When identifying areas where food deserts and food assistance deserts spatially coincide, the requirements are straightforward. Utilizing the definitions of past studies on food deserts and food assistance deserts (Dutko et al. 2012; Furey et al. 2001; Guy et al. 2004; Hendrickson, 2006; Jones et al. 2021; LeClair & Askan, 2014; Waity, 2016) and the methodology described

previously, neighborhoods of their overlap are represented by census tracts classified as both a food desert and food assistance desert.

Tracts that are neither a food desert nor food assistance desert represent the remaining areas in the county that did not meet the methodological requirements of being considered either food desert or a food assistance desert. These tracts are within reasonable range of a food site (i.e., within the one-mile buffer from the census tract's population weighted center) or have an overall median income that is higher than the USDA's (2019) low-income definition for the tract.

3.4: Data and Variables

Statistical comparisons of food deserts, food assistance deserts, areas of overlap, and tracts that are considered neither a food desert nor food assistance desert are based on socio-demographic characteristics of census tracts in El Paso, County. The data source is the 2015-2019 American Community Survey (ACS) five-year estimates. The first set of socio-demographic variables used for this study include race/ethnicity, nativity, and language proficiency. To examine both race and ethnicity, the analysis included the percentages of the population who self-identify as Hispanic/Latino, non-Hispanic Black, and other non-Hispanic minority groups (i.e., Asian, Native American, Pacific Islander, Native Hawaiian, and Other Races). Non-Hispanic White is used as a reference group for comparing statistical results associated with racial/ethnic minorities. Racial/ethnic minority categories are important here because people of color are more likely to suffer from food insecurity as compared to their White counterparts (Clay & Rogus, 2021; Dutko et al. 2012; Giang et al. 2008; Janda et al. 2021; Morales et al. 2020; Walker et al. 2020; Wolfson & Leung, 2020). The next variable included was the percentage of foreign born individuals, which includes all residents whose country of

birth was somewhere other than the US, regardless of citizenship status. The percentage of the population with limited English proficiency encompassed residents who are 5 and over who have self-identified themselves as speaking English either "not well" or "not at all" (United States Census Bureau, 2022). Both nativity and language proficiency are important to consider because being foreign-born or having limited proficiency in English could bring additional challenges in attaining food needs. This includes the inability to access governmental services due to either ineligibility or language barriers which can make it increasingly difficult to attain their food needs.

The second set of variables focus on socioeconomic disadvantage and comprise individuals 25 and over that have an education that is less than high school, those 16 and over who are unemployed, renter occupied housing units, and vacant housing units. Unemployment has been identified as another indicator that could increase the likelihood of food insecurity (Bacon & Baker, 2017) and an important characteristic for understanding food insecurity. Renter occupancy and home vacancy percentages have been identified in a USDA report as additional variables that serve as indicators of living in a more food insecure neighborhood (Dutko et al. 2012). Detailed descriptions of all socio-demographic variables used in the statistical analyses can be found in Table 3.1

Table 3.1: Definitions of Socio-Demographic Variables

Variable	Definition
Race and Ethnicity:	
Percent Non-Hispanic White	Non-Hispanic individuals identifying themselves as White as a percentage of the census tract total population.
Percent Hispanic	Individuals identifying themselves as Hispanic/Latino (of any race) as a percentage of the census tract total population.

Percent Non-Hispanic Black	Non-Hispanic individuals identifying themselves as Black as a percentage of the census tract total population.
Percent Non-Hispanic Other Person of Color	Non-Hispanic individuals, identifying themselves as American Indian or Alaskan Native, Asian, Pacific Islander or some other race, as a percentage of the census tract total population.
Educational Attainment:	
Percent Less than High School:	Educational grade level of less than high school, as a percentage of the census tract population 25 years and over.
Language Proficiency:	
Percent Limited English Proficiency	Percent of individuals who speak a language other than English at home. This refers to their assessment of their inability to speak and write English, "not at all" or "not well" as a percentage of the census tract population five years and over.
Nativity:	
Percent Foreign Born	Refers to individuals who are not U.S citizens at birth. This includes naturalized U.S. citizens, permanent residents, temporary migrants, humanitarian migrants and individuals who are illegally residing in the U.S., as a percentage of the census tract total population.
Employment Status:	
Percent Unemployed:	Refers to the percent of individuals who are 16 and over and unemployed (those not currently working who are actively looking for work during the past 4 weeks and are available to start work) as a percentage of the civilian labor force.
Homeownership:	
Percent Renters:	Percent of all occupied units which are not owner occupied. These are units that are rented for cash rent or occupied without payment of cash rent. They are classified as

	renter-occupied, as a percentage of housing units that are occupied.
Occupancy Status: Vacant Housing Percent	Refers to the percent of housing units where no one is living in it at the time of survey. Units occupied at the time of survey entirely by persons who are staying two months or less and who have a more permanent residence elsewhere are considered to be temporarily occupied, and are classified as "vacant."

3.5: Statistical Analysis

3.5.1: Bivariate Comparisons

The first phase of the statistical analysis focuses on estimating and comparing socio-demographic characteristics between the different categories of census tracts based on food access. The tract categories used for this statistical comparison are listed below:

- Food deserts vs. non-food deserts (rest of El Paso County):

This analysis examines how the socio-demographic characteristics of food deserts and non-food deserts differ within El Paso County. Significant differences between the two kinds of tracts are used to determine if racial/ethnic minorities and other socially disadvantaged individuals are more likely to reside in neighborhoods classified as a food desert.

- Food assistance deserts vs non-food assistance deserts (rest of El Paso County):

This analysis examines how the socio-demographic characteristics of food assistance deserts and non-food assistance deserts differ within El Paso County. Significant differences between the two kinds of tracts are used to determine if racial/ethnic minorities and other socially disadvantaged individuals are more likely to reside in neighborhoods classified as a food assistance desert.

- Areas of overlap of food deserts and food assistance deserts vs non-overlap tracts food (rest of El Paso County).

This analysis examines how the socio-demographic characteristics of tracts where food deserts and food assistance deserts spatially coincide are different from other tracts in El Paso County. Significant differences between the two kinds of tracts are used to determine if racial/ethnic minorities and other socially disadvantaged individuals are more likely to reside in neighborhoods classified as both a food desert and food assistance desert, compared to the rest of the county.

- Neighborhoods that not considered either a food desert or food assistance desert vs rest of El Paso County.

This analysis examines how the socio-demographic characteristics of tracts that are neither a food desert nor food assistance desert differ from all other tracts in El Paso County. Significant differences between the two kinds of tracts are used to determine if racial/ethnic minorities and other socially advantaged individuals are less likely to reside in neighborhoods classified as neither a food desert nor food assistance desert, compared to all other neighborhoods in this county.

The statistical methodology for these bivariate comparisons consists of a two-sample Z-test of proportions, which determines any significant differences in the socio-demographic characteristics of each category when compared to the others. For this significance test, the null hypothesis assumes that the proportions in each category will be equal to each other, while the alternative hypothesis assumes that the difference between these proportions will be significantly different from zero, indicating either an over or underrepresentation of that variable (Hessing, 2021).

The equation below indicates how the test statistic for a two-sample Z test of proportions is calculated. The Z is the test statistic, $\hat{p}_1$ and $\hat{p}_2$ are observed proportion of events, and the $n1$ and $n2$ are the sample sizes which will come from the total population of those categories (Hessing, 2021). In this case, the $\hat{p}_1$ and $\hat{p}_2$ represent the variable totals from each respective category of census tracts. The sample sizes ($n1$, $n2$) will be the total number of the applicable population of each variable from within the particular food access category. This test shows that if the Z score is within the critical region of the distribution, then the null hypothesis is rejected and there is a significant difference between the categories. On the other hand, if the Z score is not in the critical region, the null hypothesis is confirmed and there is not a significant difference in the categories.

$$Z_{1-\frac{a}{2}} = \frac{\hat{p}1 - \hat{p}2}{\sqrt{(\frac{\hat{p}1(1-\hat{p}1)}{n1} + \frac{\hat{p}2(1-\hat{p}2)}{n2})}}$$

3.5.2: Multivariate Analysis

Multivariate statistical models are used to analyze the relationship between socio-demographic characteristics of the population and the likelihood of living in a food desert, food assistance desert, their zones of convergence, and neighborhoods that are neither a food desert nor food assistance desert in El Paso County. Each multivariate model is based on a binary or dichotomous dependent variable. This variable has been coded as either 1 if the census tract is classified as a food desert, food assistance desert, area of overlap, and neither a food desert nor food assistant desert, respectively, or 0 if it falls outside these areas. The structure of the four multivariate models used to examine the relationships between the likelihood of being located in a particular census tract category and their socio-demographic characteristics is shown below. The dependent variables for the models that are used in the multivariate analysis are:

- Model 1: Food desert tracts (1) vs. remaining tracts in county (0)
- Model 2: Food assistance desert tracts (1) vs. remaining tracts in county (0)
- Model 3: Food deserts and food assistance desert overlap tracts (1) vs. remaining tracts in county (0)
- Model 4: Neither food deserts nor food assistance desert tracts (1) vs. remaining tracts in county (0)

The multivariate models used for this analysis are based on generalized estimating equations (GEEs), which extend the generalized linear model to account for clustered data (Nedler and Wedderburn, 1972). GEEs are suitable for this study because they provide a general method of analyzing clustered dichotomous variables, relax several assumptions of traditional regression models (e.g., normality), and support population-averaged inquiries about disproportionate access (Collins et al. 2015a, 2015b; Maldonado et al. 2016; Chakraborty et al. 2022).

Since all dependent variables are dichotomous (coded as either 1 or 0), binary logistic GEE models were used for estimating the likelihood of a tract being located in a particular food access category as a function of the independent variables describing various tract-level characteristics mentioned previously. To fit a GEE, clusters of observations must be specified, assuming that observations within a cluster are correlated and observations from different clusters are independent. Following a recent study on emergency food access in El Paso County, the clustering variable deemed most appropriate was the median decade of housing construction for each census tract (Chakraborty et al., 2022): before 1940, 1940-1949, 1950-1959, 1960-1969, 1970-1979, 1980-1989, 1990-1999, 2000-2009, and 2010 or later. This clustering variable

resulted in 9 clusters of tracts in this county, with the number of tracts per cluster ranging from 1 to 34.

The multivariable GEE analysis comprised several steps. First, all independent variables used were standardized before GEE model entry to ensure that all of them were being measured on the same scale for effect comparisons. The second task was to determine an appropriate intra-cluster dependency correlation matrix, another requirement for GEE models. This was done through experimentation using three different specifications on each model to determine which would be the best fit based on the QIC (quasi-likelihood under the independence model criterion) score (Garson, 2013). The first correlation matrix tested was 'independent', which assumes the nonexistence of dependency so that all off-diagonal elements of the working correlation matrix are zero. The next was 'exchangeable', which assumes constant intra-cluster dependency so that all the off-diagonal elements of the correlation matrix are equal. The last of these matrices to test was 'unstructured' which assumes a completely general correlation matrix that is estimated without constraints. After experimentation, an unstructured correlation matrix was found to be the most appropriate specification for all multivariate GEE models based on the QIC value. Lastly, statistical significance of each independent variable coefficient was tested using two-tailed *p*-values from the Wald Chi-squared test.

Chapter 4: Results

This chapter presents the results of the analyses for identifying the racial/ethnic and socioeconomic characteristics of census tracts that are characterized as a food desert, food assistance desert, overlap of a food desert and food assistance desert, and those that are neither a food desert nor food assistance desert, respectively, in El Paso County, Texas. The analyses are guided by research questions introduced in Chapter 1 which seek to investigate whether racial/ethnic minorities and other socially disadvantaged individuals are more likely to reside in low-income neighborhoods that are not proximate to a supermarket, food assistance site, or both. The chapter is organized into three sections. In the first section, a series of maps are used to visualize and describe the spatial distributions of these food access categories. The second section focuses on estimating and comparing the socio-demographic characteristics of the population residing in the different food access categories of census tracts to those residing elsewhere in the county. In the third section, multivariate generalized estimating equations (GEEs) are used to estimate the likelihood of being located in one of the food access categories based on relevant socio-demographic characteristics of census tracts.

4.1: Descriptive Mapping and Statistics

Dichotomous choropleth mapping was first used to visualize the different food access categories within El Paso County. The methodology to spatially define these food access categories has been described in the previous chapter (Chapter 3). In Figures 4.1 to 4.4, tracts shaded in red indicate those that are classified as a food desert (Figure 4.1), food assistance desert (Figure 4.2), overlap of food deserts and food assistance deserts (Figure 4.3), and either a food desert or food assistant desert (Figure 4.4), respectively. Tracts shaded in grey (Figures 4.1 to 4.4) represent the remaining tracts of the county that do not belong to these respective food

access categories. Table 4.1 outlines the number and percent of tracts within each food access category, as well as the population residing within each category.

Table 4.1: Descriptive Statistics for Food Access Categories, El Paso County.

	El Paso County	**Food Desert Tracts**	**Food Assistance Desert Tracts**	**Tracts that are an Overlap**	**Tracts that are Neither**
Number of Tracts	*160*	40	39	16	97
Percentage of Tracts	*100*	25.00	24.38	10.00	60.63
Percentage of Population	*100*	25.21	24.34	10.59	61.04

Figure 4.1 indicates the locations of 40 census tracts that were classified as a food desert in El Paso County and found to contain 25.21% of the total county population (Table 4.1). Most food deserts are located along or near the shared border between Juarez and El Paso County along the western part of the county. A majority of these food desert tracts are located within the city limits of Anthony, El Paso, Socorro, Clint, and San Elizario.

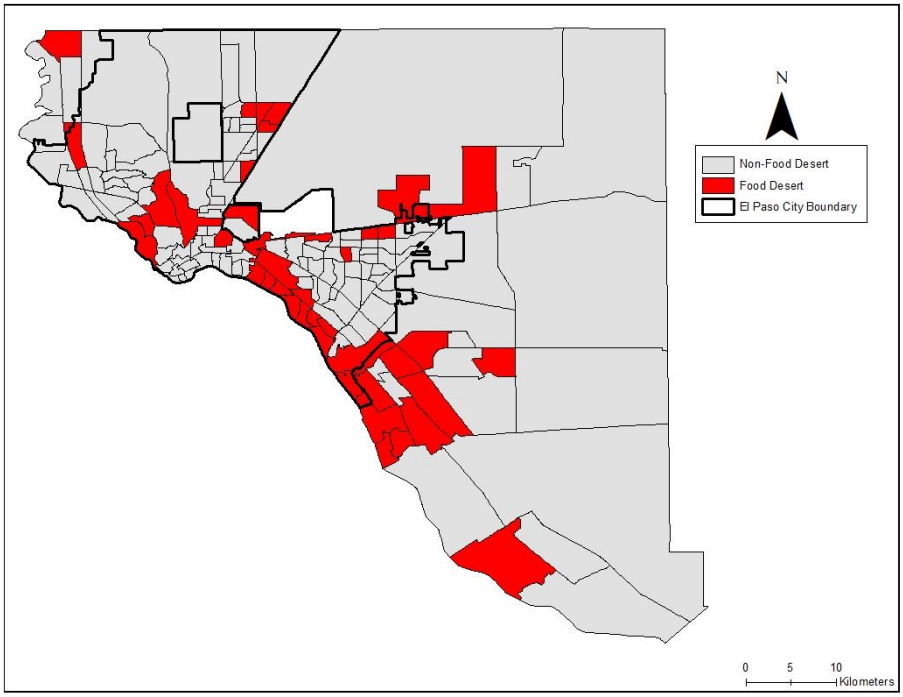

Figure 4.1: Location of Food Desert tracts in El Paso County

Figure 4.2 indicates the locations of 49 census tracts that were classified as a food assistance desert and found to contain 24.38% of the total county population (Table 4.1). These tracts are spatially dispersed throughout the county, appearing on both the west and east sides of the county boundary, with the majority of them located in the eastern section outside city limits and within downtown El Paso. The neighborhoods that are classified as not being a food assistance desert mostly fall within the city limits of El Paso.

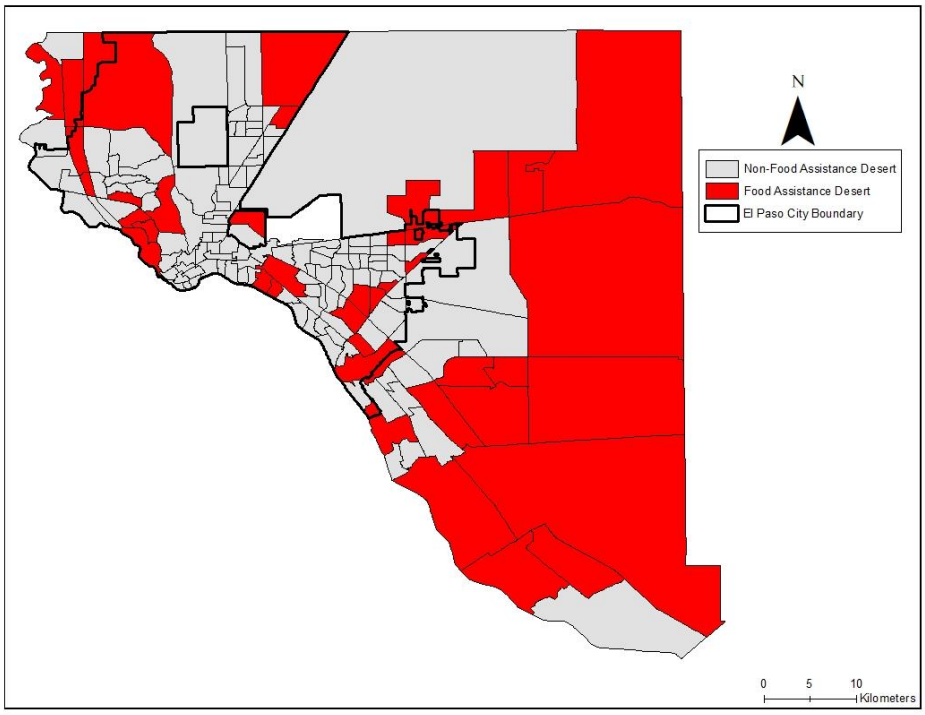

Figure 4.2: Location of Food Assistance Desert tracts in El Paso County.

Figure 4.3 indicates the locations of 16 census tracts that were classified as both a food desert and a food assistance desert and contain 10.59% of the total county population (Table 4.1). These tracts where food deserts and food assistance deserts overlap are located predominantly near the southwestern border of the county, with a few found near the border of El Paso County as well as in downtown El Paso. They are seen within the city limits of El Paso, Socorro, and San Elizario.

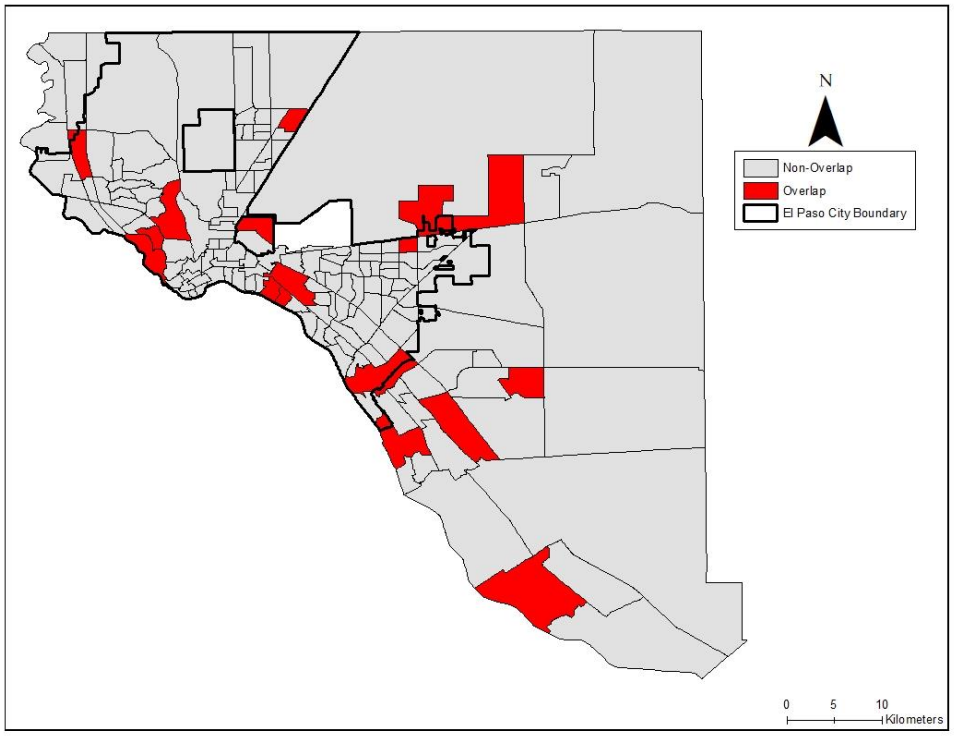

Figure 4.3: Location of Overlap of Food Desert and Food Assistance Desert tracts in El Paso County.

Figure 4.4 indicates the locations of 97 census tracts that were classified as neither a food desert nor food assistance desert and contain 61.04% of the total county population (Table 4.1). All cities within the county consist of at least one census tract that is either a food desert or food assistance desert. The locations of those that are considered neither a food desert nor food assistance desert were mainly found within the city of El Paso.

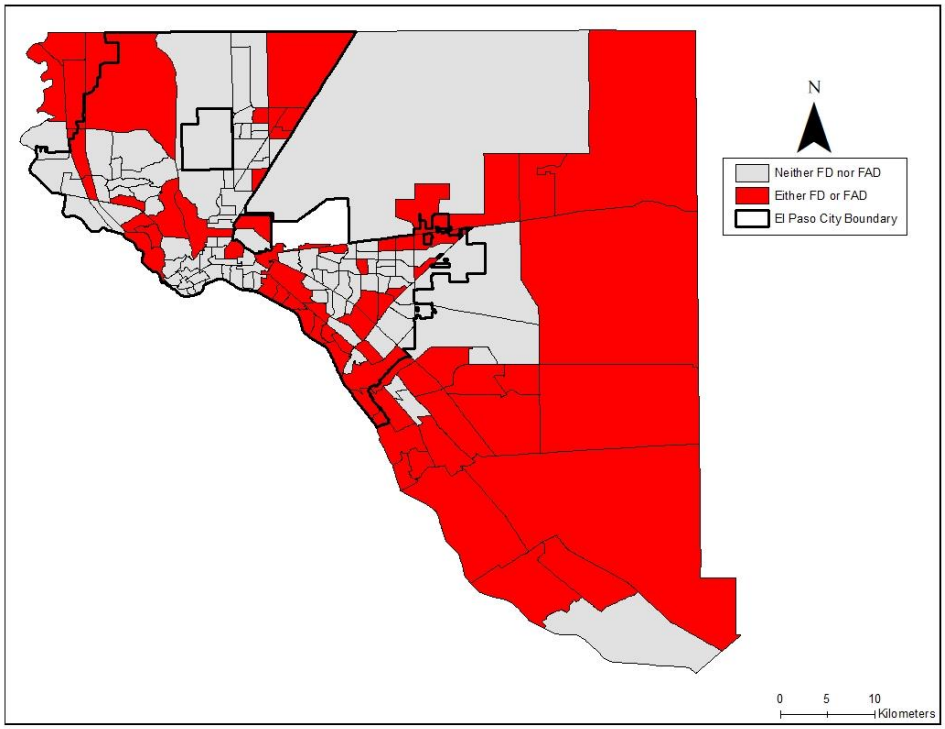

Figure 4.4: Location of tracts that are neither a Food Desert nor Food Assistance Desert in El Paso County.

The next phase of the analysis examines the socio-demographic characteristics of each food access category, based on independent variables described in Chapter 3. Table 4.2 shows the different food access categories and the percentages of individuals or housing units in each socio-demographic group residing within each category. For the non-Hispanic White population, neighborhoods that were neither a food desert nor food assistance desert indicated their highest percentage (14.11%) and food deserts showed their lowest (8.27%). For the Hispanic population, the highest percentages were observed in food deserts (87.28%) and food assistance deserts (85.46%), and the lowest in neighborhoods that were neither a food desert nor food assistance desert (79.74%). Although the number and percentage of the non-Hispanic Black population are relatively smaller in this county, tracts that were neither a food desert nor food assistance desert indicated the highest percentage (3.35%), followed by tracts that were both a food desert and food assistance desert (3.32%), while the lowest were observed in food assistance deserts

(2.56%) and food deserts (2.55%). Other non-Hispanic minorities also comprise a relatively small part of the county; their highest percentage was seen in neighborhoods that were neither food deserts nor food assistance deserts (2.80%) and neighborhoods that were both a food desert and food assistance desert (2.60%). The lowest percentage of other non-Hispanic people of color was seen in food deserts (1.89%). The highest percentages of individuals aged 25 and over with less than a high school education was be observed in food deserts (42.20%) and the lowest was found in neighborhoods that were neither a food desert nor food assistance desert (18%). For the foreign born population, the highest percentage can be observed in food deserts (27.98%) and neighborhoods classified as both a food desert and food assistance desert (27.70%), while the lowest percentage resided in neighborhoods that were neither a food desert nor food assistance desert (22.39%). For percentage of the population that is unemployed, all values were within a percentage point of one another, showing negligible differences between the food access categories. The highest percentage was observed in food deserts (3.71%), followed by tracts that were neither a food desert nor food assistance desert (3.57%), then food assistance deserts (3.43%), and lastly, neighborhoods that were both a food desert and food assistance desert (3.32%). For percentage of population aged 5 and over and with limited English proficiency, the highest percentages can be seen in neighborhoods classified as both a food desert and food assistance desert (41.07%), while the lowest can be seen within neighborhoods that were neither a food desert nor food assistance desert (26.98%). For housing units that are renter occupied, the highest percentage can be seen in neighborhoods that were both a food desert and food assistance desert (45.25%), while the lowest was seen in neighborhoods that were neither a food desert nor food assistance desert (37.80%). The last variable used within this study was percentage of vacant housing units. For this variable, there was negligible differences between the categories

because they were all within 1% of each other. The highest could be seen in food deserts (9.68%), food assistance deserts (9.54%), followed by neighborhoods that were neither a food desert nor food assistance desert (9.11%), and lastly, neighborhoods classified as both a food desert and food assistance desert (8.70%).

Table 4.2: Socio-Demographic Characteristics of Food Access Categories in El Paso County.

	El Paso County	**Food Desert Tracts**	**Food Assistance Desert Tracts**	**Tracts that are an Overlap**	**Tracts that are Neither**
Percent non-Hispanic White Population	*11.97*	8.27	9.55	9.90	14.11
Percent Hispanic Population	*82.56*	87.28	85.46	84.18	79.74
Percent non-Hispanic Black Population	*2.96*	2.55	2.56	3.32	3.35
Percent Other non-Hispanic People of Color	*2.50*	1.89	2.43	2.60	2.80
Percent Population that is 25 and over with Education less than High School	*27.44*	42.20	34.19	40.66	18.00
Percent Population over 5 that has limited English Proficiency	*31.78*	40.99	38.44	41.07	26.98
Percent Population that is Foreign Born	*24.14*	27.98	26.09	27.70	22.39
Percent of Population that is 16 and over and is Unemployed	*3.60*	3.71	3.43	3.32	3.57

Percent Occupied Housing Units that are Renter Occupied	*38.87*	41.86	41.32	45.25	37.80
Percent Vacant Housing Units	*9.39*	9.68	9.54	8.70	9.11

4.2: Bivariate Comparisons of Socio-Demographic Characteristics of Food Access Categories

The next phase of the analysis focuses on comparing the socio-demographic characteristics of each food access category to those in areas outside (e.g., rest of El Paso County). For this phase, two-sample Z-tests of proportions were used to determine if the observed percentage differences between tracts found inside food deserts, food assistance deserts, overlap neighborhoods, and neighborhoods that were neither a food desert nor food assistance desert, respectively, are significantly different from zero when compared to tracts outside these areas. Tables 4.3 to 4.6 provide the percentages inside and outside, percentage differences, and Z-test results, for each independent variable.

When comparing food desert tracts with other tracts in the county (Table 4.3), all socio-demographic variables showed a statistically significant difference ($p<0.001$). Variables indicting a significantly positive difference or higher values inside food deserts include the percentages of Hispanic, less than high school educated, limited English proficient, foreign born, and unemployed populations, as well as renter occupied and vacant housing units. Variables indicting a significantly negative difference or lower values inside food deserts include the percentages non-Hispanic White, non-Hispanic Black, and other non-Hispanic people of color populations. These bivariate comparisons suggest that all socially disadvantaged groups are significantly overrepresented in food desert tracts, with the exception of non-Hispanic Black and other non-Hispanic people of color populations.

Table 4.3: Comparison of Socio-Demographic Characteristics of Food Desert Tracts to All Other Tracts.

	Percentage Inside Food Deserts	Percentage Outside Food Deserts	Percent Difference	Z-Score	P-Value
Non-Hispanic White Population	8.27	13.22	-4.95	-60.512	<0.001
Hispanic Population	87.28	80.97	6.31	66.009	<0.001
Non-Hispanic Black Population	2.55	3.10	-0.55	-12.784	<0.001
Other non-Hispanic People of Color	1.89	2.71	-0.82	-20.702	<0.001
Population that is 25 and over with Education less than High School	29.68	18.84	10.84	81.440	<0.001
Population that is 5 and over and has Limited English Proficiency	40.99	28.70	12.29	100.549	<0.001
Population that is Foreign Born	27.98	22.84	5.14	47.705	<0.001
Population that is 16 and over and is Unemployed	3.71	3.56	0.15	2.751	<0.001
Occupied Housing Units that are Renter Occupied	41.86	37.92	3.94	17.877	<0.001
Vacant Housing Units	9.68	9.29	0.39	3.140	<0.001

When comparing food assistance desert tracts with other tracts in the county (Table 4.4), all socio-demographic variables showed a statistically significant difference (p<0.001) except for

vacant housing units. Variables indicting a significantly positive difference or higher values inside food assistance deserts include the percentages of Hispanic, less than high school educated, limited English proficient, and foreign born populations, as well as renter occupied and vacant housing units. Variables indicting a significantly negative difference or lower values inside food assistance deserts include the percentages of non-Hispanic White, non-Hispanic Black, other non-Hispanic people of color, and unemployed populations. These bivariate comparisons suggest that all socially disadvantaged groups are significantly overrepresented in food assistance desert tracts, except for non-Hispanic Black, other non-Hispanic people of color, and unemployed residents.

Table 4.4: Comparison of Socio-Demographic Characteristics of Food Assistant Desert Tracts to All Other Tracts.

	Percentage Inside Food Assistance Deserts	Percentage Outside Food Assistance Deserts	Percent Difference	Z-Score	P-Value
Non-Hispanic White Population	9.55	12.75	-3.20	-38.681	<0.001
Hispanic Population	85.46	81.63	3.83	39.582	<0.001
Non-Hispanic Black Population	2.56	3.09	-0.53	-12.266	<0.001
Other non-Hispanic People of Color	2.43	2.52	-0.09	-2.438	<0.001
Population that is 25 and over with Education less than High School	25.48	20.35	5.13	37.630	<0.001
Population that is 5 and over and has Limited	38.44	29.67	8.77	70.713	<0.001

English Proficiency					
Population that is Foreign Born	26.09	23.51	2.58	23.676	<0.001
Population that is 16 and over and is Unemployed	3.43	3.65	-0.22	-4.013	<0.001
Occupied Housing Units that are Renter Occupied	41.32	38.13	3.19	14.278	<0.001
Vacant Housing Units	9.54	9.34	0.20	1.541	0.12345

When comparing tracts that were an overlap of a food desert and food assistance desert (Table 4.5), all socio-demographic variables showed a statistically significant difference (p<0.001). Variables indicating a significantly positive difference or higher values inside overlap tracts include the percentages of Hispanic, non-Hispanic Black, other non-Hispanic people of color, less than high school educated, limited English proficient, and foreign born populations, as well as renter occupied housing units. Variables indicting a significantly negative difference or lower values inside overlap tracts include the percentages of non-Hispanic White, unemployed populations, and vacant housing units. These bivariate comparisons suggest that all socially disadvantaged groups are significantly overrepresented in tracts where food deserts and food assistance deserts overlap, except for unemployed populations and vacant housing units.

Table 4.5: Comparison of Socio-Demographic Characteristics of Tracts that are an Overlap of Food Deserts and Food Assistance Deserts to All Other Tracts.

	Percentage Inside Overlap	Percentage Outside Overlap	Percent Difference	Z-Score	P-Value
Non-Hispanic White Population	9.90	12.22	-2.32	-20.144	<0.001

Hispanic Population	84.18	82.37	1.81	13.427	<0.001
Non-Hispanic Black Population	3.32	2.92	0.40	6.642	<0.001
Other non-Hispanic People of Color	2.60	2.49	0.11	2.044	<0.001
Population that is 25 and over with Education less than High School	28.91	20.71	8.20	42.875	<0.001
Population that is 5 and over and has Limited English Proficiency	41.07	30.70	10.37	59.765	<0.001
Population that is Foreign Born	27.70	23.71	3.99	26.240	<0.001
Population that is 16 and over and is Unemployed	3.32	3.63	-0.31	-4.097	<0.001
Occupied Housing Units that are Renter Occupied	45.25	38.19	7.06	22.132	<0.001
Vacant Housing Units	8.70	9.46	-0.76	-4.155	<0.001

When comparing tracts that were neither a food desert nor food assistance desert (Table 4.6), all socio-demographic variables showed a statistically significant difference (p<0.001) except for percent unemployed. Variables indicting a significantly negative difference or lower values inside tracts that were neither a food desert nor food assistance desert include the percentages of Hispanic, less than high school educated, limited English proficient, and foreign

born populations, as well as renter occupied and vacant housing units. Variables indicting a significantly positive difference or higher values inside tracts that were neither a food desert nor food assistance desert include the percentages of non-Hispanic White, non-Hispanic Black, and other non-Hispanic people of color populations. These bivariate comparisons suggest that socially disadvantaged groups are significantly underrepresented in tracts that were neither a food desert nor food assistance desert, with the exception of non-Hispanic Black and other non-Hispanic people of color populations.

Table 4.6: Comparison of Socio-Demographic Characteristics of Tracts that are Neither Food Deserts nor Food Assistance Deserts to All Other Tracts

	Percentage Inside Neither	Percentage Outside Neither	Percent Difference	Z-Score	P-Value
Non-Hispanic White Population	14.11	8.63	5.48	75.208	<0.001
Hispanic Population	79.74	86.98	-7.24	-85.135	<0.001
Non-Hispanic Black Population	3.35	2.35	1.00	26.369	<0.001
Other non-Hispanic People of Color	2.80	2.03	0.77	21.869	<0.001
Population that is 25 and over with Education less than High School	18.00	27.32	-9.32	-78.659	<0.001
Population that is 5 and over and has Limited English Proficiency	26.98	39.38	-12.40	-114.053	<0.001
Population that is Foreign Born	22.39	26.87	-4.48	-46.753	<0.001
Population that is 16 and over and is Unemployed	3.57	3.65	-0.08	-1.521	0.12852

Population that has limited English Proficiency	26.98	39.38	-12.40	-114.053	<0.001
Occupied Housing Units that are Renter Occupied	37.80	40.66	-2.86	-14.732	<0.001
Vacant Housing Units	9.11	9.84	-0.73	-6.633	<0.001

Overall, the results of these bivariate comparisons suggest that there are specific groups that are overrepresented or underrepresented in each food access category. In food deserts, Hispanic, less that high school educated, limited English proficient, foreign born, and unemployed populations, as well as renter occupied and vacant housing units were all significantly overrepresented. However, non-Hispanic White, non-Hispanic Black, and other non-Hispanic people of color are all significantly underrepresented in food desert tracts. In food assistance deserts, there is a significant overrepresentation of Hispanic, less than high school educated, non-English proficient, and foreign born populations, as well as renter occupied vacant housing units. There is a significant underrepresentation of non-Hispanic White, non-Hispanic Black, and other non-Hispanic people of color, and unemployed populations in food assistance desert tracts. In tracts that were an overlap of food deserts and food assistance deserts, there was a significant overrepresentation of Hispanic, non-Hispanic Black, non-Hispanic people of color, less than high school educated, non-English proficient, and foreign born populations, as well as renter occupied housing units. There was a significant underrepresentation of non-Hispanic White, unemployed populations, and vacant housing units in these overlap tracts. In tracts that were neither a food desert nor food assistance desert, there is a is a significant underrepresentation of Hispanic, less than high school educated, limited English proficient, and foreign born populations, as well as renter occupied and vacant housing units. There is a

significant overrepresentation of non-Hispanic White, non-Hispanic Black, and other non-Hispanic people of color populations.in tracts that were neither a food desert nor food assistance desert.

4.2: Multivariate Analysis

To predict the likelihood of a tract being classified as any of the food access categories on the basis of independent variables, multivariable binary logistic GEE models were used. The dependent variable in each GEE is the respective food access category, which is coded as 1, with all other tracts coded as 0. The GEE models account for spatial clustering, based on the median decade of housing construction within each census tract. This produced 9 clusters of tracts, with 1 to 34 tracts within each cluster. The GEE model results are summarized in Tables 4.7 to 4.10.

Table 4.7 shows that after controlling for other independent variables and spatial clustering, the odds of food desert classification indicates a significant and positive association with the percentages of non-Hispanic Black ($p<0.10$) and other non-Hispanic people of color ($p<0.10$) populations, and the percentage of renter occupied housing units ($p<0.05$). Specifically, a 1% increase in the percentages of non-Hispanic Black, percentages of other non-Hispanic people of color, and percentages of renter occupied housing units in a tract is associated with 22.6%, 26.1% and 19.7% increases, respectively, in its odds of being classified as a food desert. The odds of food desert classification indicates a significant and negative association with the percentage of vacant housing units ($p<0.001$). A 1% increase in the percentage of vacant housing units is associated with a 27.0% decrease in the odds of being classified as a food desert.

Table 4.7: Multivariable Generalized Estimating Equation (GEE) for Predicting the Odds of Tract Location in a Food Desert in El Paso County.

	Beta	Standard Error	Wald Chi-Squared	Exp (Beta)	P-value
% Hispanic	0.075	0.1722	0.191	1.078	0.662

% Non-Hispanic Black	0.204	0.1123	3.310	1.226	0.069*
% Other non-Hispanic People of Color	0.232	0.1242	3.481	1.261	0.062*
% of Population 25 and over with Less than a High School education	0.265	0.1927	1.888	1.303	0.169
% Population 5 and over has Limited English Proficiency	-0.032	0.2406	0.018	0.969	0.893
% Population that is Foreign Born	0.138	0.2872	0.230	1.148	0.632
% Population 16 and over that is Unemployed	0.060	0.066	0.819	1.062	0.365
% Occupied Housing Units that are Renter Occupied	0.180	0.0712	6.385	1.197	0.012**
% Vacant Housing Units	-0.315	0.0736	18.314	0.730	<0.001***

***p <0.001; **p < 0.05; *p< 0.10.
Note: GEE is based on a binary logistic function and an unstructured correlation matrix with control for clustering by median decade of housing stock (9 clusters); N=160 tracts.

Table 4.8 shows that after controlling for other independent variables and spatial clustering, the odds of food assistance desert classification indicates a significant and positive association with the percentages of Hispanic (p<0.05), non-Hispanic Black (p<0.10), other non-Hispanic people of color (p<0.05), and non-English proficient (p<0.05) populations, and the percentage of vacant housing units (p<0.10). Specifically, a 1% increase in the percentages of Hispanic, percentages of non-Hispanic Black, percentages of other non-Hispanic people of color, percentages of limited English proficient, and percentages of vacant housing units in a tract is associated with 61.4%, 21.4%, 40.2%, 99.8%, and 16.1% increases, respectively, in its odds of being classified as a food assistance desert.

Table 4.8: Multivariable GEE for Predicting the Odds of Tract Location in a Food Assistance Desert in El Paso County.

	Beta	Standard Error	Wald Chi-Squared	Exp (Beta)	P-value
% Hispanic	0.479	0.2422	3.919	1.614	0.048**
% Non-Hispanic Black	0.194	0.1153	2.842	1.214	0.092*
% Other non-Hispanic People of Color	0.338	0.1515	4.969	1.402	0.026**
% of Population 25 and over with Less than a High School education	-0.307	0.3414	0.808	0.736	0.369
% Population 5 and over has Limited English Proficiency	0.692	0.2822	6.010	1.998	0.014**
% Population that is Foreign Born	-0.130	0.2095	0.386	0.878	0.534
% Population 16 and over that is Unemployed	-0.091	0.0867	1.102	0.913	0.294
% Occupied Housing Units that are Renter Occupied	0.140	0.1357	1.060	1.150	0.303
% Vacant Housing Units	0.149	0.0864	2.968	1.161	0.085*

***p <0.001; **p < 0.05; *p< 0.10.
Note: GEE is based on a binary logistic function and an unstructured correlation matrix with control for clustering by median decade of housing stock (9 clusters); N=160 tracts.

Table 4.9 shows that after controlling for other independent variables and spatial clustering, the odds of being classified as both a food desert and food assistance desert (area of overlap) indicates a significant and positive association with other non-Hispanic people of color percent (p<0.10), non-English proficient percent p<0.10), unemployed percent (p<.005), and renter occupied household percent (p<0.001). Specifically, a 1% increase in the percentages of percentages of other non-Hispanic people of color, percentages of limited English proficient,

percentages of unemployed, and percentages of renter occupied housing units in a tract is associated with 23.2%, 0.02%, 33.2%, and 57.9% increases, respectively, in its odds of being classified as an overlap of being a food desert and food assistance desert. The odds of overlap classifications indicates a significant and negative association with vacant housing unit percentage at (p<0.001). A 1% increase in the percentage of vacant housing units is associated with a 74.6% decrease in the odds of being classified as an overlap tract.

Table 4.9 Multivariable GEE for Predicting the Odds of Tract Location in a Tract that is an Overlap of a Food Desert and Food Assistance Desert in El Paso County.

	Beta	Standard Error	Wald Chi-Squared	Exp (Beta)	P-value
% Hispanic	-0.058	0.3279	0.031	0.160	0.860
% Non-Hispanic Black	0.209	0.1838	1.293	0.944	0.256
% Other non-Hispanic People of Color	0.272	0.1611	2.855	1.232	0.091*
% of Population 25 and over with Less than a High School education	0.002	0.3137	<0.001	1.865	0.995
% Population 5 and over has Limited English Proficiency	0.611	0.3289	3.454	1.002	0.063*
% Population that is Foreign Born	0.287	0.1800	2.550	1.842	0.110
% Population 16 and over that is Unemployed	0.273	0.1123	5.897	1.332	0.015**
% Occupied Housing Units that are Renter Occupied	0.597	0.1501	15.837	0.579	<0.001***
% Vacant Housing Units	-0.547	0.0941	33.845	0.254	<0.001***

***p <0.001; **p < 0.05; *p< 0.10.

Note: GEE is based on a binary logistic function and an unstructured correlation matrix with control for clustering by median decade of housing stock (9 clusters); N=160 tracts.

Table 4.10 shows that after controlling for other independent variables and spatial clustering, the odds of a tract being classified neither a food desert nor food assistance desert indicates a significant and negative association with limited English proficiency percent (p<0.001) and vacant housing unit percent (p<0.10). A 1% increase in the percentage of those with limited English proficiency and vacant housing units is respectively associated with a 17.9% and 61.2% decrease in the odds of being classified as neither a food desert nor food assistance desert. The odds of a classification of being neither a food desert nor food assistance desert indicates a significant and positive association with foreign born percent (p<0.05). Specifically, a 1% increase in the percentages of foreign born in a tract is associated with an 106.5% increase, in its odds of being classified as neither a food desert nor food assistance desert.

Table 4.10 Multivariable GEE for Predicting the Odds of Tract Location in Neither a Food Desert nor Food Assistance Desert in El Paso County.

	Beta	Standard Error	Wald Chi-Squared	Exp (Beta)	P-value
% Hispanic	-0.291	0.2548	1.308	0.748	0.253
% Non-Hispanic Black	-0.190	0.1369	1.934	0.827	0.164
% Other non-Hispanic People of Color	-0.022	0.2034	0.012	0.978	0.914
% of Population 25 and over with Less than a High School education	-0.306	0.2520	1.477	0.736	0.224
% Population 5 and over has Limited English Proficiency	-0.946	0.2281	17.180	0.388	<0.001***
% Population that is Foreign Born	0.725	0.3051	5.652	2.065	0.017**
% Population 16 and over that is Unemployed	0.138	0.1002	1.891	1.148	0.169

% Occupied Housing Units that are Renter Occupied	0.340	0.2706	1.579	1.405	0.209
% Vacant Housing Units	-0.197	0.1131	3.049	0.821	0.081*

***p <0.001; **p < 0.05; *p< 0.10.
Note: GEE is based on a binary logistic function and an unstructured correlation matrix with control for clustering by median decade of housing stock (9 clusters); N=160 tracts.

These multivariate results show that there are specific socio-demographic characteristics that are positively or negatively associated with a tract being classified a specific food access category, after accounting for the effects of clustering and other explanatory factors. The percentages of non-Hispanic Black, and other non-Hispanic populations, and renter occupied housing units are significantly and positively related to the likelihood of food desert location, while the percentage of vacant housing units are negatively related. The percentages of Hispanic, non-Hispanic Black, other non-Hispanic people of color, and limited English proficient populations, and vacant housing units are significantly and positively related to the likelihood of food assistance desert location. The percentages of other non-Hispanic people of color, limited English proficient, and unemployed populations, and renter occupied housing units are significantly and positively related to the likelihood of being in an area classified as both a food desert and food assistance desert, while the percentage of vacant housing units are negatively related. The percentages of people with limited English proficiency and vacant housing units are negatively related to the likelihood of being in a location that is neither a food desert nor food assistance desert, while the foreign born percentage was positively associated.

Chapter 5: Concluding Discussion

This thesis project has sought to contribute to food security research by identifying the locations and socio-demographic characteristics of neighborhoods classified as a food desert, food assistance desert, overlap of food deserts and food assistance desert, and those that are neither a food desert nor food assistance desert, in El Paso County, Texas. Prior studies have examined food insecurity by comparing social characteristics of food deserts and non-food deserts, or food assistance deserts and non-food assistance deserts, respectively. Few studies have systematically examined how and where these two food access categories spatially coincide or overlap with each other, and thus identify the characteristics of neighborhoods and residents in a given study area may have the most difficulty attaining their food needs.

Previous empirical research has shown that socially advantaged populations are more likely to reside in food secure neighborhoods or are able to meet their food needs (Dutko et al. 2012; Furey et al. 2001; Guy et al. 2004; Hendrickson, 2006; Jones et al. 2021; Lang et al. 1998; LeClair & Askan, 2014; Mead. 2008; Morton et al. 2005; Raysoni, 2018; Rincón et al. 2020; Waity, 2016). To examine whether findings in El Paso County align with prior studies on food access (Curran & Armenia, 2021; Furey et al., 2001; Hendrickson et al., 2006; Jones et al., 2021; LeClair & Askin, 2014; Morton et al., 2005; Waity, 2016), this thesis analyzed the socio-demographic characteristics of neighborhoods that represent different food access categories and identified which groups were more likely to reside within each food access category. Bivariate analyses were conducted to determine if racial/ethnic minorities, less than high school educated, foreign born, unemployed, and limited English proficient populations, as well as renter occupied and vacant housing units are significantly overrepresented inside food insecure low-income neighborhoods when compared to the rest of El Paso County. Multivariate analyses were also

performed to identify which are the strongest determinants of a neighborhood being classified as a particular food access category.

Results indicated that locations of food deserts, food assistance deserts, and neighborhoods that are an overlap of both categories vary spatially throughout the county. Food deserts were observed predominantly along or near the border of El Paso County, Texas and Juarez, Mexico. Food assistance deserts are located throughout the county, but most of these neighborhoods can be found near the western and eastern borders or the county. Neighborhoods that are classified as both a food desert and food assistance desert are mostly within the city limits of El Paso and near downtown areas, as well as along the shared US-Mexico border.

The first research question focused on identifying the socio-demographic characteristics of food deserts to determine if racial/ethnic minorities and other socially disadvantaged individuals are more likely to reside in neighborhoods classified as food deserts. Bivariate comparisons indicated significant differences between the socio-demographic characteristics of people that live inside and outside food deserts. Socio-demographic groups that were significantly overrepresented inside food deserts included Hispanic, less than high school educated, limited English proficient, foreign born, and unemployed populations, as well as renters. Groups that were significantly underrepresented included non-Hispanic White, non-Hispanic Black, and other non-Hispanic people of color populations. These findings point to an overrepresentation of socially disadvantaged groups, except for non-Hispanic Black and other non-Hispanic people of color in food deserts. Multivariate models that account for spatial clustering and other independent variables indicated that the percentages of non-Hispanic Black, other non-Hispanic people of color, and renters were significant indicators of food desert classification.

The second research question focused on determining whether racial/ethnic minorities and other socially disadvantaged individuals are more likely to reside in neighborhoods classified as food assistance deserts. Bivariate comparisons indicated significant differences between the socio-demographic characteristics of people that live inside and outside food assistance deserts. Socio-demographic groups that were significantly overrepresented inside food assistance deserts included Hispanic, less than high school educated, limited English proficient, and foreign born populations, as well as renters. Groups that were significantly underrepresented included non-Hispanic White, non-Hispanic Black, other non-Hispanic people of color, and unemployed populations. These findings revealed that there was an overrepresentation of socially disadvantaged groups, except for non-Hispanic Black and other non-Hispanic people of color, in food assistance deserts. Multivariate models that account for spatial clustering and other independent variables indicated that the percentages of Hispanic, non-Hispanic Black, other non-Hispanic people of color, and limited English proficient populations are significant indicators of a neighborhood being classified as a food assistance desert.

The third research question identifies where neighborhoods that food deserts and food assistance deserts spatially coincide with one another and to see if more socially vulnerable populations such as racial/ethnic minorities and other socially disadvantaged individuals are more likely to reside in overlap neighborhoods. Bivariate comparisons indicated significant differences between the socio-demographic characteristics of people that live inside and outside overlap neighborhoods. Socio-demographic groups that were significantly overrepresented in these neighborhoods included Hispanic, non-Hispanic Black, other non-Hispanic people of color, less than high school educated, limited English proficient, and foreign born populations, as well as renters. Groups that were significantly underrepresented included non-Hispanic White, and

unemployed populations. These findings revealed that there was an overrepresentation of socially disadvantaged groups in these areas, except for unemployed populations. Multivariate models that account for spatial clustering and other independent variables indicated that percentages of other non-Hispanic people of color, non-English proficient, unemployed, and renters were significant indicators of a neighborhood being classified as both a food desert and food assistance desert.

The last research question focused on identifying where neighborhoods neither a food desert nor food assistance desert are located and if non-Hispanic White and other socially advantaged populations are more likely to live in these food secure neighborhoods. Socio-demographic groups that were significantly underrepresented in these neighborhoods included Hispanic, less than high school educated, limited English proficient, and foreign born populations, as well as renters. Variables that were overrepresented in these neighborhoods included non-Hispanic White, non-Hispanic Black, and other non-Hispanic people of color populations. These finding point to an overrepresentation of socially advantaged groups residing in these neighborhoods, except for non-Hispanic Black and other non-Hispanic people of color. Multivariate models that account for spatial clustering and control for other variables indicated that the percentage of foreign born population was a positive and significant indicator of a neighborhood being classified as a neither a food desert nor food assistance desert, while the percentage of limited English proficient population was negative indicator.

Overall, the statistical results indicated that most socially vulnerable groups are significantly overrepresented in food insecure and low-income areas of El Paso County. In food deserts, food assistance deserts, and neighborhoods classified as both food deserts and food assistance deserts, certain groups were consistently and significantly overrepresented. This

included Hispanic, foreign born, less than high school educated, and limited English proficient populations, as well as renters. Additionally, non-Hispanic Whites were significantly underrepresented in all these categories and overrepresented in neighborhoods that were neither a food desert nor food assistance desert. The only variable that was a significant indicator of a tract being classified as either a food desert, food assistance desert, and both a food desert and food assistance desert in the multivariate analysis was other non-Hispanic people of color. Additional variables that were positive and significant indicators of at least two food access categories included non-Hispanic Black (food deserts and food assistance deserts), limited English proficiency (food assistance deserts and overlap of food deserts and food assistance deserts), and renters (food deserts and overlap of food deserts with food assistance deserts). These results are consistent with those from prior studies that have identified racial/ethnic and the socioeconomic characteristics of food deserts in other urban areas (e.g., Dutko et al., 2012; Furey et al., 2001; Hendrickson et al., 2006; Jones et al., 2021; LeClair & Askin, 2014; Mead, 2008; Morton et al., 2005) and food assistance deserts (Curran & Armenia, 2021; Waity, 2016). While racial/ethnic minorities such as non-Hispanic Blacks and other non-Hispanic people of color were underrepresented in food deserts and food assistance deserts, these variables were significant indicators of a neighborhood's classification as a food desert and food assistance desert in multivariate models that control for other socio-demographic variables. Despite the smaller number of El Paso County residents in these minority groups relative to the Hispanic population, they are strong indicators of neighborhoods being classified as food insecure.

It is important to acknowledge some of the limitations of the data and methodology utilized in this thesis. First, this study uses data from the 2019 ACS, USDA Food Access Research Atlas, and Sun City Hunger Coalition's Hunger Relied Calendar, but the food

environment in El Paso County has likely changed considerably after the COVID-19 pandemic. While this is unlikely to influence the statistical results significantly, future avenues of research should utilize data from the latest ACS, USDA Food Access Research Atlas, and Sun City Hunger Coalition's Hunger Relief Calendar when they are updated and become available. Second, this study treated all supermarkets and food assistance sites equally and did not distinguish between them in terms of the hours they were open, food prices, food quality, and products available. While a neighborhood may be identified as having adequate access to either a supermarket or food assistance site, these attributes could present additional barriers that may not them attractive to local residents. Third, this research was also limited by the choice and location of the study site. El Paso County is a US-Mexico border community that is racially/ethnically dominated by Hispanic residents, as well as foreign-born and limited English proficient populations. Future studies should apply the methodology used in this thesis in other counties and states to identify if the patterns and trends of more socially disadvantaged people residing in food insecure classifications remain consistent in those study areas. Fourth, this analysis treated Hispanic residents as a single category, and did not consider the diversity or heterogeneity of Hispanics in El Paso County. Future research should disaggregate Hispanic residents into contextually relevant subgroups such as native-born and foreign-born Hispanics to obtain a more in-depth understanding of food access disparities in this border community. Finally, it is important to note that this thesis focused on identifying the spatial patterns and socio-demographic characteristics of various food access categories, and which groups are more likely to reside in these areas compared to others. The findings cannot be used to understand the historical or socioeconomic processes through which food deserts, food assistance deserts, or their areas of overlap were created or infer why specific racial/ethnic or socially disadvantaged

groups are more likely to reside in certain food access categories as opposed to others. However, suburbanization in El Paso County may have contributed to some of the food access patterns reported in this study, based on outward expansion of residential communities in the eastern and western sections of the county. This expansion has led to the closure of grocery stores in the northeast and central areas of El Paso, as well as in some of the older neighborhoods, as stores began to serve these new neighborhoods. More detailed longitudinal analysis that focuses on specific food insecure neighborhoods and their residents may be necessary to assess the reasons why disadvantaged groups are more likely to reside in food insecure neighborhoods,.

This study has sought to contribute to research on food security and food access by identifying the locations of food deserts, food assistance deserts, their areas of overlap, and neighborhoods that are neither a food desert nor food assistance desert within El Paso County, Texas. Subsequent statistical analyses indicated that racial/ethnic minority and more socially vulnerable populations were overrepresented in neighborhoods that comprise food insecure categories, including those at the intersection of food deserts and food assistance deserts. The results demonstrate the need to conduct food security studies that include not only food deserts or food assistance deserts, but to include both categories as well as their neighborhoods of overlap to gain a better understanding of social inequities of food access in urban environments. These findings can be used to formulate strategies and policies that promote access to nutritionally adequate food. Food deserts tend to be rich with corner stores and dollar stores, which have the potential to supplement these areas by incentivizing them to carry healthy food items such as fresh fruit at competitive prices. Recent healthy food financing in El Paso has been addressing this issue, and should continue to do so to meet the needs of those living in neighborhoods with low access to provide them health foods within close proximity (El Paso

County, 2022). Additionally, food assistance sites should consider the findings presented in this study to provide additional food assistance support through mobile food assistance sites or other means to target residents that may be in most need but out of range of their services.

Chapter 6: References

Alwitt, L. F., & Donley, T. D. (1997). Retail stores in poor urban neighborhoods. *Journal of consumer affairs*, *31*(1), 139-164.

Anderson, S.A. (1990). Core indicators of nutritional state for difficult-to-sample populations. *Journal of Nutrition, 120*, 1557–1600.

Bacon, C. M., & Baker, G. A. (2017). The rise of food banks and the challenge of matching food assistance with potential need: towards a spatially specific, rapid assessment approach. *Agriculture and Human Values*, *34*(4), 899-919.

Beaulac, J., Kristjansson, E., & Cummins, S. (2009). Peer reviewed: A systematic review of food deserts, 1966-2007. *Preventing chronic disease*, *6*(3).

Bianchi, S. M., Farley, R., & Spain, D. (1982). Racial inequalities in housing: An examination of recent trends. *Demography*, *19*(1), 37-51.

Clay, L. A., & Rogus, S. (2021). Impact of Employment, Essential Work, and Risk Factors on Food Access during the COVID-19 Pandemic in New York State. *International Journal of Environmental Research and Public Health*, *18*(4), 1451.

Collins, T., Grineski, S., Chakraborty, J., Montgomery, M., Hernandez, M (2015a). Downscaling environmental justice analysis: Determinants of household-level hazardous air pollutant exposure in Greater Houston. *Annals of the American Association of Geographers*, 105, 684–703.

Collins, T., Grineski, S., Chakraborty, J (2015b). Household-level disparities in cancer risks from vehicular air pollution in Miami. *Environmental Research Letters*., 10, 095008.

Cummins, S., & Macintyre, S. (2002). "Food deserts"—evidence and assumption in health policy making. *Bmj*, *325*(7361), 436-438.)

Curran, E., & Armenia, A. (2021). Food Assistance Deserts in Central Florida: Identifying Service Gaps Using Spatial Analysis. *Journal of Applied Social Science*, *15*(1), 95-106.

Data Commons (2020). City in El Paso, County, Texas, United States of America, North America. https://datacommons.org/place/geoId/4824000?utm_medium =explore&mprop=count&popt=Person&hl=en

Dutko, P., Ver Ploeg, M., & Farrigan, T. (2012). *Characteristics and influential factors of food deserts* (No. 1477-2017-3995).

Eisinger, P. (1998). Toward an end to hunger in America. Washington, DC: Brookings Institution Press.

El Paso County (2022). Healthy food financing initiative application cycle 2022. https://www.epcounty.com/economic/food.htm

Fong, K., Wright, R. A., & Wimer, C. (2016). The cost of free assistance: Why low-income individuals do not access food pantries. *J. Soc. & Soc. Welfare*, *43*, 71.

Furey, S., Strugnell, C., & McIlveen, M. H. (2001). An investigation of the potential existence of "food deserts" in rural and urban areas of Northern Ireland. *Agriculture and Human Values*, *18*(4), 447-457.

Garson, G. D. (2013). *Hierarchical linear modeling: Guide and applications*. Sage.

Giang, T., Karpyn, A., Laurison, H. B., Hillier, A., & Perry, R. D. (2008). Closing the grocery gap in underserved communities: the creation of the Pennsylvania Fresh Food Financing Initiative. *Journal of Public Health Management and Practice*, *14*(3), 272-279.

Guy, C., Clarke, G., & Eyre, H. (2004). Food retail change and the growth of food deserts: a case study of Cardiff. *International Journal of Retail & Distribution Management*. Vol. 32 No. 2, pp. 72-88. https://doi.org/10.1108/09590550410521752

Hendrickson, D., Smith, C., & Eikenberry, N. (2006). Fruit and vegetable access in four low-income food deserts communities in Minnesota. *Agriculture and Human Values*, *23*(3), 371-383.

Hessing, T (2021) *Two Sample Z Test of Proportions.* 6 Sigma Study Guide (Accessed 4/19/2022). https://sixsigmastudyguide.com/two-sample-test-of-proportions/

Janda, K. M., Hood, R., Price, A., Night, S., Marty, W. E., Rohlich, A., & van den Berg, A. E. (2021). Examining food insecurity and areas with unmet food needs during COVID-19: A geospatial, community-specific approach. *Journal of agriculture, food systems, and community development*, *10*(3), 55.

Jones, R. E., Walton, T. N., Duluc-Silva, S., & Fly, J. M. (2021). Household Food Insecurity in an Urban Food Desert: A Descriptive Analysis of an African American Community. *Journal of Hunger & Environmental Nutrition*, 1-19.

Kissane, R. J. (2010). "'We Call It the Badlands': How Social-Spatial Geographies Influence Social Service Use." Social Service Review March, 84:3–28.

Krieger, N. (2006). A century of census tracts: health & the body politic (1906–2006). *Journal of urban health*, *83*(3), 355-361.

Lang, T. & Caraher, M (1998). "Access to healthy foods: Part II. Food poverty and shopping deserts: What are the implications for health promotion policy and practice?" *Health Education Journal,* 57, 202-211.

LeClair, M. S., & Aksan, A. M. (2014). Redefining the food desert: Combining GIS with direct observation to measure food access. *Agriculture and Human Values*, *31*(4), 537-547.

Leung, C. W., Epel, E. S., Willett, W. C., Rimm, E. B., & Laraia, B. A. (2015). Household food insecurity is positively associated with depression among low-income supplemental nutrition assistance program participants and income-eligible nonparticipants. *The Journal of nutrition*, *145*(3), 622-627.

Mead M. N. (2008). The sprawl of food deserts. *Environmental health perspectives*, *116*(8), A335. https://doi.org/10.1289/ehp.116-a335a

Mikelbank, B. A. (2021) Spatial, Temporal, and Transit Access to Emergency Food Providers, The Professional Geographer, 73:4, 725-736, DOI: 10.1080/00330124.2021.1934881

Morales, D. X., Morales, S. A., & Beltran, T. F. (2020). Racial/ethnic disparities in household food insecurity during the COVID-19 pandemic: a nationally representative study. *Journal of Racial and Ethnic Health Disparities*, 1-15.

Morton, L. W., Bitto, E. A., Oakland M. J., & Sand M. (2005). Solving the Problems of Iowa Food Deserts: Food Insecurity and Civic Structure." Rural Sociology 70:94–112.

National Geographic (2022). Deserts. https://education.nationalgeographic.org/resource/desert

National Research Council. (2006). *Food insecurity and hunger in the United States: an assessment of the measure*. National Academies Press.

Nelder, J. A., & Wedderburn, R. W. (1972). Generalized linear models. *Journal of the Royal Statistical Society: Series A (General)*, *135*(3), 370-384.

Nyden, P., Lukehart, J., Maly, M. T., & Peterman, W. (1998). Chapter 1: Neighborhood Racial and Ethnic Diversity in U.S. Cities. *Cityscape*, *4*(2), 1–17. http://www.jstor.org/stable/41486474

O'Brien, D., Torres, A. H., Uchima, S., & Staley, E. (2004). The UPS Foundation and the Congressional Hunger Center 2004 Hunger Forum Discussion Paper: Hunger in America, The Definitions, Scope, Causes, History, and Status of the Problem of Hunger in the United States. *America's Second Harvest*.

Poppendieck, J. (1999). *Sweet charity?: Emergency food and the end of entitlement*. Penguin.

Raysoni, A. U. (2018). A Comparative Assessment of Food Deserts Using Geographic Information Systems (GIS) in El Paso County, TX and Loudoun County, VA. University of Texas at El Paso.

Rincón, E. T., & Tiwari, C. (2020). Demand Metric for Supermarket Site Selection: A Case Study. *Papers in Applied Geography*, *6*(1), 19-34.

Rose, D., Bodor, J. N., Hutchinson, P. L., & Swalm, C. M. (2010). The importance of a multi-dimensional approach for studying the links between food access and consumption. *The Journal of nutrition*, *140*(6), 1170-1174.

Shevky, E., & Bell, W. (1955). Social area analysis; theory, illustrative application and computational procedures.

Thomas, B. J. (2010). Food deserts and the sociology of space: distance to food retailers and food insecurity in an urban American neighborhood. *International Journal of Humanities and Social Sciences*, *4*(7), 1545-1554.

United States Census Bureau (2019). American Community Survey 5-year Estimates Data Profiles. Retrieved from: https://data.census.gov/table?q=population&g=0500000 US48141$1400000&d=ACS+5Year+Estimates+Data+Profiles&tid=ACSDP5 Y2020.DP05

United States Census Bureau (2020a). El Paso County, Texas. QuickFacts. https://www.census.gov/quickfacts/fact/table/elpasocitytexas,US/PST045221

United States Census Bureau (2020b). Glossary. https://www.census.gov/programssurveys/ geography /about/ glossary.html#:~:text= The%20primary%20purpose%20of%20census, optimum %20size%20of%204%2C000%20people.

United States Census Bureau (2022). *Assessing the validity of the ACS english-ability question*. The United States Census Bureau. https://www.census.gov/newsroom/blogs/research-matters/2015/10/how-well-do-you-speak-english-assessing-the-validity-of-the-american-community-survey-english-ability-question.html

United States Department of Agriculture (USDA). (2015). Food Deserts. Creating Access to Healthy, Affordable Food. USDA Agricultural Marking Services Report. http://apps.ams.usda.gov.fooddeserts.fooddeserts.aspx.

U.S. Department of Agriculture (USDA) and Economic Research Service (2019). Food Access Research Atlas. https://www.ers.usda.gov/data-products/food-access -research-atlas/go-to-the-atlas/

U.S. Department of Agriculture and U.S. Department of Health and Human Services. (1994). *Conference on food security measurement and research: Papers and proceedings*. January 21–22, 1994. Washington, DC.

Ver Ploeg, M., Dutko, P., & Breneman, V. (2015). Measuring food access and food deserts for policy purposes. *Applied Economic Perspectives and Policy*, *37*(2), 205-225.

Waity, J. F. (2016). Spatial inequality in access to food assistance in Indiana. *Sociological Inquiry*, *86*(1), 103-126.

Walker, R. E., Keane, C. R., & Burke, J. G. (2010). Disparities and access to healthy food in the United States: A review of food deserts literature. *Health & place*, *16*(5), 876-884.

Watkins R.J., Swift A. Jr., Green H.W., & Eckler A.R. (1956). *Golden Anniversary of Census Tracts, 1956*. Washington, DC: American Statistical Association.

Wolfson, J. A., Bleich, S. N., Smith, K. C., & Frattaroli, S. (2016). What does cooking mean to you?: Perceptions of cooking and factors related to cooking behavior. *Appetite*, *97*, 146-154.

Wolfson, J. A., & Leung, C. W. (2020). Food insecurity and COVID-19: disparities in early effects for US adults. *Nutrients*, *12*(6), 1648.

Wolfson, J. A., Ramsing, R., Richardson, C. R., & Palmer, A. (2019). Barriers to healthy food access: Associations with household income and cooking behavior. *Preventive medicine reports*, *13*, 298-305.

Wrigley. N, Warm D., Margetts B., & Whelan A. (2002). "Assessing the Impact of Improved Retail Access on Diet in a 'Food Desert': A Preliminary Report." *Urban Studies,* 39(11), 2061-2082.

Curriculum Vita

Jacob J. Aun was born in El Paso, Texas in 1997. Through building a close connection to his community, he decided to attend the University of Texas at El Paso (UTEP). After earning his Bachelor of Arts in Sociology and Minor in Music, he was accepted into the Master of Arts Sociology program at the UTEP in 2020. He worked as a graduate research assistant under the supervision of Dr. Jayajit Chakraborty, Professor in the Department of Sociology and Anthropology, and Dr. Gregory Schober, Assistant Professor in the Department of Rehabilitation Sciences and many more. While completing research, Jacob acquired expertise and hands-on experience with geographic information system (GIS) software, as well as downloading and using American Community Survey (ACS) data. Jacob aspired to contribute to the El Paso del Norte Region and promote local community initiatives that promote social justice. As a result, he was hired as a Development Assistant at the YWCA where he assists with grants, volunteer engagement and events, and manages donor information. He graduated from the M.A. in Sociology in the fall of 2022.