# A Comparison of Community Characteristics Relating to Food Deserts

Rhianna Leach
*Department of Resource Analysis, Saint Mary's University of Minnesota, Minneapolis, MN 55404*

*Keywords:* Food desert, GIS, Poverty, Race, Age, SNAP, Healthy Food, Urban, Minnesota, Ramsey County

## Abstract

This study focuses on exploring relationships between food deserts and factors contributing to the prevalence of food deserts in Ramsey County, Minnesota. Descriptive statistical analysis and Geographic Information Systems (GIS) were used to identify relationships between food deserts and related factors. These factors included Modified Retail Food Environment Index (mRFEI), poverty, income, race/ethnicity, age, access to healthy foods, access to vehicles, origin of birth and use of Supplemental Nutrition Assistance Program (SNAP).

## Introduction

### *History*

Food deserts have become a topic of discussion in the United States, especially within the United States Department of Agriculture (USDA). Cummins and Macintyre (1999) states the term "food desert" was coined in Scotland in the 1990s; it became a widely discussed topic in the United States during the Obama Administration. Through the First Lady's Let's Move! initiative and the Health Food Financing Initiative (HFFI), there was a promise to expand the availability of healthy food, specifically across low-income areas (Dutko, Ver Ploeg, and Farrigan, 2012).

Food deserts are defined by the USDA as "parts of the county vapid of fresh fruit, vegetables, and other healthful whole foods, usually found in impoverished areas. This is largely due to a lack of grocery stores, farmer's markets, and healthy food providers" (Gallagher, 2011).

### *Food Desert Data Used by the USDA*

The USDA uses census tracts to define food deserts. Census tracts are subdivisions of a county typically containing an average of approximately 4,000 people but can have anywhere from 1,000 to 8,000 people (Dutko *et al.*, 2012).

To determine access distance to supermarkets, according to USDA food desert metadata documentation, the entire country is divided into half kilometer square grids, and data on the population is aerially allocated to these grids (Ver Ploeg and Rhone, 2017). Next, the distance to the nearest supermarket is measured for each grid cell by calculating the distance between the geographic center of each grid that contains estimates of the population, and the center of the grid with the nearest supermarket. After the distance to the nearest supermarket has been calculated, estimates of people or households that are more than one mile from a supermarket in urban census tracts is aggregated.

The Food Access Research Atlas (FARA) is a mapping tool designed by the

Leach, R. 2019. Significance of Community Characteristics Relating to Food Deserts. Volume 22, Papers in Resource Analysis. 26 pp. Saint Mary's University of Minnesota University Central Services Press. Winona, MN. Retrieved (date) http://www.gis.smumn.edu

USDA to determine food deserts by census tract. The USDA maps census tracts that are low-income (LI), low-access (LA), or both low-income and low-access (LILA). This helps researchers to understand the multiple ways characteristics of census tracts contribute to food deserts.

For a census tract to be considered low-access (food desert), a census tract must qualify as a low-access community. This means that at least 500 people, or 33 percent of the census tract's population, must reside more than one mile from a supermarket or large grocery store for urban areas (Dutko *et al.*, 2012).

For a census tract to be considered low-income, it must have a poverty rate of 20 percent or more, a median income of less than 80 percent of the state-wide median family income, or be a tract in a metropolitan area with a median family income of less than 80 percent of the surrounding metropolitan area family income (Ver Ploeg and Rhone, 2017).

### *Community Characteristics*

Community characteristics that will be analyzed in relation to food deserts include demographics on age, income, origin of birth, poverty, race, access to vehicles, Modified Retail Food Environment Index (mRFEI), and usage of the Supplemental Nutrition Assistance Program (SNAP). These characteristics within a census tract can give more insight as to who is being affected by food deserts.

### *Study Area*

Minnesota has the seventh highest population with low retail access to healthy food in the country (Rausch and Mattessich, 2016). Approximately 1.6 million Minnesotans have low retail access to healthy food, with 990,000 of this population living in the Twin Cities.

The area for this study is located in Ramsey County, Minnesota. Ramsey County includes the state capital, St. Paul. Figure 1 (below) shows the study area.

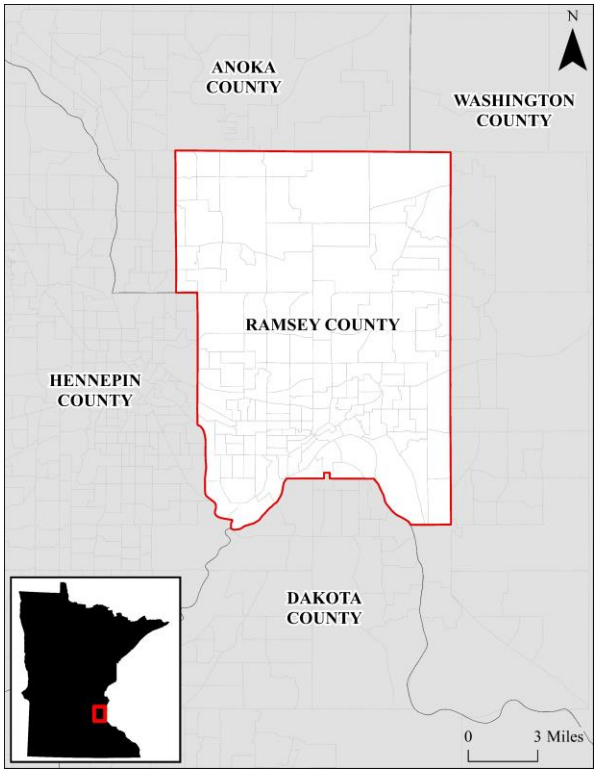

Figure 1. Study Area of Ramsey County, Minnesota.

Ramsey County is the second most populous county in Minnesota. The county has a few defining characteristics that stand out compared to Minnesota as a whole:

- Lower median age than the state of Minnesota
- Lower mean and median incomes than the state as a whole
- Higher percentage of non-U.S. citizens than the State of Minnesota as a whole
- Higher percentage of population living below poverty level
- Lower percentage of white alone population (higher percentage of

other races/ethnicities)

- Higher percentage of households using SNAP than the state of Minnesota
- Lower LA and LILA census tracts than the state of Minnesota as a whole

Figure 2 shows a detailed view of the study area, including the cities of Ramsey County.

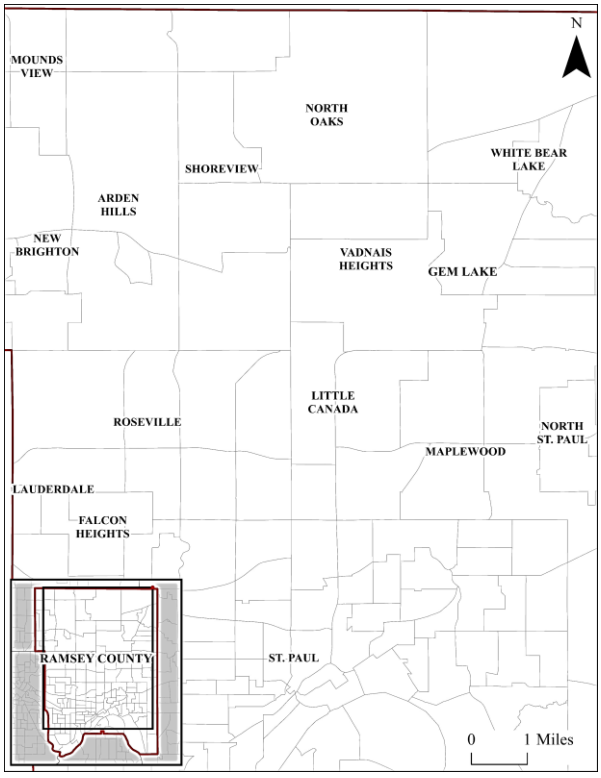

Figure 2. Cities in Ramsey County, Minnesota.

Northwestern cities of Ramsey County include Mounds View, New Brighton, Arden Hills and Shoreview. Northeastern cities include North Oaks, White Bear Lake, Vadnais Heights and Gem Lake. Cities in central Ramsey County include Lauderdale, Falcon Heights, Roseville, Little Canada, Maplewood and North St. Paul. The southern portion of Ramsey County consists of St. Paul, the state's capital.

Table 1 shows an overview of characteristics included in the study. The table shows statistics of Ramsey County, and Minnesota as a whole, for comparison.

Table 1. Comparison of Community Characteristics between Ramsey County and the State of Minnesota.

| **Characteristics** | **Ramsey County** | **Minnesota** |
|---|---|---|
| Total Population | 527,411 | 5,419,171 |
| Total Households | 208,504 | 2,153,202 |
| Median Age | 34.6 | 37.7 |
| Mean Income | $92,802 | $96,258 |
| Median Income | $56,104 | $61,492 |
| % Not U.S. Citizen | 7.81% | 3.97% |
| % Living Below Poverty Level | 16.5% | 11.3% |
| % White Alone | 68.7% | 84.9% |
| % Households No Vehicle | 4.2% | 2.8% |
| % Households Using SNAP | 13.1% | 8.6% |
| Retrieved from the U.S. Census Bureau Quick Facts (2017) | | |
| Total Census Tracts | 137 | 1,336 |
| % Low-Access (LA) | 27% | 33% |
| % Low-Income, Low-Access (LILA) | 7.3% | 12.9% |
| Retrieved from the USDA Food Access Research Atlas (2017) | | |

Figure 3 illustrates the locations of low-income, low-access (LILA) food desert census tracts, low-access (LA) food desert census tracts, and non-food desert census tracts. While LILA food deserts are mostly centered around the outside portions of St. Paul, LA census tracts are mostly focused in the north-northeastern portion of Ramsey County.

While Ramsey County has a lower percentage of both low-income, low-access (LILA) food desert census tracts,

and low-access (LA) food desert census tracts than the state of Minnesota as a whole, there are other characteristics that could be considered detrimental to the communities within Ramsey County, such as higher poverty levels and lower incomes.

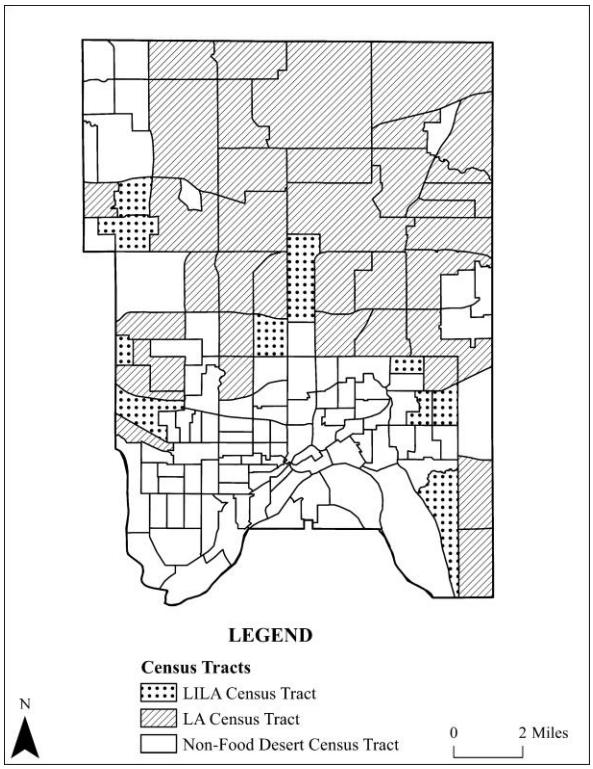


Figure 3. Low-Income, Low-Access (LILA) Food Desert Census Tracts, Low-Access (LA) Food Desert Census Tracts, and Non-Food Desert Census Tracts in Ramsey County.

These examples of community characteristics can lead to higher disproportions of minorities and other sensitive populations within food deserts.

In 2009, the USDA found that, on average, supermarkets were closer for low-income and minority populations than higher income and non-Hispanic white populations (Ver Ploeg *et al.*, 2012). However, after running multivariate analysis techniques, the USDA found that measures of income inequality and racial segregation were important predictors of low-access communities in urban areas.

This is especially important to consider within Ramsey County, due to the constraints of racial segregation in the Twin Cities metropolitan area. Orfield, Stancil, Luce, and Myott (2015) compared the Minneapolis-St. Paul metropolitan area to like-minded, progressive cities, such as Portland and Seattle. It was found the population of segregated, high-poverty neighborhoods in the Twin Cities area has tripled since the start of the twenty-first century.

Rausch and Mattessich (2016) states while distance to healthy food access is important when determining a food desert, the most significant role in healthy food access is income. Racial segregation, coupled with lower incomes and higher poverty rates can lead to distressed communities, even if they are not defined as low-access communities.

## Methods

The intention of this study was to explore the characteristics of the people within the census tracts of Ramsey County. This was conducted by first gathering demographic data on the population, then analyzing the demographics based on descriptive statistical analysis. After statistical analysis, visual representation was added through spatial analysis, graphs, and tables. The final product of this research was to understand what kind of economic and demographic factors are present in food deserts, and if any attributes of the demographics point to patterns typically observed in food deserts across the United States.

For all intents and purposes, the research conducted refers only to the USDA definition of food deserts. Therefore, only low-access or both low-access, low-income urban census tracts in

a one-mile radius from large grocery stores and supermarkets were examined and considered food deserts.

***Data***

Supplemental data, such as boundaries, were collected, as well as demographic data.

County Boundary Data

County boundary features were collected, queried to include only Ramsey County, and exported as a feature class in a geodatabase. This data was collected from the Minnesota Geospatial Commons, courtesy of the Minnesota Department of Transportation (MnDOT).

Census Tract Boundary Data

Census tract boundaries were collected, queried to include only Ramsey County, and exported as a feature class to a geodatabase. This data was collected from the United States Census Bureau.

Food Desert Data

Food desert data was collected through the United States Department of Agriculture. Tabular data was provided by census tract to include food desert data. Data was queried and filtered out in a new Excel table. The new table included a column depicting census tract identification numbers, a column depicting if census tracts low-access and a column depicting if the census tract was both low-income and low-access.

If a census tract indicates yes for low-income and low-access (LILA), it means that the census tract must have:

- 500 people or 33 percent of the census tract's population residing more than one mile from a supermarket or large grocery store, and;
- Have a poverty rate of 20 percent or more, a median income of less than 80 percent of the state-wide median family income, or be a tract in a metropolitan area with a median family income of less than 80 percent of the surrounding metropolitan area family income (Ver Ploeg and Rhone, 2017).

If a census tract indicates no for LILA and yes for low-access (LA), it means that the census tract must have:

- 500 people or 33 percent of the census tract's population residing more than one mile from a supermarket or large grocery store.

If a census tract indicates no for both LILA and LA, it is not considered a food desert.

The food desert data table was then imported into ArcMap to be spatially joined with census tract polygons based on census tract identification numbers. After the join, it was exported as a feature class into a geodatabase to include food desert data within census tract polygons.

Community Characteristic Data

Census tract demographic data was collected through the U.S. Census Bureau American Community Survey. Data was retrieved by census tract for Ramsey County in American Community Survey (ACS) 2017 five-year estimates. Data was collected by the U.S. Census Bureau between January 1, 2013 and December 31, 2017.

The ACS offers five-year estimates and 1-year estimates. The five-year estimate data contains the largest sample size and is the only data that is broken down in census tracts. ACS states five-

year estimate data is the most reliable and precise data, though is considered to be the least current data. It is the most beneficial data to use when examining small populations, such as census tracts.

Census tract 408.02, Bethel University, was removed due to lack of consistent demographic data. Census tract 9800, St. Paul Downtown Airport, was removed as there is no residential population within the census tract.

Data pertaining to the research was downloaded into individual tabular data, then aggregated into new tables to be spatially joined in ArcMap to census tract polygons and food desert data based on census tract identification numbers. It was then exported as a new feature class in a database. A table was also exported to a CSV text file to be imported in Excel.

The list below contains the community characteristics used in this study. Rationale for these characteristics is discussed in succeeding sections.

1. Age: Raw population counts by census tract, sorted by different age groups.
2. Income: Median income and mean income averages by census tract.
3. Origin of Birth: Raw population counts by census tract, broken down by nativity and place of birth.
4. Poverty: Raw population counts by census tract, broken down by multiple characteristics, such as age, employment, race, and educational attainment.
5. Race: Breakdown by race for total population in each census tract. Subcategories of race include White Alone, Black, Asian, Native Hawaiian/Pacific Islander, American Indian/Alaska Native, Some Other Race, and Two or More Races.
6. Vehicles: Count of vehicles per housing units in each census tract.
7. SNAP Benefits: Housing units in each census tract receiving SNAP benefits. Data is further broken down by poverty levels, elderly and children, disability, and race.

Modified Retail Food Environment Index

Modified Retail Food Environment Index (mRFEI) measures the number of healthy and less healthy food retailers within census tracts (CDC, 2011). The CDC includes supermarkets, larger grocery stores, supercenters, and produce stores as healthy food retailers. Less healthy food retailers examples are convenience stores, fast food restaurants, and small grocery stores with three or fewer employees.

mRFEI is calculated by number of healthy food retailers divided by number of healthy food retailers plus less healthy food retailers, multiplied by 100. The mRFEI score ranges from zero to 100, with a lower score number indicating more convenience stores and/or fast food restaurants in comparison to number of healthy food retailers, such as grocery stores.

A score of zero would indicate no healthy food retailers within the census tract. While a score of zero would indicate a food desert, a lower score could indicate a food swamp. Food swamps are defined as “areas in which large relative amounts of energy-dense snack foods inundate healthy food options (CDC, 2011). A score of ten would indicate that only ten out of 100 stores offer healthy foods. A score of 100 would indicate that all stores are likely to offer healthy foods.

The Modified Retail Food Environment Index (mRFEI) was an important piece of information when gathering data about food deserts. Obesity

is a growing issue in the United States and racial disparities in obesity are prominent (Bower, Thorpe, Rohde, and Gaskin, 2014). Research has found positive associations with healthy food availability in neighborhoods and the intake of healthy foods by residents in those neighborhoods according to Cheadle *et al.* (1991), Laraia *et al.* (2004), Larson *et al.* (2009), and Morland and Evenson (2009) cited by Bower, Thorpe, Rohde and Gaskin (2014).

Poor supermarket access can increase difficulty to find healthy foods and increase consumption of energy-dense ("empty calorie") foods according to Drewnowski and Specter (2004) cited by Walker *et al.* (2010). Energy-dense foods are often found at convenience stores and fast-food restaurants, which are easily available in urban areas. mRFEI data can pinpoint areas that are more likely to have unhealthy food options, which can contribute to obesity.

The mRFEI data was downloaded as an Excel table from the Centers for Disease Control and Prevention, Division of Nutrition, Physical Activity, and Obesity. The tabular data was separated by census tract identification number. The data was spatially joined in ArcMap to census tract polygons based on Ramsey County census tract identification numbers and exported as a new feature class in a geodatabase. Twelve census tracts had incomplete data, and therefore were not included in the analysis.

### *Community Characteristic Selection*

Community characteristics used for analysis were chosen based on previous research done relating to demographics and food deserts. Prior research studies have used age, poverty, income, race/ethnicity, SNAP and healthy food access in relation to food deserts. These characteristics have been studied to further analyzed who is living in food deserts.

#### Age

Age was chosen as a community characteristic to study because of prior research. Elderly populations and children are often studied because of their sensitivity to food desert conditions.

Elderly age groups are often studied when studying food deserts. Fitzpatrick, Greenhalgh-Stanley, and Ver Ploeg (2015) studied the impact of food deserts on food insufficiency and SNAP participation among the elderly. The researchers found that elderly people find difficulty in finding healthy food in food desert census tracts due to higher prices and means of transportation. Elderly food desert residents may also have strong neighborhood attachments, which means they would be more likely to stay in the neighborhood, even after food retailers leave that neighborhood.

Children are often directly affected by food insecurity and low-income environments. In 2017, it was found that 16.4 percent of households with children under the age of six were living with food insecurity (Coleman-Jensen, Rabbitt, Gregory, and Singh, 2018).

Frndak (2014) conducted a study on 232 suburban and urban school districts in New York State, specifically on fourth grade children. Results found correlations for proportion of children that are low-access and low-income, as well as households at low-access without a vehicle. Morrissey, Oellerich, Meade, Simms, and Stock (2016) found children living in high-poverty census tracts were more likely to live in households that had low food insecurity.

#### Income, Poverty and SNAP

Income and poverty often go hand and hand with food insecurity. Jang and Kim (2018) cite Zenk *et al.*; 2011, stating low-income neighborhoods have fewer chain supermarkets and more liquor stores. In addition to poor access to food, food desert areas often have more limited health care services, less transportation options, less access to parks, and higher prices for healthy food. These limitations can contribute to a poor diet and unhealthy lifestyle. It has been shown that areas with access to a large grocery store, government benefit programs, such as Electronic Benefits Transfer (EBT) or Supplemental Nutrition Assistance Program (SNAP), can see an increase in benefit amounts given in those areas. This issue further disadvantages those living in a food desert. Poverty and racial segregation in neighborhoods are associated with disparities in food store availability (Bower *et al.*, 2014).

Race and Origin of Birth

Food insecurity is often found in low-income families and among racial and ethnic minorities. Gundersen, Kreider, and Pepper (2011) cite Nord and Kantor (2010), who found that households headed by an African American or Hispanic person were more likely to be food insecure.

Other research on food deserts shows that central city communities are more likely to have supermarkets than communities with higher rates of poverty and higher percentages of African Americans according to Beaulac, Kristjansson, and Cummins (2009), Larson *et al.* (2009), Lovasi, Hutson, and Guerra (2009), and McKinnon, Reedy, and Morrissette (2009) cited by Thibodeaux (2016).

Immigrants and refugees may struggle to access healthy food through supermarkets because of cultural hindrances (Jossart-Marcelli, Rossiter, and Bosco, 2017). This could include issues with prejudice and discrimination, language barriers, religion differences, and different eating practices.

Vehicle Access

In a food desert, it can be difficult and time consuming to find ways to access healthy food. Bader, Purciel, Yousefzadeh, and Neckerman (2010) found poor neighborhoods often have lower vehicle ownership rates. Those not using a private vehicle often rely on public transportation, other modes of shared transportation, or walking for grocery shopping. Distance, high crime in neighborhoods, disabilities, and time commitments may also deter people from walking to grocery stores.

***Analysis***

To analyze community characteristics as they relate to food deserts, two different analysis procedures were used, descriptive statistical analysis and visual analysis. Descriptive statistics were utilized in the research as descriptive statistics can properly accomplish the end goal of describing who is living in census tracts. Spatial analysis, tables, and graphs were used to create a visual attribute to add to the statistical analysis. Figure 4 illustrates the workflow of examining and analyzing the data for food deserts and community characteristics.

Descriptive Statistical Analysis

First, raw population of the characteristic was divided by the overall population of either the entire census tract, or a specific

demographic population. If the demographic was reported by number of households, the households of the characteristic was divided by total number of households. This step was conducted to create a percentage of the number of people in the census tract, so that the percentage could more easily be statistically analyzed when grouped by LILA census tract, LA census tract, and non-food desert census tract.

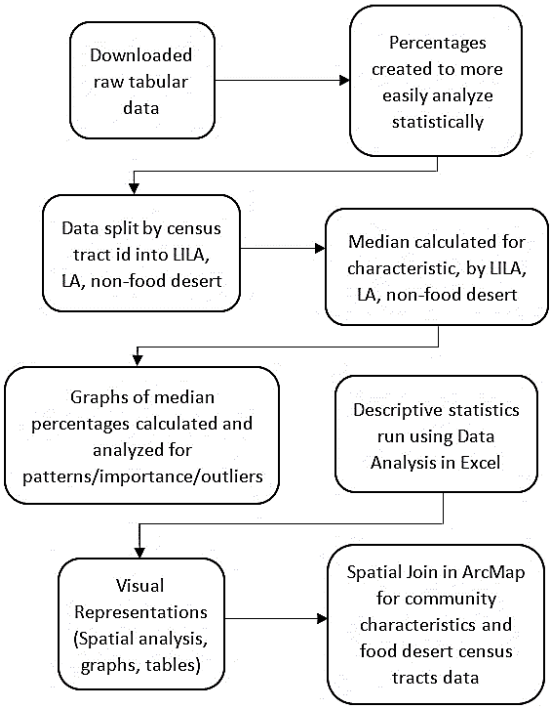


Figure 4. Workflow for analyzing the relationship between food deserts and community characteristic data.

This was completed for all community characteristics and split up by those living in LILA census tracts, LA census tracts and non-food desert census tracts. Each census tract type then had a median percentage produced for each column.

The median was used as a baseline to find patterns in the data. Median was used instead of mean because the median is less influenced by outliers in the data set (ACCG, 2015). This process gave a more centralized output, in case of any outliers that are often found in population data.

Next, graphs were created of median percentages to analyze any patterns between community characteristics and those living in food deserts. If there were obvious patterns found, descriptive statistics were run through the Data Analysis tool in Microsoft Excel. New tables including descriptive statistics run were created in Excel for data that was important to the research. Statistics including mean, median, range, minimum number, and maximum numbers, were used to analyze community characteristics and food desert relationships. Descriptive statistics were all run with the median percentage of the census tract, similar to the graphs that were created to analyze patterns.
To create visual representations, graphs, tables, and spatial analysis were used.

## Spatial Analysis

Community characteristic tabular data was imported into ArcMap and spatially joined to census tract boundary data by census tract identification numbers, then exported to individual features classes into a geodatabase. Spatial analysis was effective in visualizing community characteristics as they relate to food deserts. To create figures, community characteristic data was divided into categories using Jenks Natural Breaks classification, then rounded to the nearest number. Jenks Natural Breaks was chosen as it is designed to optimize arrangement of values into natural classes, or the most ideal class range found naturally in data sets.

The data was normalized by the total population in each census tract. Therefore, each census tract had one mean percentage. This created a mean

percentage for display purposes.

## Results

Results found in this study were based on descriptive statistical analysis. Results show differences between groups of community characteristics of those in low-income, low-access (LILA), low-access census tracts (LA), and non-food desert census tracts. Findings were divided by community characteristic.

### Age

Results of the project analysis found that the median percentage for children ages ten to 14 years old living in LILA census tracts are higher compared to LA census tracts and non-food desert census tracts.

Figure 5 illustrates the median percentage of age group zero to 19 years old living in Ramsey County.

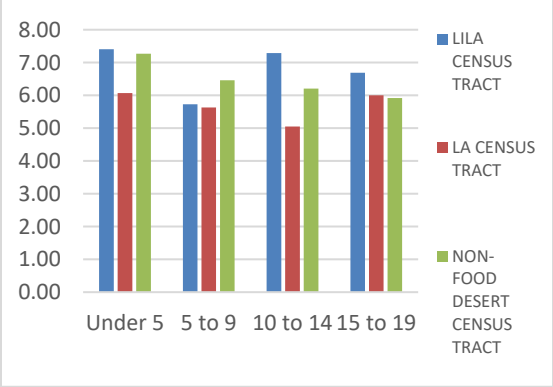


Figure 5. Median percentage of ages zero to 19 living in census tracts in Ramsey County. Census tracts are split by LILA, LA, and non-food desert census tracts.

Table 2 conveys descriptive statistics run on children ages ten to 14 living in Ramsey County. The average median percentage of children ages ten to 14 years old living in a low-income, low-access (LILA) census tract is almost five percent higher than non-food desert census tracts, and 19 percent higher than low-access (LA) census tracts.

The minimum percentage of children living in a LILA census tract is over 70 percent higher than those living in a non-food desert or and LA census tract.

Figure 6 shows the distribution of ages zero to 19 are living in Ramsey County.

Table 2. Descriptive statistics of children ages ten to 14 living in LILA census tracts, LA census tracts, and non-food desert census tracts.

| Statistics | LILA | LA | Non-Food Desert |
|---|---|---|---|
| Count | 10 | 37 | 88 |
| Mean | 6.66 | 5.37 | 6.34 |
| Median | 7.29 | 5.05 | 6.21 |
| Range | 8.58 | 8.88 | 13.09 |
| Minimum | 1.84 | 0.51 | 0.44 |
| Maximum | 10.42 | 9.39 | 13.53 |

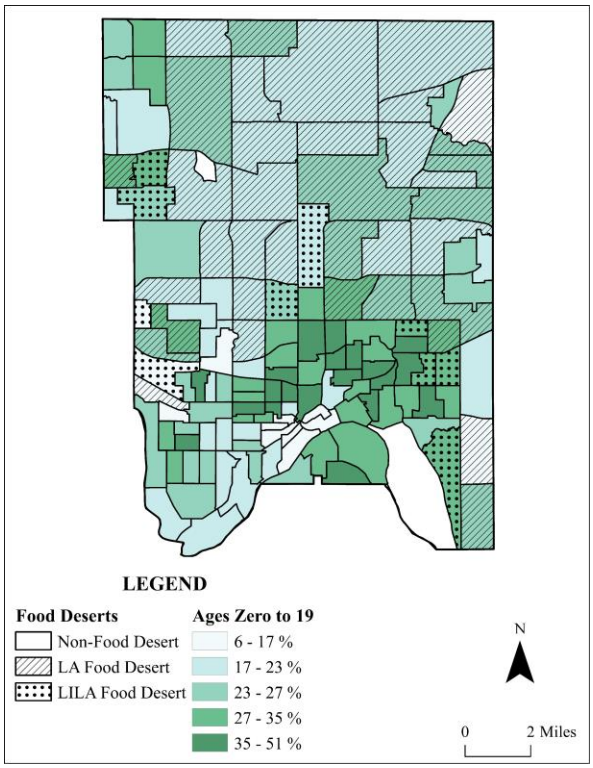


Figure 6. Population of ages zero to 19 living in Ramsey County. Divided by LILA, LA, and non-food desert census tracts.

Children under five years old have a slightly higher median percentage living in a LILA census tract than a non-food desert census tract, and children ages five to nine have a higher percentage living in non-food desert census tracts. There is also a higher median percentage for children ages 15 to 19 living in LILA tracts in Ramsey County. Figure 7 shows the graph of median percentages for age groups 20 to 39 years-old living in Ramsey County.

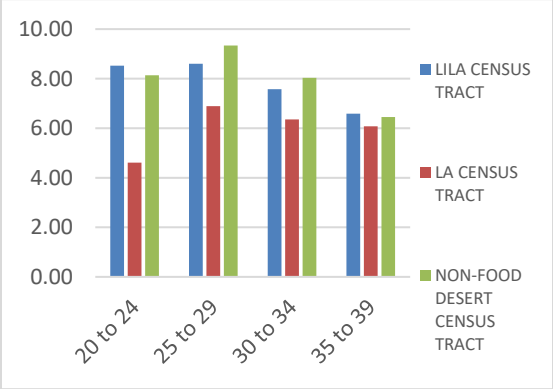


Figure 7. Median percentage of adults aged 20 to 39 living in LILA, LA, and non-food desert census tracts in Ramsey County.

Young adults, specifically ages 20 to 24 years-old, are 45 percent more likely to be living in LILA census tracts than LA census tracts. Adults aged 25 to 34 are more likely to live in non-food desert census tracts. Adults aged 35 to 39 are mostly balanced among the census tracts, with a slightly higher median percentage in LILA census tracts.

Figure 8 illustrates areas where adults aged 20 to 39 are living in Ramsey County. This age group has concentrations in St. Paul, as well as Lauderdale and Falcon Heights. The percentage of those living in northern suburbs is much lower than in the southern portion of the county.

While the age group 40 to 44 years-old is more likely to live in a LILA census tract, ages 45 to 59 years-old are more likely to live in an LA census tract.

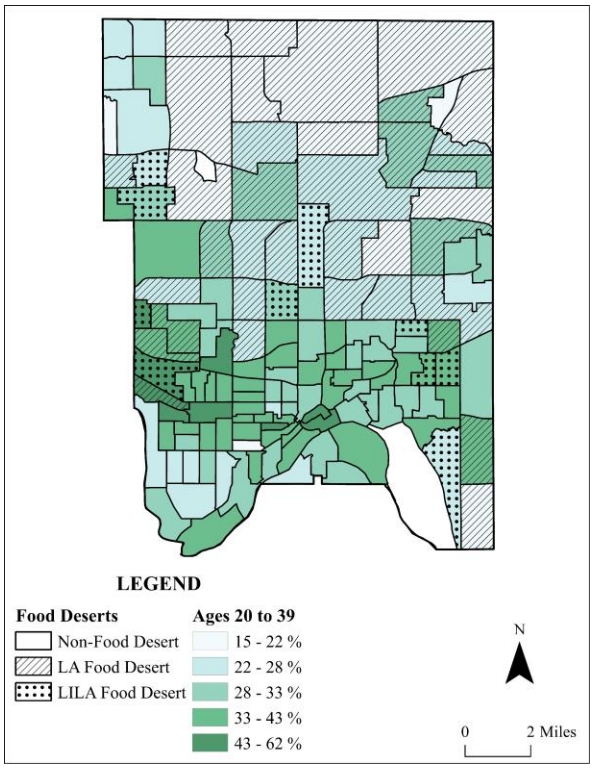


Figure 8. Population of ages 20 to 39 living in Ramsey County. Divided by LILA, LA, and non-food desert census tracts.

Figure 9 shows the graph of median percentages for age groups 40 to 59-years old living in Ramsey County.

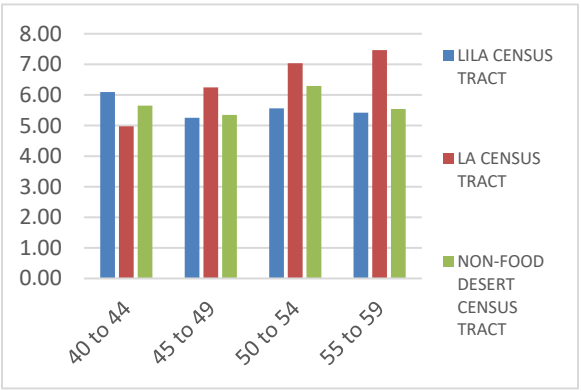


Figure 9. Median percentage of adults aged 40 to 59 living in census tracts in Ramsey County. Divided into LILA, LA tracts, and non-food desert census tracts.

Populations aged 45 to 49 years-old living in low-income (LA) census tracts are approximately 14 and 16 percent higher

than non-food desert census tracts and low-income, low access (LILA) census tracts, respectively. Populations aged 50 to 54 years-old are more likely living in LA census tracts as well, with a population 21 percent higher than LILA census tracts. Ages 55 to 59 percent have a 27 percent higher population living in LA census tracts than LILA census tracts.

Figure 10 depicts areas where adults aged 40 to 59 are living in Ramsey County. There is a concentration in the northern portions of Ramsey County, where many of the LA census tracts are located. This includes cities such as Vadnais Heights, White Bear Lake, Shoreview and Arden Hills.

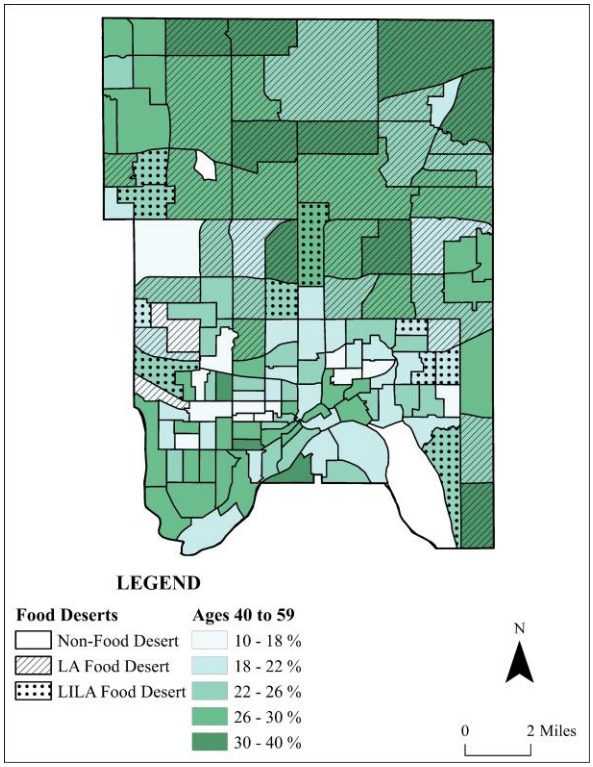


Figure 10. Population of ages 40 to 59 years-old living in Ramsey County. Census tracts are divided into LILA tracts, LA tracts and non-food desert tracts.

All age groups 60 years and older are more likely to be living in an LA census tract than a non-food desert or LILA census tract. Figure 11 shows the median percentage of adults aged 60 and up living in Ramsey County.

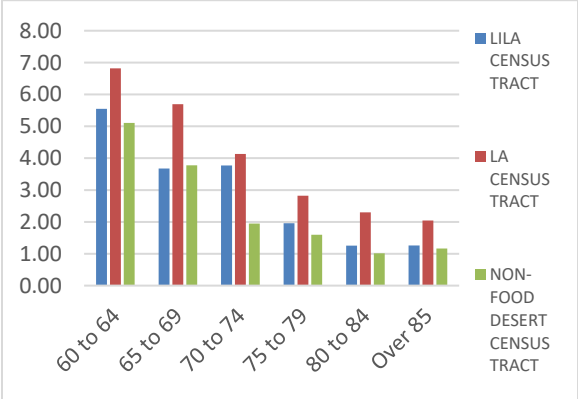


Figure 11. Median percentage of adults aged 60 and up living in census tracts in Ramsey County. Census tracts are divided into LILA census tracts, LA census tracts, and non-food desert census tracts.

All age groups 60 years and older combined living in an LA census tract is approximately 34 percent higher than a non-food desert census tract, and 28 percent higher than a LILA census tract. Table 3 tabulates descriptive statistics for adults 60 years and older living in Ramsey County.

Table 3. Descriptive statistics of adults 60 years and older living in LILA census tracts, LA census tracts and non-food desert census tracts.

| Statistics | LILA | LA | Non-Food Desert |
|---|---|---|---|
| Count | 10 | 37 | 88 |
| Mean | 2.97 | 4.13 | 2.73 |
| Median | 2.50 | 3.75 | 2.21 |
| Range | 8.11 | 12.71 | 10.33 |
| Minimum | 0.22 | 0.43 | 0.00 |
| Maximum | 8.33 | 13.13 | 10.33 |

In addition, Figure 12 illustrates the distribution of adults 60 years and older living in Ramsey County. The distribution is mostly in the northern portions of Ramsey County, such as North Oaks,

White Bear Lake, and Shoreview.

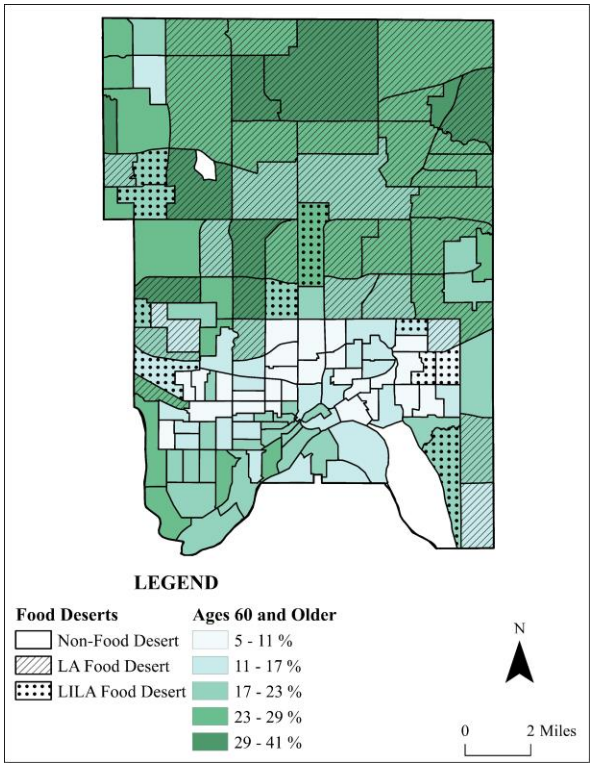


Figure 12. Population of ages 60 years and older living in Ramsey County. Tracts are divided into LILA, LA, and non-food desert tracts

## Income

Median income was analyzed instead of mean income to obtain a clearer depiction of the middle income. Kiersz (2015) suggests using median income when looking for typical household incomes, as high-income outliers can increase the mean and skew the data.

Figure 13 breaks down the median income for LILA census tracts, LA census tracts, and non-food desert census tracts. Results showed that those living in LILA census tracts have much lower median incomes than those living in LA census tracts and non-food desert census tracts.

Those living in LA census tracts have an approximately 40 percent higher median income than in LILA census tracts and an approximately 28 percent higher median income than non-food desert census tracts.

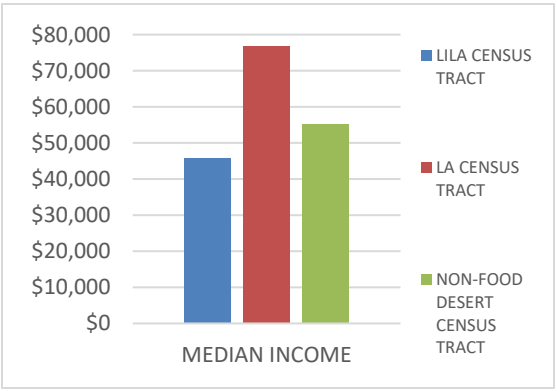


Figure 13. Median income for Ramsey County, divided by LILA census tracts, LA census tracts, and non-food desert census tracts.

Figure 14 shows the distribution of income within Ramsey County.

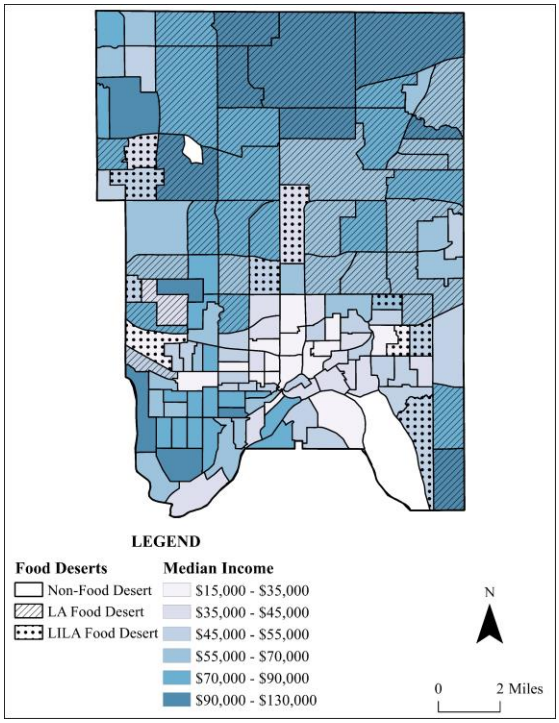


Figure 14. Median income in Ramsey County, divided by LILA, LA, and non-food desert tracts.

Higher incomes are often found in the northern portion of Ramsey County, where many LA census tracts are found. Higher median incomes are also found in

the in the southeastern and southwestern portions of Ramsey County, while lower median incomes are found in downtown St. Paul, as well as other areas of northern St. Paul, especially those containing LILA census tracts.

Table 4 conveys descriptive statistics of median income in Ramsey County, separated by LILA, LA, and non-food desert census tracts.

Table 4. Descriptive statistics of median income in Ramsey County. Census tracts are separated by LILA, LA, and non-food desert census tracts.

| Statistics | LILA | LA | Non-Food Desert |
|---|---|---|---|
| Count | 10 | 37 | 88 |
| Mean | $45,735 | $76,720 | $55,344 |
| Median | $48,270 | $71,660 | $52,934 |
| Range | $35,828 | $84,813 | $89,858 |
| Minimum | $28,235 | $41,800 | $16,089 |
| Maximum | $64,063 | $126,613 | $105,947 |

An important factor in the descriptive statistical analysis could be the maximum income in the census tracts. The highest income in a LILA census tract is $64,063, compared to $126,613 for LA census tracts, and $105,947 in non-food desert census tracts. The maximum income for a LILA census tract is half of the maximum income for LA census tracts, and only 60 percent of the maximum income for a non-food desert census tract.

The highest median income in a low-access (LA) census tract is approximately 16 percent higher than in a non-food desert census tract, and 49 percent higher than a low-income, low-access (LILA) census tract.

Origin of Birth

Results of this study found a higher median percentage of foreign born, non-U.S. citizens live in Ramsey County LILA census tracts than in LA census tracts and non-food desert census tracts. A slightly higher percentage of naturalized U.S. citizens live in LILA census tracts compared to LA and non-food desert census tracts, and native U.S. citizens are more likely to be living in LA census tracts than non-food desert census tracts.

Figure 15 shows the median percentages of U.S. citizens, naturalized U.S. citizens, and non-U.S. citizens living in Ramsey County.

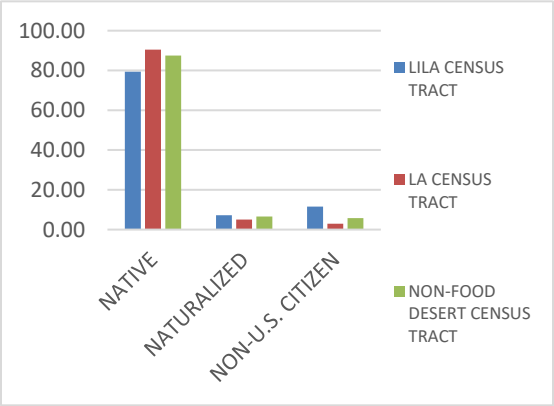


Figure 15. Median percentage of U.S. citizens, naturalized U.S. citizens, and non-U.S. citizens in Ramsey County, separated by LILA, LA, and non-food desert census tracts.

Non-U.S. citizens living in LILA census tracts in Ramsey County is approximately 74 percent higher than non-U.S. citizens living in LA census tracts and 50 percent higher than non-food desert census tracts. Table 5 tabulates the distribution of non-U.S. citizens living in Ramsey County, divided by LILA census tracts, LA census tracts, and non-food desert census tracts.

Naturalized U.S. citizens had a slightly higher median percentage in LILA census tracts, 7.18 percent, compared to 5.05 percent in LA census tracts, and 6.54 percent in non-food desert census tracts.

Table 5. Descriptive statistics for non-U.S. citizens.

| Statistics | LILA | LA | Non-Food Desert |
|---|---|---|---|
| Count | 10 | 37 | 88 |
| Mean | 13.97 | 4.44 | 8.13 |
| Median | 11.52 | 2.96 | 5.74 |
| Range | 23.79 | 29.44 | 28.01 |
| Minimum | 7.26 | 0.37 | 0.20 |
| Maximum | 31.05 | 29.81 | 28.21 |

Figure 16 shows further the distribution of non-U.S. citizens in Ramsey County.

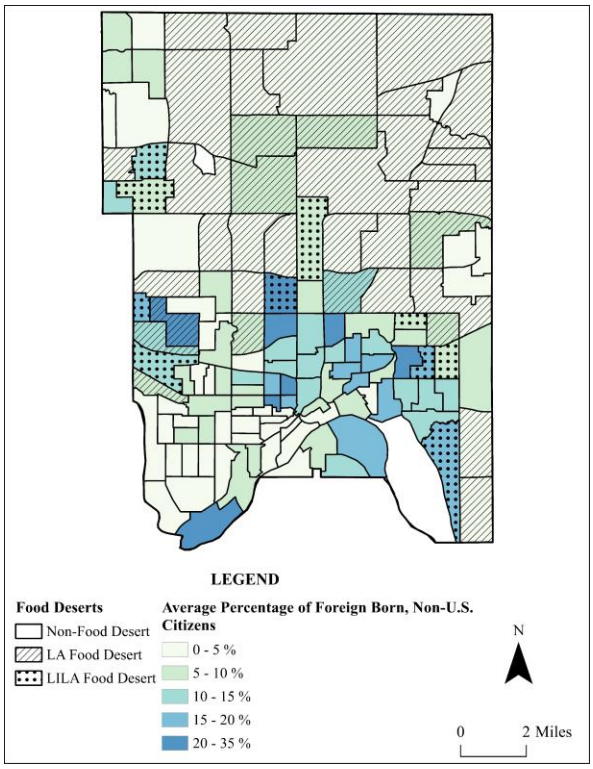


Figure 16. Distribution of foreign born, non-U.S. citizens in Ramsey County. Data is separated by LILA, LA and non-food desert census tracts.

Additionally, Figure 17 indicates the median percentages of naturalized citizens in Ramsey County, by birthplace. Naturalized citizens born in Asia and Africa are more likely to live in a LILA census tract than an LA census tract or a non-food desert census tract.

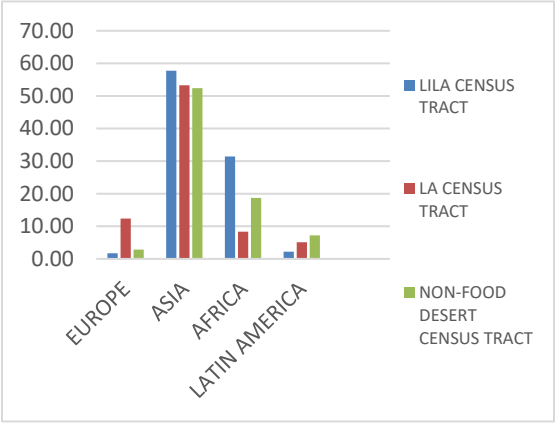


Figure 17. Median percentage of naturalized U.S. citzens, by birthplace, in Ramsey County. Data is seperated by LILA, LA, and non-food desert census tract.

African-born naturalized U.S. citizens living in LILA census tracts is approximately 74 percent higher than LA census tracts, and approximately 40 percent higher than non-food desert census tracts. Table 6 shows descriptive statistics of African-born naturalized U.S. citizens living in Ramsey County.

Table 6. Descriptive statistics for African-born, naturalized U.S. citizens in Ramsey County. Statistics are separated by LILA, LA, and non-food desert census tracts.

| Statistics | LILA | LA | Non-Food Desert |
|---|---|---|---|
| Count | 10 | 37 | 88 |
| Mean | 29.16 | 16.89 | 22.99 |
| Median | 31.45 | 8.33 | 18.72 |
| Range | 57.05 | 63.87 | 72.64 |
| Minimum | 2.56 | 0.00 | 0.00 |
| Maximum | 59.60 | 63.87 | 72.64 |

The range of African-born naturalized U.S. citizens living in a non-food desert is 21 percent higher than LILA census tracts, and almost 11 percent higher than LA census tracts. While LA and non-food desert census tracts have higher maximum counts than LILA tracts, LILA census tracts have a minimum of 2.56, compared to zero for LA and non-food

desert census tracts. Naturalized citizens born in Europe are more likely to live in LA census tracts, and those born in Latin America are more likely living in non-food desert census tracts.

Race

Results of this study show a higher median percentage of those who identify as non-white in Ramsey County live in LA census tracts compared to LILA or non-food desert census tracts.

Figure 18 illustrates the areas in which those who identify as white live in Ramsey County. Highest median percentages of those who identify as white has a concentration in the northern and southwestern portions of Ramsey County.

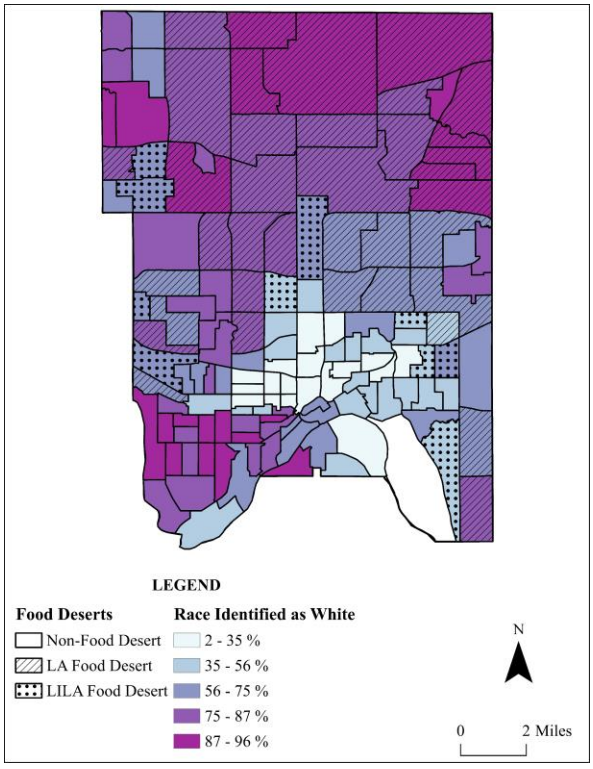


Figure 18. Distribution of population that identifies as white in Ramsey County. Data is separated by LILA, LA and non-food desert census tracts.

Those who identify as white and living in LA census tracts is approximately 26 percent higher than those identifying as white living in LILA census tracts, and approximately 16 percent higher than those living in non-food desert census tracts.

Figure 19 displays the median percentages of the population by race for LILA census tracts, LA census tracts, and non-food desert census tracts. A higher median percentage of the population identifying as black or Asian live in LILA census tracts than LA or non-food desert census tracts. Median percentages were either zero or close to zero for those who identified as Native Hawaiian/Pacific Islander or American Indian/Alaska Native.

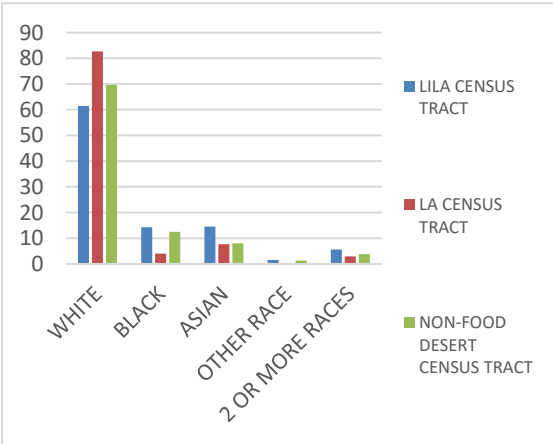


Figure 19. Median percentages, by race, in Ramsey County. Data is divided by LILA census tract, LA census tract, and non-food desert census tract.

The population in Ramsey County that identifies as black is more likely to live in a LILA census tract, with a median percentage of 14.28 percent. This median percentage is approximately 72 percent higher than the median percentage of those that identify as black in LA census tracts, and 13 percent higher than those living in non-food desert census tracts.

Table 7 shows descriptive statistics for those identifying as black in Ramsey County. Although the maximum

percentage of those that identify as black in LILA census tracts is lower than a non-food desert census tract, the minimum percentage of population identifying as black in LILA census tracts is 95 percent higher than those that identify as black in non-food desert census tracts.

Table 7. Descriptive statistics of Ramsey County population identifying as black. Data is divided by LILA census tracts, LA census tracts, and non-food desert census tracts.

| Statistics | LILA | LA | Non-Food Desert |
|---|---|---|---|
| Count | 10 | 37 | 88 |
| Mean | 14.12 | 5.23 | 15.42 |
| Median | 14.28 | 4.03 | 12.47 |
| Range | 31.57 | 19.12 | 72.92 |
| Minimum | 5.60 | 0.03 | 0.27 |
| Maximum | 37.17 | 19.14 | 73.19 |

## Poverty

Results of the analysis showed that those living in LILA census tracts have a higher median percentage living below the poverty line than in LA census tracts or non-food desert census tracts.

Table 8 indicates those living below the poverty line in Ramsey County, divided by LILA, LA, and non-desert census tracts.

The median percentage of those living below poverty levels in LILA census tracts is 18.70, which is 66 percent higher than those living below poverty in LA census tracts, and approximately 14 percent higher than those living below poverty level in non-food desert census tracts. The minimum percentage of those living below the poverty line in a LILA census tract is over 66 percent higher than a non-food desert census tract, and over 81 percent higher than an LA census tract.

Figure 20 depicts the distribution of median percentages of children ages five to 17 living below the poverty line in Ramsey County.

Table 8. Descriptive statistics for the population living below poverty level in Ramsey County. Data is separated by LILA, LA, and non-food desert census tracts.

| Statistics | LILA | LA | Non-Food Desert |
|---|---|---|---|
| Count | 10 | 37 | 88 |
| Mean | 19.92 | 7.17 | 19.27 |
| Median | 18.70 | 6.35 | 16.03 |
| Range | 26.18 | 18.04 | 45.93 |
| Minimum | 7.90 | 1.50 | 2.65 |
| Maximum | 34.09 | 19.55 | 48.58 |

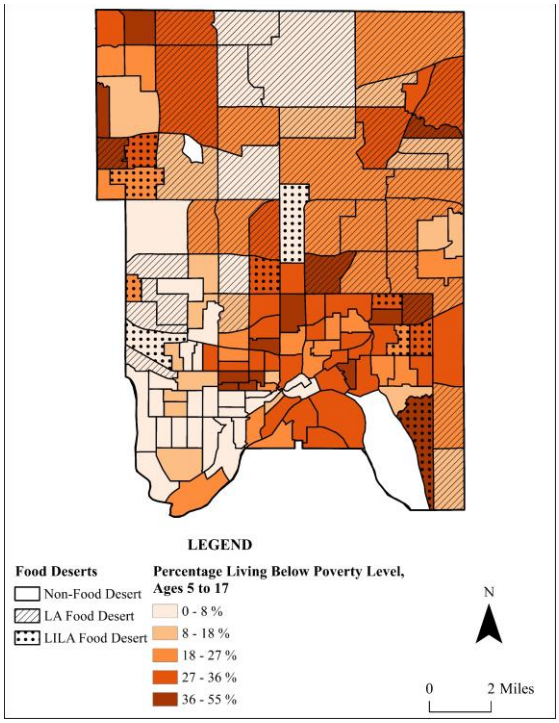


Figure 20. Ages five to 17 living below the poverty line in Ramsey County, separated by LILA, LA and non-food desert census tracts.

Children ages five to 17 see a higher median percentage living below the poverty line in a LILA census tract than an LA or non-food desert census tract. Distribution of children ages five to 17 living below the poverty line is scattered but tends to concentrate in or near LILA

census tracts.

Figure 21 shows adults 65 years and older living below the poverty line in Ramsey County. Adults aged 65 years and older see a higher median percentage living in LA census tract than in a LILA census tract or a non-food desert census tract.

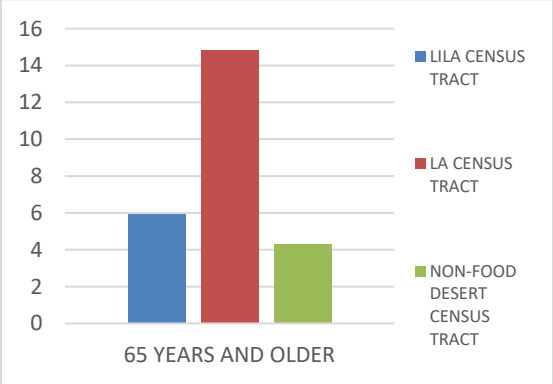


Figure 21. Median percentage of adults 65 years and older living below the poverty line. Data is separated by LILA tract, LA tract, and non-food desert tract.

Results of the research show those who identify as white have a higher median percentage living below the poverty line in LA census tracts than in LILA or non-food desert census tracts. Figure 22 shows the median percentages of those living below the poverty line by race, divided by census tract type.

Those who identify as black see a higher median percentage in LILA census tracts than those in LA census tracts and non-food desert census tracts. The median percentage for those who identify as black and live below the poverty line in LILA census tracts is 24.18 percent, 75 percent higher than those who identify as black in LA census tracts, and approximately 23 percent higher than those who identify as black in non-food desert census tracts.

Figure 22 also displays the distribution of those who identify as black and live below the poverty line in Ramsey County. There is a higher density of those living below the poverty line that identify as black in the southern portion of Ramsey County, near St. Paul. There is also a portion of the western part of the county, near New Brighton, that has a higher percentage of population that lives below the poverty level and identifies as black.

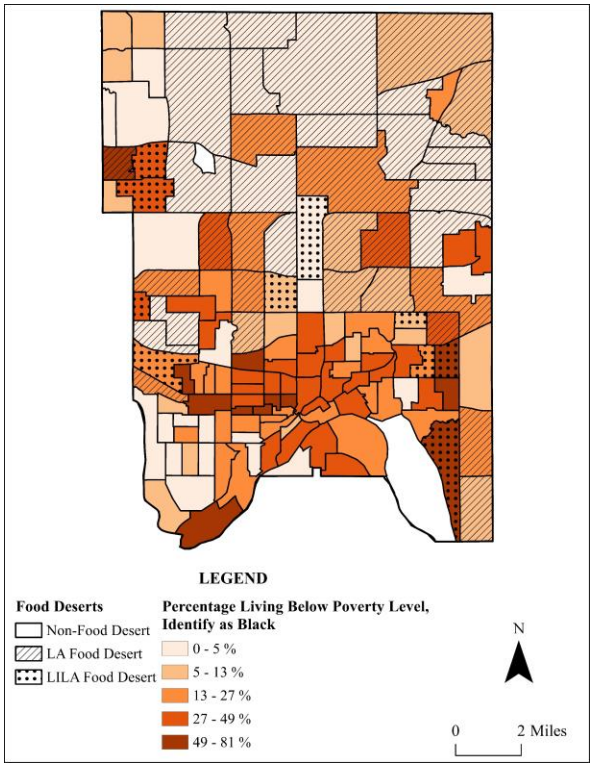


Figure 22. Those who identify as black and live below the poverty line in Ramsey County. Data is shown with LILA census tracts, LA census tracts, and non-food desert census tracts.

## SNAP

Results from the analysis found that the median percentage of households using the Supplemental Nutrition Assistance Program (SNAP) is slightly higher in non-food desert census tracts than LILA census tracts.

The median percentage of households using SNAP in non-food desert census

tracts is approximately four percent higher than in LILA census tracts, and approximately 68 percent higher than in LA census tracts.

Figure 23 shows the distribution of median percentages of households using SNAP in Ramsey County. The distribution is highly concentrated almost exclusively in St. Paul, especially the downtown area.

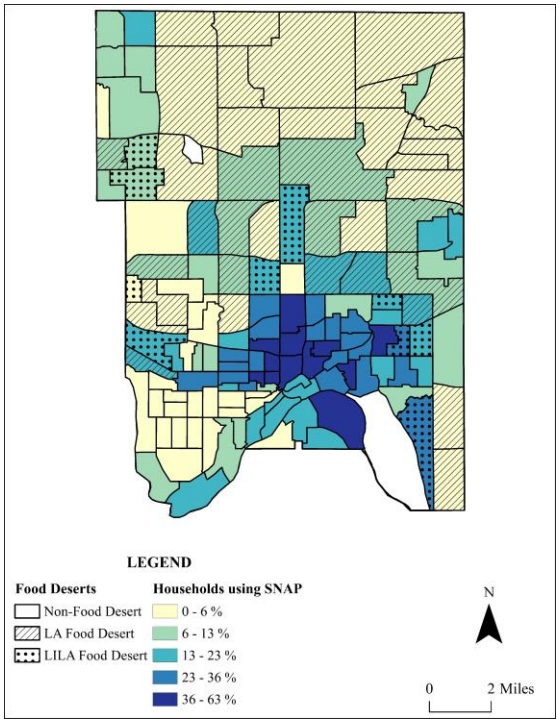


Figure 23. Households in Ramsey County using SNAP. Data includes LILA, LA, and non-food desert census tracts.

Households using SNAP that have one or more persons under the age of 18 living LILA census tracts have a slightly higher median percentage than those living in LA census tracts or non-food desert census tracts. Figure 24 illustrates the distribution of households using SNAP that have one or more persons under 18 in LILA, LA, and non-food desert census tracts.

Table 9 provides descriptive statistics for households using SNAP that have one or more persons under 18.

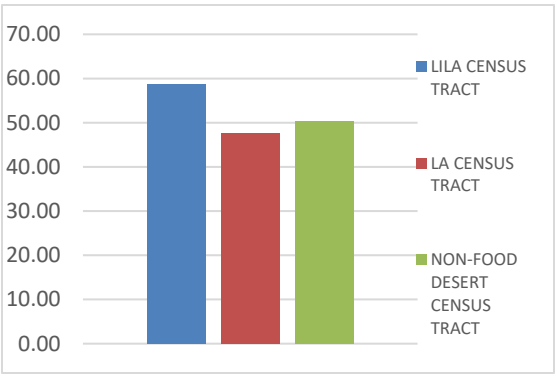


Figure 24. Median percentage of households using SNAP that have one or more persons under 18. Data is separated by LILA census tract, LA census tract, and non-food desert census tract.

Almost 60 percent of households using SNAP in LILA census tracts have at least one child under the age of 18 in that household, as opposed to 48 percent of LA census tracts and 50 percent of non-food desert census tracts. LILA, LA, and non-food desert census tracts have high ranges of households using SNAP that have one or more persons under 18. LA and non-food desert census tracts have a minimum of zero and a maximum of 100, meaning that some census tracts have zero households and some census tracts have all households using SNAP with one or more persons under 18. LILA census tracts have a much higher minimum percentage, 7.53, and a similar maximum, 95.80.

Table 9. Descriptive statistics for households using SNAP that have one or more persons under 18 years-old. Statistics include LILA census tracts, LA census tracts, and non-food desert census tracts.

| Statistics | LILA | LA | Non-Food Desert |
|---|---|---|---|
| Count | 10 | 37 | 88 |
| Mean | 55.64 | 50.25 | 47.95 |
| Median | 58.63 | 47.67 | 50.38 |
| Range | 88.27 | 100.00 | 100.00 |
| Minimum | 7.53 | 0.00 | 0.00 |
| Maximum | 95.80 | 100.00 | 100.00 |

Households using SNAP that have one or more persons over 60 are more likely to be living in LILA and LA food desert census tracts compared to non-food desert census tracts. Households using SNAP that have one or more person over 60 that are living in LILA census tracts make up a median percentage of about 30 percent. LA census tracts also have a median percentage of about 30 percent, and non-food desert census tracts have a median percentage of about 24 percent.

Figure 25 shows the distribution of households using SNAP that have one or more persons over 60 years-old.

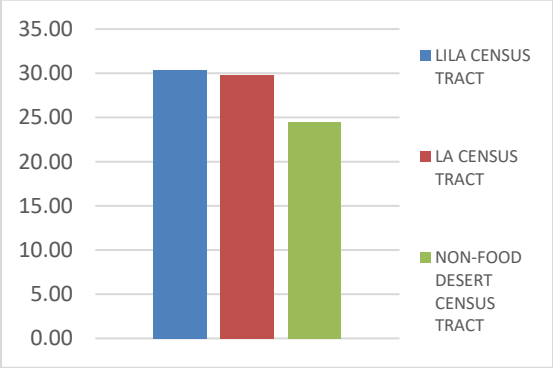


Figure 25. Median percentage of households using SNAP that have one or more persons over the age of 60. Data is separated by LILA, LA, and non-food desert census tracts.

Figure 26 shows the distribution of median percentages living in LILA, LA, and non-food desert census tracts in Ramsey County, by householder identified race. Results from the analysis showed that households using SNAP that have a householder who identified as white were more likely to be living in LA census tracts.

A household in which the householder identified as white has a median percentage of approximately 68 percent in LA food deserts, compared to 42 percent in LILA food deserts, and 46 percent in non-food desert census tracts.

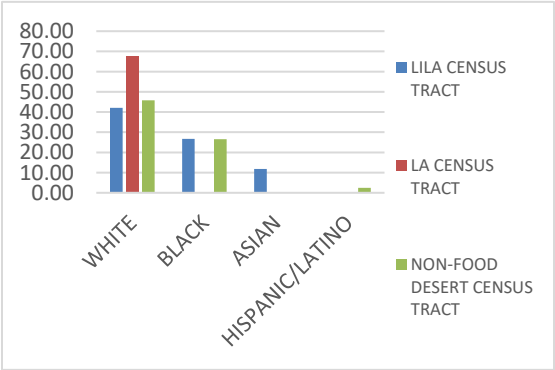


Figure 26. Median percentages of population using SNAP by race. Data is separated into LILA, LA, and non-food desert census tract.

Householders who identified as black in a household using SNAP were more likely to live in LILA census tracts or non-food desert census tracts. Median percentages were close to zero in LILA, LA, and non-food desert census tracts for householders who identified as Native Hawaiian/Pacific Islander, American Indian/Alaska Native, Other Race, or Two or More Races. Households in which householders identified as Hispanic/Latino were more likely to be living in non-food desert census tracts.

The concentration of householders using SNAP and identifying as Asian tends to be in St. Paul, specifically the northern portions of St. Paul. There is also a smaller concentration in the northwestern portion of Ramsey County, near New Brighton. Householders who identified as Asian were more likely to be living in LILA census tracts, with a median percentage of 11.77 percent, compared to a median percentage of zero for both LA census tracts and food desert census tracts. Figure 27 shows the distribution in Ramsey County of households using SNAP with a householder identifying as Asian.

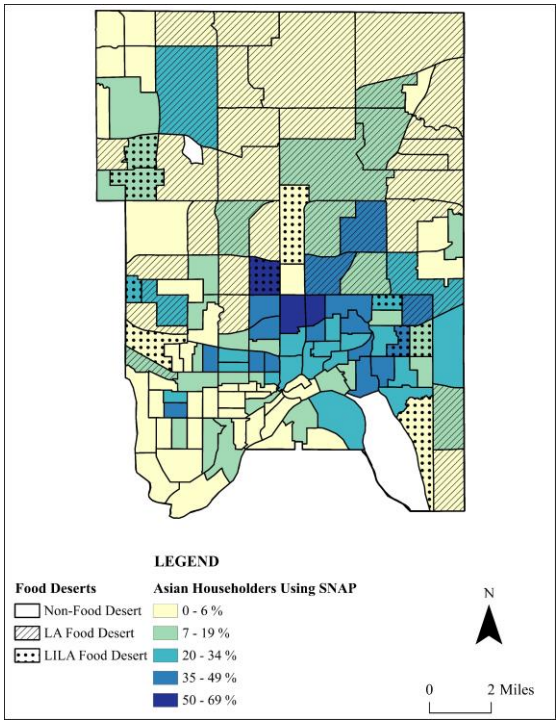


Figure 27. Distribution of households using SNAP that have a householder identifying as Asian. Broken up by LILA census tract, LA census tract, and non-food desert census tract.

## Vehicles

Figure 28 shows distribution in Ramsey County of those with no vehicles in the household. Results from the analysis showed that those living in LILA census tracts have an approximate five percent higher median percentage for households with one vehicle than non-food desert census tracts, and approximately 20 percent higher percentage than those living in LA census tracts.

Those with no vehicle have a 22 percent higher median percentage in non-food desert census tracts compared to LILA census tracts, and 58 percent higher than LA census tracts.

Households with two or more vehicles in non-food desert census tracts have an approximately 36 percent higher median percentage than those living in LILA census tracts, and approximately 29 percent higher than those living in LA census tracts.

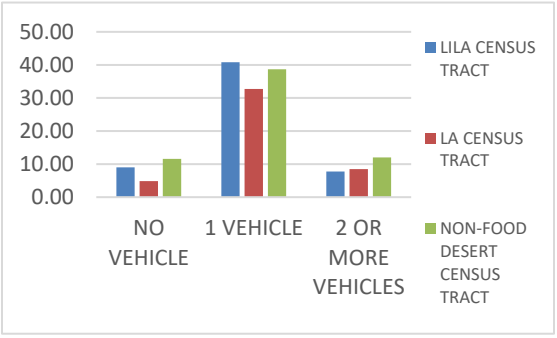


Figure 28. Vehicles per household in Ramsey County, divided by LILA census tracts, LA census tracts, and non-food desert census tracts.

Figure 29 outlines distribution in Ramsey County of those with no vehicles in the household. Areas with no vehicles tend to be concentrated in downtown areas, specifically in non-food desert census tracts.

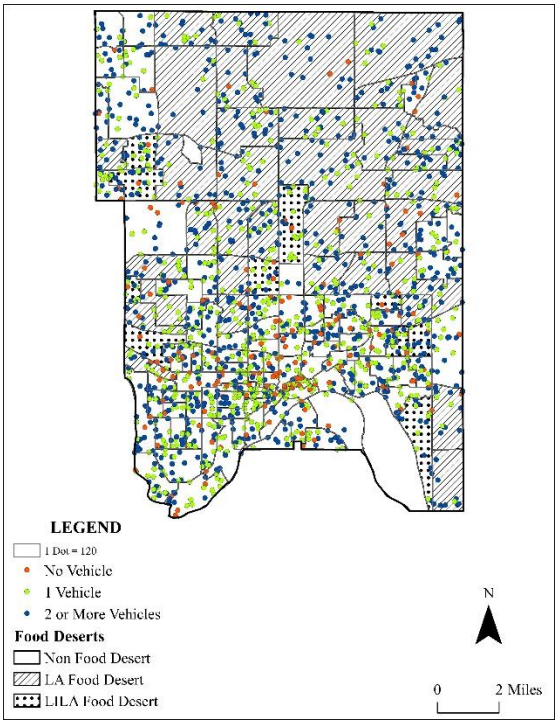


Figure 29. Dot density map showing households with no vehicle, one vehicle, and 2 or more vehicles in Ramsey County.

Central and southwestern portions of Ramsey County tend to have a higher

percentage of the population with one vehicle. There is also some density in downtown St. Paul. Many of the LILA census tracts see higher concentrations of one-vehicle households, especially in Roseville and Little Canada. Households with two or more vehicles have a heavy concentration in the northern portion of Ramsey County. These areas include New Brighton, Mounds View, North Oaks, White Bear Lake, and Vadnais Heights. These are areas that have higher likelihood of low-access census tracts than the rest of Ramsey County. There is also a portion of eastern St. Paul with a denser concentration of households with two or more vehicles in Ramsey County.

mRFEI

Results show 40 percent of the LILA census tracts have an mRFEI score of zero in Ramsey County. A score of zero indicates that no healthy food access is available in the census tract. The median mRFEI score in a LILA census tract is 7.5 which is 42 percent lower than an LA census tract and 25 percent lower than a non-food desert census tract.

Areas with lower mRFEI scores in Ramsey County include the northern portions of St. Paul, as well as census tracts in the New Brighton and Mounds View area. Areas seeing an mRFEI score of 11 to 38 tend to be in the southwestern portion of Ramsey County, as well as the southeastern and northeastern portions.

Lower scores of one to five, which could indicate a food swamp, are few. These areas include a small northern portion of St. Paul, one census tract in the southern portion of Ramsey County, and a census tract near the central-eastern portion of Ramsey County. Figure 30 shows the distribution of mRFEI scores in Ramsey County. The state average score and the national average mRFEI score is ten (CDC, 2011).

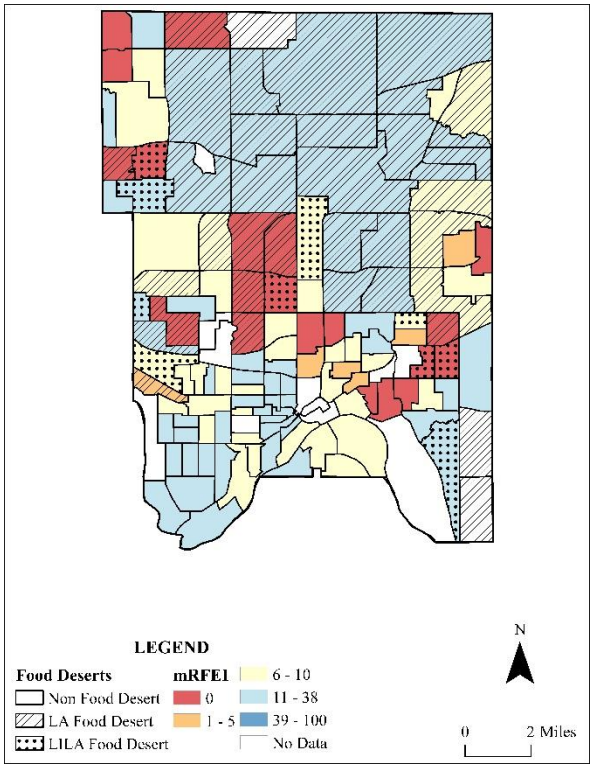


Figure 30. mRFEI scores in Ramsey County. Data includes LILA census tracts, LA census tracts, and non-food desert census tracts.

## Discussion

### *Age*

Results showed that children and young adults are likely to be affected more by both low-income and low-access in the census tracts they live in in Ramsey County. While elderly population percentages are not as high in low-income, low-access areas, the percentages are high in low-access areas.

### *Income, Poverty, and SNAP*

Results were consistent to low-income, low-access (LILA) census tracts having a low median income compared to other

areas in Ramsey County. Surprisingly, low-access (LA) census tracts had higher median incomes than non-food desert census tracts. Even though LA census tracts have lower access to healthy foods than non-food desert census tracts, the population living within LA census tracts may have the means to more easily find alternatives to access healthy foods.

Those who identify as black are more likely to live in LILA census tracts, and in those tracts, more likely to live below the poverty line and use SNAP. Those who identify as Asian, or who identify as two or more races are also more likely to live in LILA census tracts.

### *Race, Ethnicity, and the Problem with Grocery Stores and Supermarkets*

An important concept contributing to food deserts is the idea of "healthy food." Mui, Lee, Adam, Kharmats, Budd, Nau, and Gittelsohn (2015), define healthy food as including lower calorie beverages, healthier essentials, and healthier snacks, compared to foods higher in salt, fat and sugar.

The USDA only includes supermarkets or large grocery stores, therefore, leaving out gas stations, corner stores, and smaller grocers. This has long been debated since the beginning of the U.S. food desert problem, which has led to further examinations into smaller stores, in an attempt to determine if corner stores or small grocers could be potential healthy food providers. Larson, Mullaney, Mwangi, Xiong, and Ziegler (2017), state corner stores in Nicollet County were surveyed for healthy food, among other variables. Of the 24 stores that were audited, there was little evidence found that corner stores were providing access to enough healthy foods. Fresh produce was scarce in corner stores, and hot dogs were the most commonly found meat.

While leaving out corner stores is understandable, because not every corner store in the country can be audited for healthy foods, it can also lead to misleading information on food deserts. There are many alternatives to finding healthy food other than through large grocery stores and supermarkets. Most of these types of food access alternatives are an additional way to find affordable, healthy food, and many accept SNAP, which can be beneficial to low-income areas.

Urban corner stores and gas stations can often have a small selection of healthy foods. A simple search on the Ramsey County website shows there are many farmer's markets, urban farms, local meat markets and community gardens accessible in many areas of Ramsey County. Those who qualify can participate in free meal programs, such as Meals on Wheels, The Free Summer Meals Program, or food shelves.

Ethnic markets, which often have foods specific to different ethnicities, can be a preferred way to buy groceries. Ethnic markets are important spaces to immigrants and refugees who are often uncomfortable in large supermarkets, as foods are unfamiliar, and employees may not understand food practices or their language (Joassart-Marcelli *et al.*, 2017). Jossart-Marcelli *et al.* (2017) talk about smaller ethnic markets being effective in improving accessibility in a neighborhood where many rely on food assistance and walking to purchase food. Although this may be a sensible alternative, there is limited research on the role an ethnic market can play in a low-income neighborhood.

Ethnic markets are especially important when considering Ramsey County, as over 15 percent of the

population is born in a country than the United States.

## Conclusion

Results from this analysis lean toward low-income paired with low-access influencing communities compared to low-access alone.

Although older populations are living in low-access (LA) census tracts, these census tracts tend to have higher median incomes, less living below the poverty line, and more vehicles per household. LA census tracts also see lower levels of SNAP usage, less non-U.S. citizens, and less diversity. Therefore, low-income, low-access census tracts are struggling with higher poverty levels, less legal citizens, and lower incomes. Minorities are more likely to be affected by these issues in LILA census tracts because minorities are more likely to be living in these tracts.

While food desert research through the USDA is important, it cannot be treated as a conclusion for every community in the United States. By using large grocery stores as the only means to access healthy foods, it becomes too exclusive. There are too many alternatives and case-by-case situations to use the USDA data as the only right way to determine food deserts.

Low-access census tract in Ramsey County do not have the same characteristics as low-income, low-access census tracts. Low-income communities should remain the focus among food desert solutions in Ramsey County. Directing the attention to ways communities can provide healthy foods, such as reduction in prices, other alternatives to grocery stores, and ease of transportation should be kept in mind.

## Acknowledgements

I would like to acknowledge the Department of Resource Analysis staff of Saint Mary's University of Minnesota, especially Mr. John Ebert, who supported me through this project. Thank you to Greta Poser for the great insight throughout the process as well. I would also like to acknowledge Saint Mary's University of Minnesota for their use of facilities. Lastly, I would like to acknowledge family and friends for their support through my degree.

## References

ACCG. 2015. Advancing Georgia's Counties. Retrieved from http://www.accg.org/library/2015_11_23_Census%20Data%20Article%20III.pdf.

Bader, M.D.M., Purciel, M., Yousefzadeh, P. and Neckerman, K.M. 2010. Disparities in Neighborhood Food Environments: Implications of Measurement Strategies. *Economic Geography, 86*(4), 409-430. Retrieved August 3, 2019 from EBSCO MegaFILE.

Bower, M.B., Thorpe Jr., R.J., Rohde, C., and Gaskin, D.J. 2014. The intersection of neighborhood racial segregation, poverty and urbancity and its impact on food store availability in the United States. *Preventative Medicine, 58*, 33-39. Retrieved January 27, 2019 from ScienceDirect database.

Center for Disease Control and Prevention (CDC). 2011. Census Tract Level State Maps of the Modified Retail Food Environment Index (mRFEI). *National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition, Physical Activity, and Obesity*. Retrieved July 1, 2019.

Coleman-Jensen, A., Rabbitt, M.P., Gregory, C.A., and Singh, A. 2018. Household Food Security in the United States in 2017. *United States Department of Agriculture Economic Research Service, Report Number 256*. Retrieved July 25, 2019 from https://www.ers.usda.gov/webdocs/publications/90023/err-256.pdf?v=0.

Cummins, S., and MacIntyre, S. 1999. The Location of Food Stores in Urban Areas: A Case Study in Glasgow. *British Food Journal, 101(7),* 545. Retrieved May 27, 2019 from Complementary Index database.

Dutko, P., Ver Ploeg, M., and Farrigan, T. 2012. Characteristics and Influential Factors of Food Deserts. *United States Department of Agriculture Economic Research Service, Report Number 140, 36.* Retrieved January 24, 2019 from Google Scholar database.

Fitzpatrick, K., Greenhalgh-Stanley, N., and Ver Ploeg, M. 2016. The Impact of Food Deserts on Food Insufficiency and SNAP Participation Among the Elderly. *American Journal of Agricultural Economics, 98(1), 19-40.* Retrieved February 17, 2019 from Business Source Premier database.

Gallagher, M. 2011. USDA Defines Food Deserts. *Nutrition Digest, Published by the American Nutrition Association 8(2).* Retrieved January 24, 2019 from http://americannutritionassociation.org/newsletter/usda-defines-food-deserts.

Gundersen, C., Kreider, B., and Pepper, J. 2011. The economics of food insecurity in the United States. *Applied Economic Perspectives and Policy, 33(3),* 281-303. Retrieved February 11, 2019 from EBSCO MegaFILE database.

Jang, S., and Kim, J. 2018. Remedying food policy invisibility with spatial intersectionality: A case study in the Detroit metropolitan area. *Journal of Public Policy and Marketing, 37(1),* 167-187. Retrieved February 17, 2019 from EBSCO MegaFILE database.

Joassart-Marcelli, P., Rossiter, J.S., and Bosco, F.J. 2017. Ethnic markets and community food security in an urban "food desert." *Environment and Planning, 49(7),* 1642-1663. Retrieved February 17, 2019 from SAGE database.

Kiersz, A. 2015. Here's the difference between averages and median. Retrieved from https://www.businessinsider.com/means-vs-medians-2015-10.

Morrissey, T.W., Oellerich, D., Meade, E., Simms, J., and Stock, A. 2016. Neighborhood poverty and children's food insecurity. *Children & Youth Services Review, 66,* 85-93. Retrieved January 24, 2019 from ScienceDirect database.

Mui, Y., Lee, B.Y., Adam, A., Kharmats, A.Y., Budd, N., Nau, C., and Gittelsohn, J. 2015. Healthy versus Unhealthy Suppliers in Food Desert Neighborhoods: A Network Analysis of Corner Stores' Food Supplier Networks. *International Journal of Environmental Research and Public Health*, (12), 15058. Retrieved July 31, 2019 from Directory of Open Access Journals.

Orfield, M., Stancil, W., Luce, T., and Myott, E. 2015. Why Are the Twin Cities So Segregated? *Institute on Metropolitan Opportunity, University of Minnesota Law School*. Retrieved July 25, 2019.

Rausch, E.J., and Mattessich, P.W. 2016. Healthy Food Access: A View of the Landscape in Minnesota and Lessons Learned from Healthy Food Financing Initiatives. *Federal Reserve Bank of Minneapolis and Wilder Research*. Retrieved May 27, 2019 from https://www.wilder.org/sites/default/files/imports/Healthy%20Food%20Access%

20Study_Final%20Report_April%202016.pdf.
Thibodeaux, J. 2016. City racial composition as a predictor of African American food deserts. *Urban Studies (Sage Publications, Ltd), 53(11),* 2238-2252. Retrieved February 17, 2019 from EBSCO MegaFILE database.
U.S. Census Bureau QuickFacts: United States. 2017. Retrieved from https://www.census.gov/quickfacts/fact/table/US/PST045218#.
USDA ERS – Download the Data. 2019. Retrieved from https://www.ers.usda.gov/data-products/food-access-research-atlas/download-the-data\.
Ver Ploeg, M., and Rhone, A. 2017. Food Access Research Atlas Documentation. *United States Department of Agriculture Economic Research Service*. Retrieved July 7, 2019 from www.er.usda.gov.
Wright, J., Donley, A., Gualtieri, M., and Strickhouser, S. 2016. Food deserts: what is the problem? What is the solution? *Society, 53(2),* 171-181. Retrieved January 24, 2019 from Points of View Reference Center database.