Combating Food Insecurity in the U.S.:

A County-Level Analysis and Recommendations

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Introduction

Food insecurity is a severe problem in the United States that affects nearly 30 million adults and 12 million children (US Department of Agriculture). According to the Food and Agriculture Organization of the United Nation, food insecurity is defined by "lacking regular access to enough safe and nutritious food for normal growth and development and an active and healthy life". In textbooks, food insecurity often links to food desert and food mirage, where food deserts are areas where people have limited access to food, and food mirage refers to lack of affordable food (Haskell, 2021). Since the U.S. Department of Agriculture defines food deserts as people living 1 mile away from supermarkets in urban areas and 10 miles away in rural areas, distance is one important factor that needs to be considered when discussing food insecurity. Food mirage, on the other hand, brings our attention to how income and poverty rate relate to food insecurity. Combining these considerations, this research analyzes the effects of relevant factors – including family income, access to food, access to vehicle, age, ethnicity, etc. - to food insecurity in the United States at county-level and provides corresponding recommendations that may help to mitigate the issue.

Methods

Datasets and Variables

In this research, the Food Insecurity Index is an external measure obtained from County Health Rankings & Roadmaps, whose dataset addresses factors including constant food supply, ability of individuals and families to provide balanced meals (fruits and vegetables), and barriers to healthy eating. In addition, the food accessibility data, as provided by the USDA Economic

Research Service's Food Access Research Atlas Dataset, relate to factors including demographics, neighborhood, incomes, vehicle access, and the SNAP program.

Data Analysis

R and RStudio are utilized in data analysis.

Food Insecurity Profile

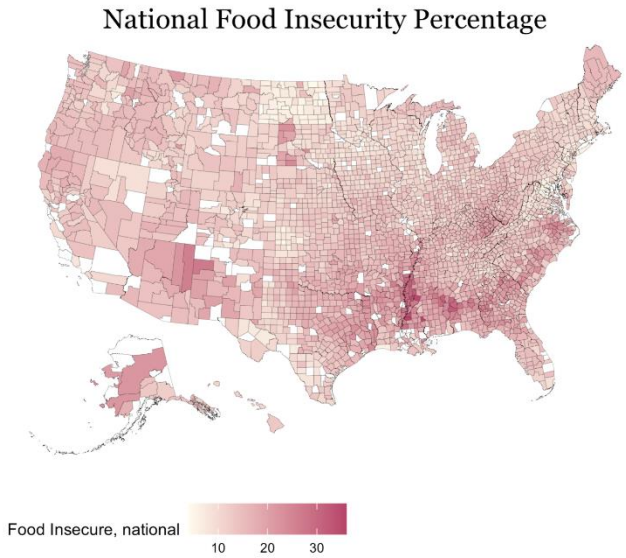

Figure 1. National Food Insecurity Percentage Map.

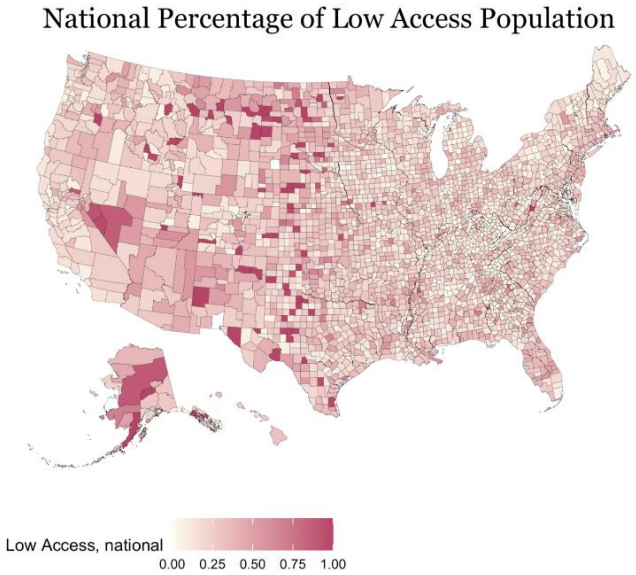

Figure 2. National Low Access Population Percentage Map.

These two maps visualize the situation of food insecurity across the country. The first heat map reflects the food insecure index at different regions across the country. A darker color (higher value of index) indicates the severer food insecure problem at the region. The second heat map depicts the percentage of people who have low access to food among the population at different regions. The result reveals that food insecure is a nationwide problem in the U.S. It can be observed that low food access coincides higher food insecure index mostly. Noteworthily, some regions at southeastern and western coast are evaluated with high food insecure index even though they have relatively low percentage of low food access population. This inconsistency may suggest that low food access is not the only, or dominant, factor that causes food insecure.

How Many People are Food Insecure?

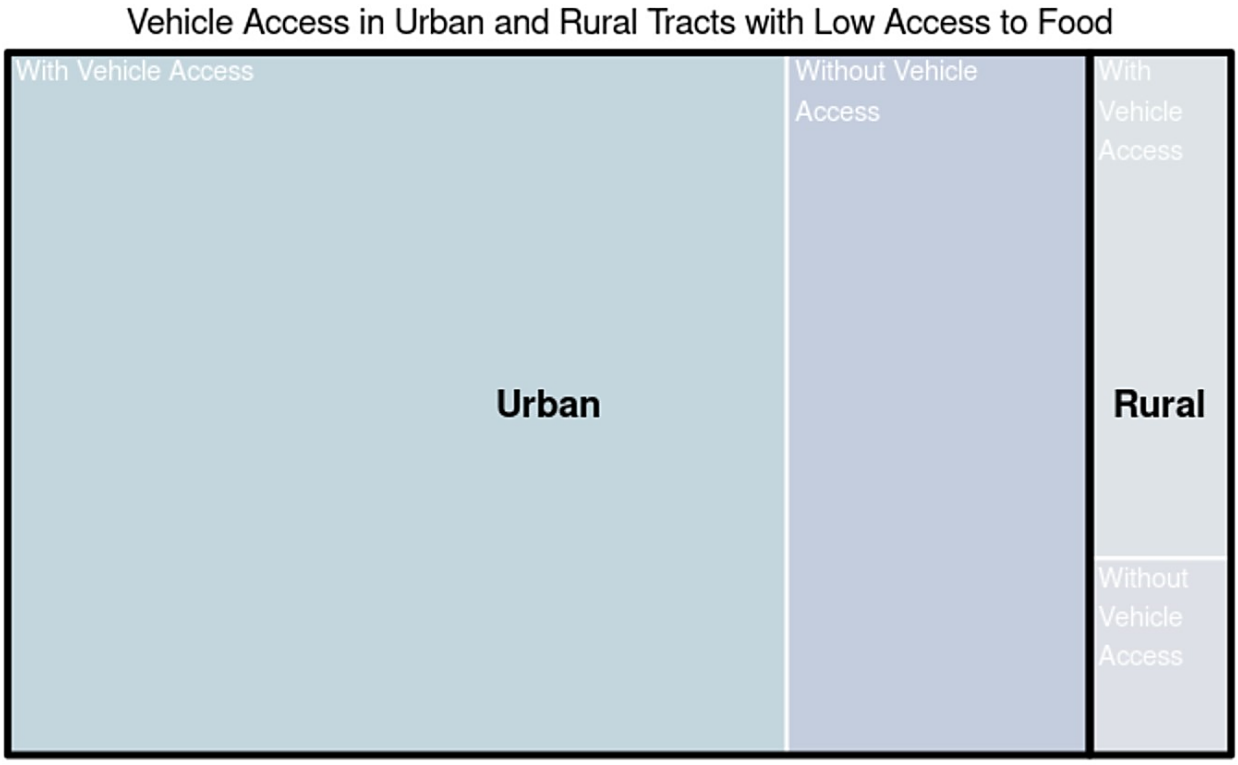

Figure 3. Treemap of Tracts with Low Access to Food.

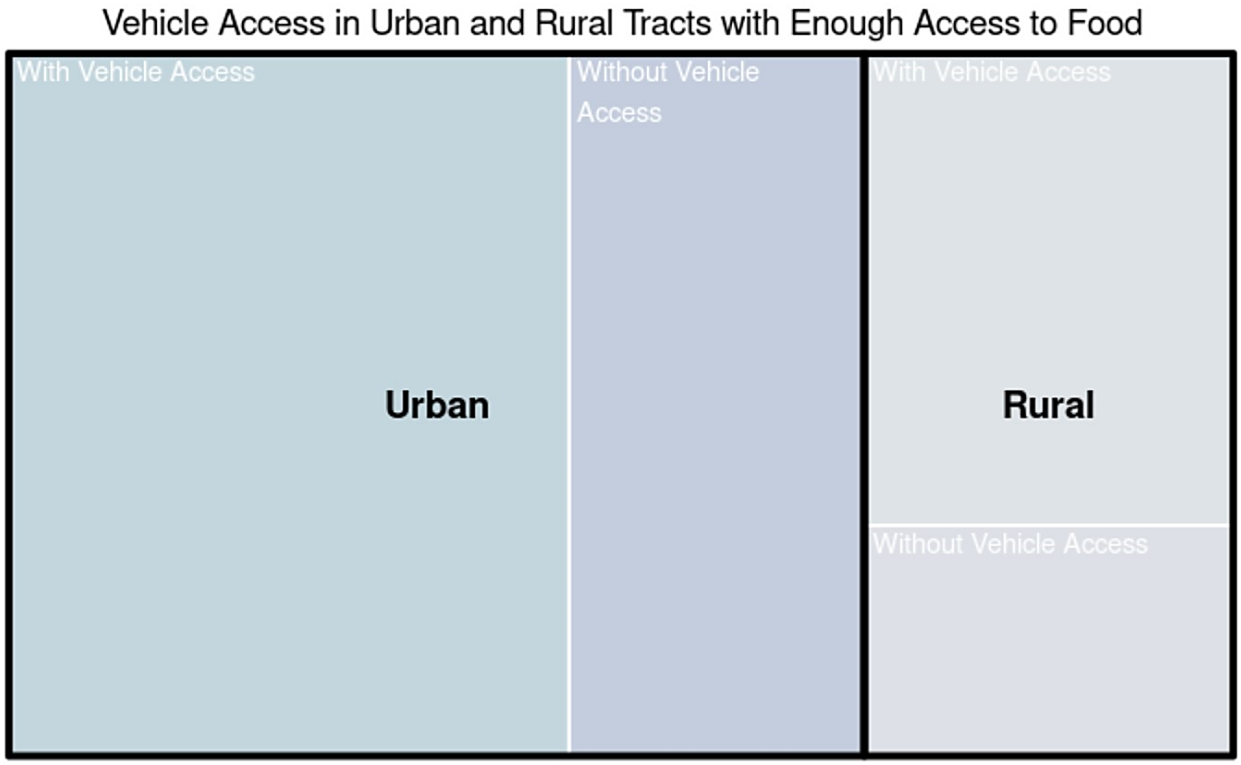

Figure 4. Treemap of Tracts with Enough Access to Food.

To investigate the problem of food insecurity, the first question to answer is: how many people does food insecurity influence? In terms of individuals, about 10.2% U.S. citizens are food insecure (US Department of Agriculture). In terms of districts, nearly 38% census tracts (i.e., 22.2% individuals) in the United States have low access to food. Among these tracts with low access to food, 88% of them are urban areas, as shown in the Figure 3. Even more, when compared with tracts with enough access to food, as shown in the Figure 4., the food insecurity problem of urban areas seems to be much severer. The long distance and low access to supermarkets make it more difficult and inconvenient for people (especially those without car access) to acquire healthy food and fresh vegetables, thus aggravating the problem of food insecurity.

Not Only Food, but Healthy Food

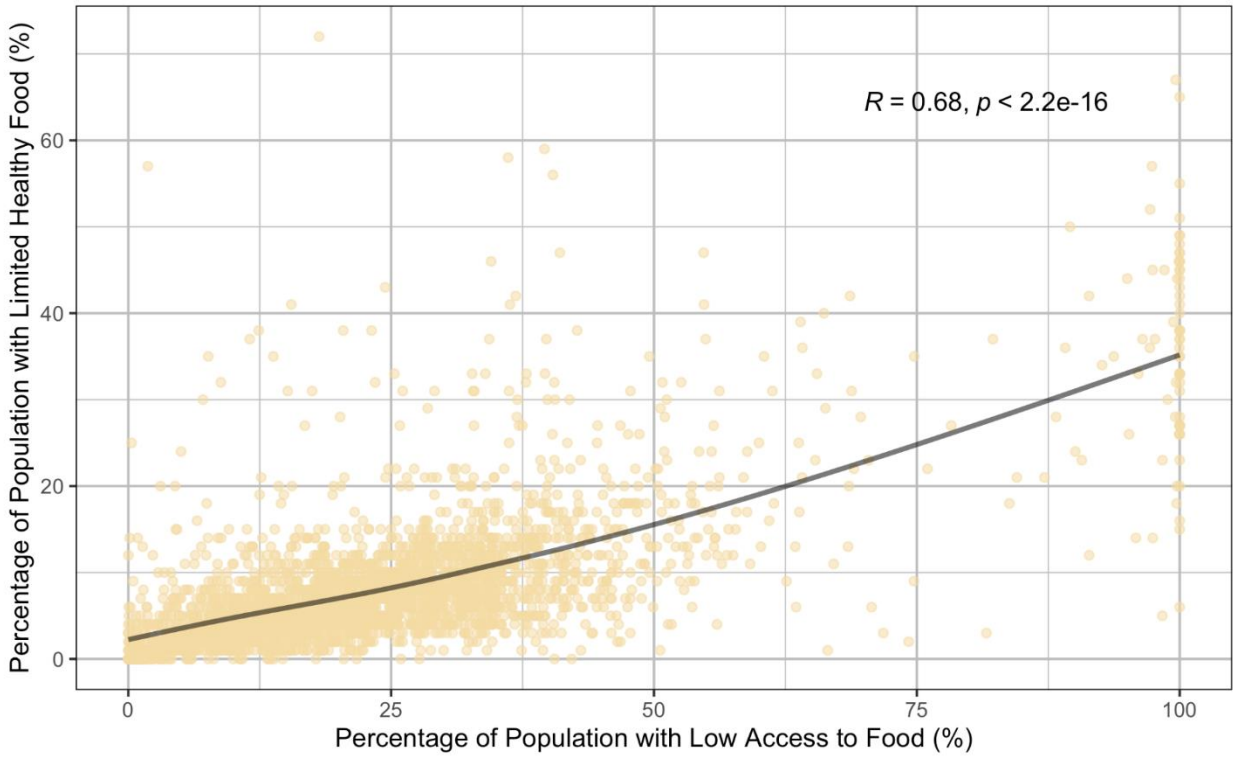

Figure 5. Relationship between Low Access to Food and Limited Healthy Food.

To justify the relationship between food access and food insecurity, we created a scatterplot that relates the food access to healthy food access. As shown in Figure 5., there is a strong positive correlation (R = 0.68) between the percentage of population with low access to food and the percentage of population with limited healthy food. Given that low access is defined as the elongated distance between supermarkets (or grocery stores) and households, this relationship seems to be reasonable. That is, healthier food options (e.g., low use of processed foods, low sugar groceries/drinks, fresh fruits, and vegetables) are generally restricted or even nonexistent due to the absence of grocery stores/ supermarkets/farmers markets within a convenient travel distance to vulnerable communities (Haskell, 2021). Therefore, the low access to food will without doubt make the food insecurity problem severer.

Relationship between ethnicity and food insecurity

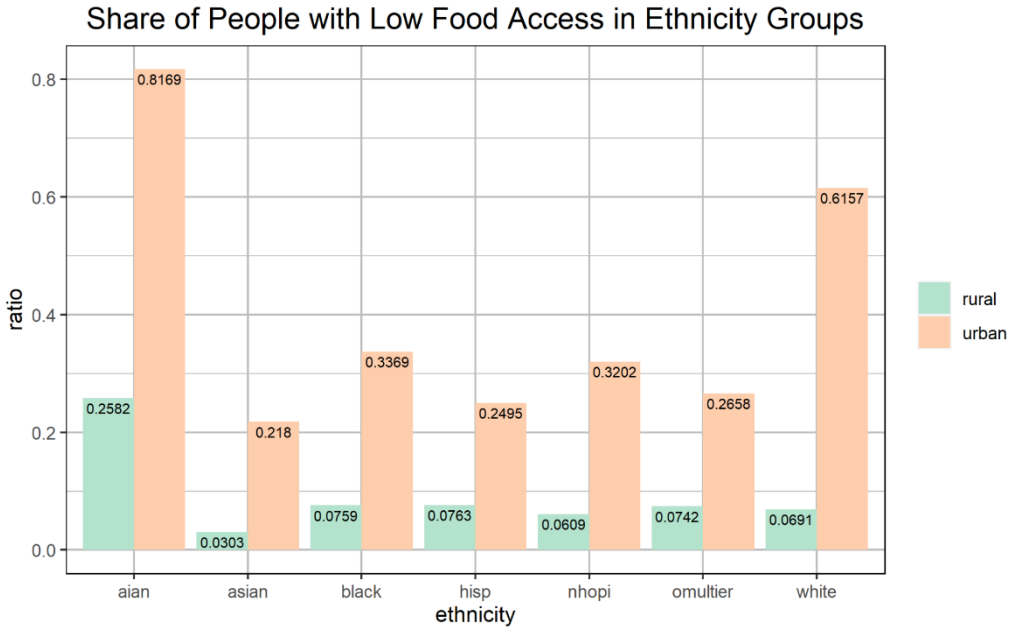

Figure 6. Proportion of Population with Low Food Access across Ethnicity Groups.

Ethnicity indeed affects food insecurity, as shown in Figure 6. Firstly, it is presented that the problem of low food access does not distribute equally across ethnicity groups. Throughout all ethnicity groups, people living in urban areas are significantly more likely to face the problem of low access to healthy food (i.e., food desert), which corresponds to the overall trend that cities witness a higher proportion of their population suffering from low food access. It is worthy to notice that white people and American Indian / native Alaska people who live in rural areas have

extremely high ratios of people living in food deserts.

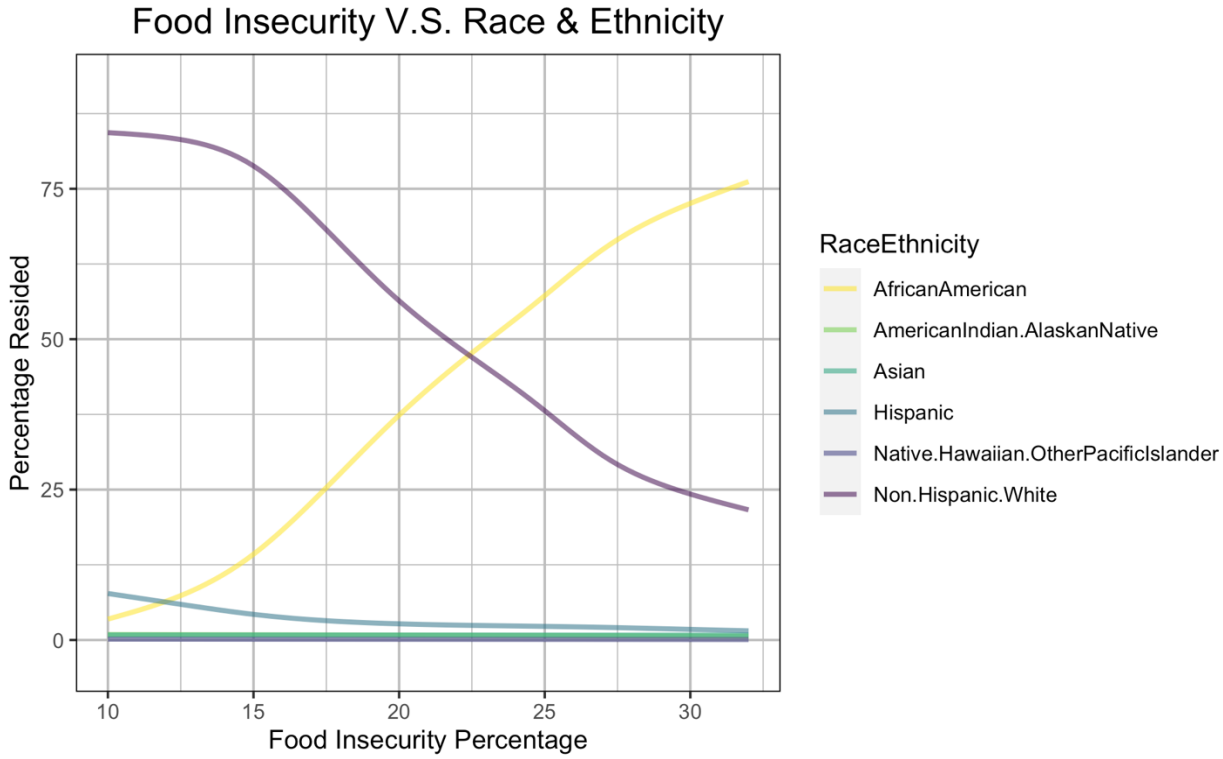

Figure 7. Relationship between Food Insecurity and Ethnicity Group.

Furthermore, trendlines in Figure 7. show the relationship between the food insecurity index of a country and percentage of different ethnic group living in that country. As a county's food insecurity index increases, the percentage of African American population residing in the county increases dramatically, and the percentage of non-Hispanic white population largely decreases. The percentage of Hispanic population decreases a little as the food insecurity percentage increases, and the percentage of Asian, American Indian/Alaskan native, Native Hawaiian/Other Pacific Islander remains approximately constant. Non-Hispanic White occupies most areas that do not have severe food insecurity problems, whereas many African American communities are in areas that have serious food insecurity problems.

Age influences food insecurity severity

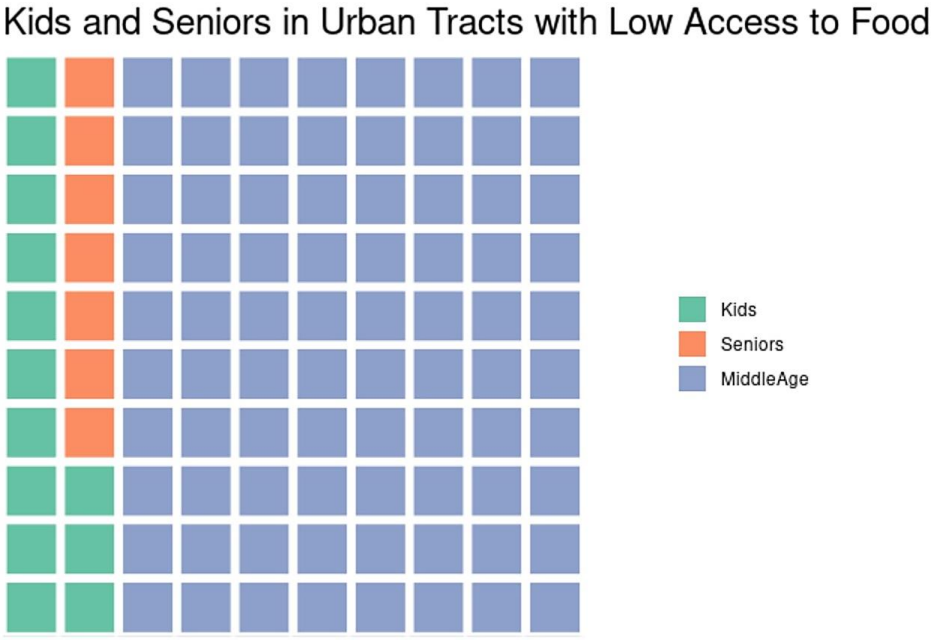

Figure 8. Distribution of Age Groups among Urban Population with Low Food Access.

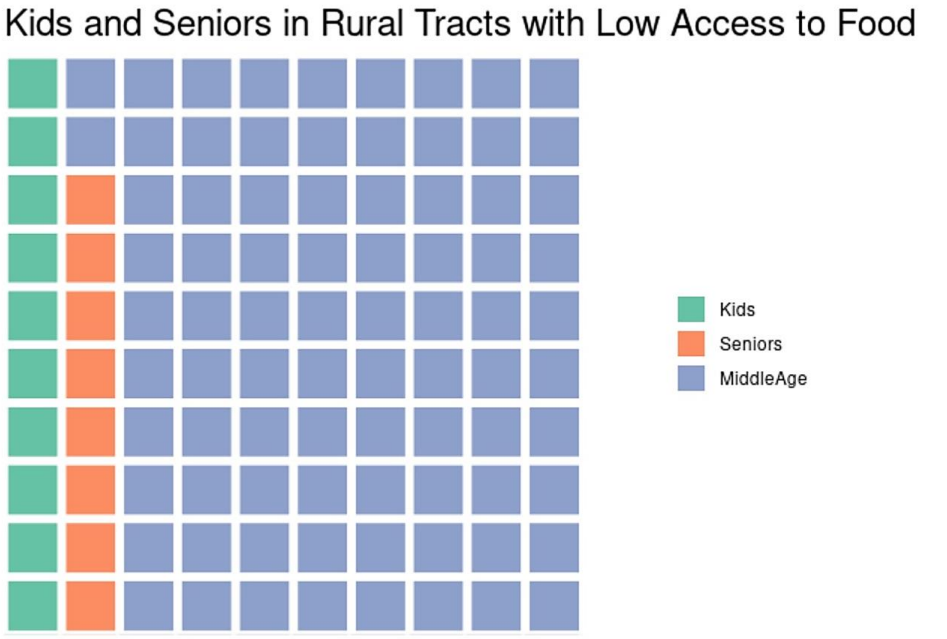

Figure 9. Distribution of Age Groups among Urban Population with Low Food Access.

In urban and rural areas, kids and seniors suffer from food insecurity to different extents. In urban tracts, the population with low access to food consists of 13% kids and 7% seniors. On the other hand, in rural tracts, the population with low access to food consists of 10% kids and 8% seniors. By comparison, kids are more likely to be influenced by inadequate food access in

urban areas, and seniors are more likely to be influenced by inadequate food access in rural areas.

General Correlation between Variables

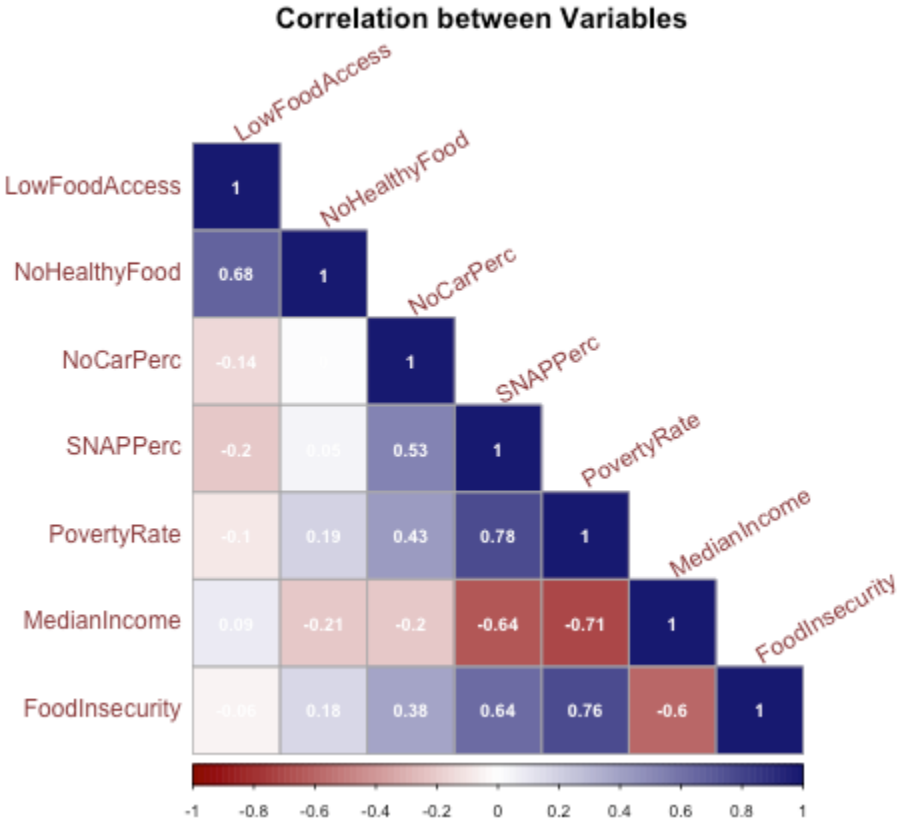

Figure 10. Strength of Correlation between Relevant Factors.

The correlation plot shown above demonstrates the correlation between important variables (e.g., the Food Insecurity Index, Poverty Rate, Percentage of Population with Low Access to Food, etc.). The deeper the color, the stronger the correlation. Red color represents a negative correlation while blue color represents a positive correlation. As shown in the graph, there are several strong and noticeable correlations. First, along with the increase of poverty rate, the tracts are more food insecure. Second, when the poverty rate increases, the percentage of the population receiving SNAP also increase. Based on these correlations, several significant relationships are selected and further explored in the following sections.

Vehicle Access or Money: Which is Playing a More Important Role?

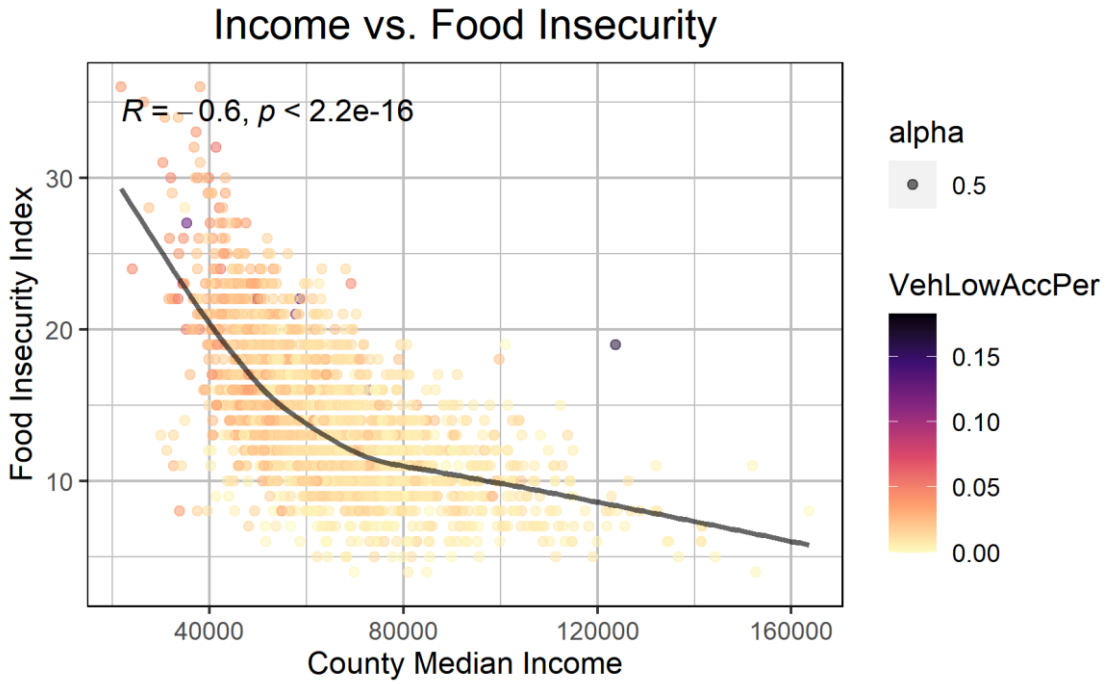

Figure 11. Relationship between County Median Income and Food Insecurity Index.

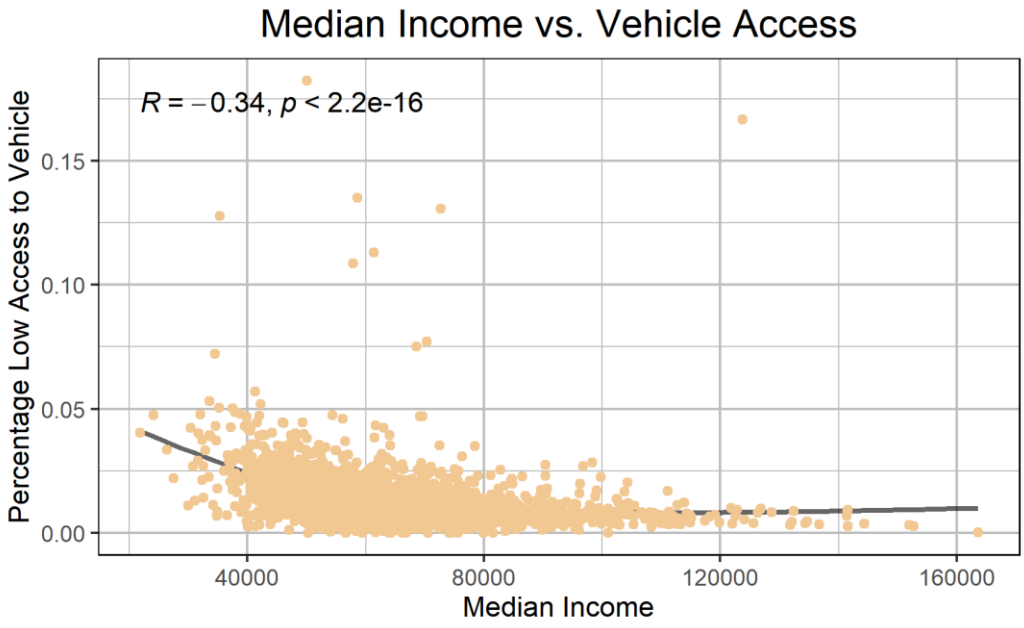

Figure 12. Relationship between Median Income and Low Access to Vehicle.

We have observed a relatively strong negative relationship between the median income of a county and the food insecurity index of that county (R = -0.6), as shown in Figure 11. Another

observation in Figure 11. is that the dots on the left have only slightly deeper color than the dots on the right, which suggests that counties across different median incomes have a similar percentage of people with low access to vehicles (R = -0.34). This demonstrates that income is the more important factor as it has a direct, negative association with food insecurity. Vehicle access across counties with different median income are all considered fairly good (only 15 counties have more than 5 percent of people have low access to vehicles), as shown in Figure 12.

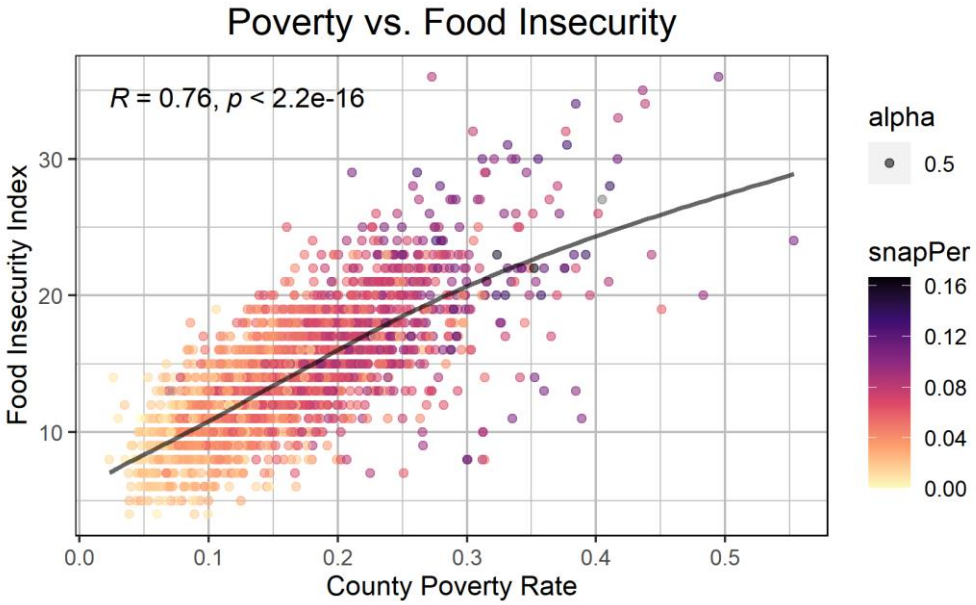

Figure 13. Relationship between County Poverty Rate and Food Insecurity.

The previous analysis demonstrates that almost all counties have good vehicle access, but counties with higher food insecurity have much larger poverty rate (R = 0.76) than counties with lower food insecurity. Therefore, poverty is more associated with food insecurity than vehicle access. Combined with the previous result that counties of higher median incomes tend to have less people face the problem of food insecurity, we believe income plays a more important role in food insecurity.

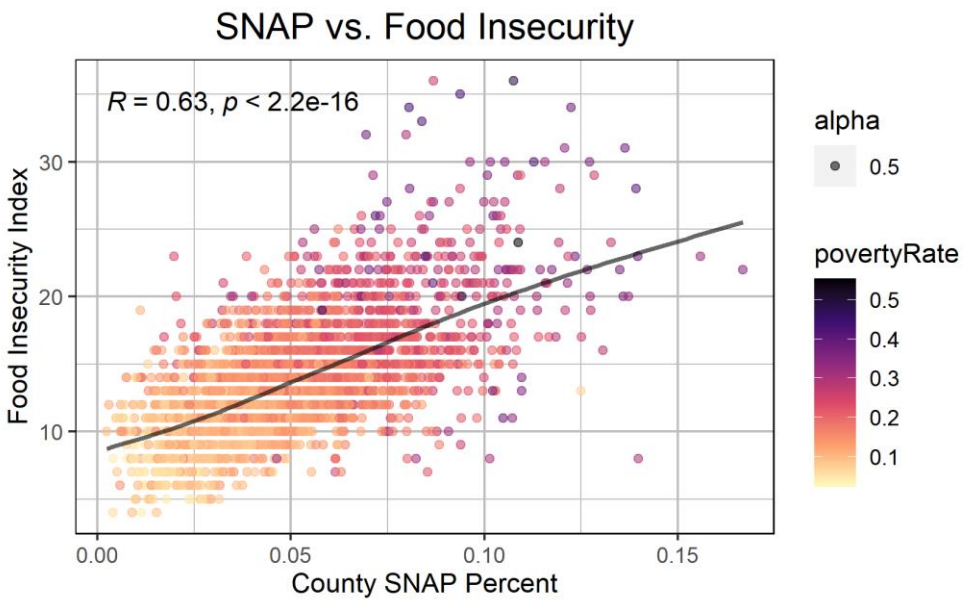

Figure 14. Relationship between Percentage Population Receiving SNAP and Food Insecurity.

The United States currently runs the SNAP program that aims to provide nutrition benefits to the food budget needy family. We have observed a very strong, positive association between the percentage population of a county receiving SNAP and the food insecurity index of that county. This strong correlation shows that the households that receive food budget benefits are also very likely to be the families that are facing food insecurity problems. The good news is that SNAP may kill two birds with one stone (i.e., solving poverty and food insecurity at the same time), but the bad news is that SNAP alone is clearly not enough to solve the problem of food insecurity. To be more specific, those counties with a high percentage of people receiving SNAP are also the ones that have the most severe food insecurity issues, and the SNAP itself may not be sufficient to support a family's consumption on food when the family's incomes are spent on other things.

No matter what, SNAP is still the right direction to go as it tries to solve food insecurity from the perspective of money. However, it is just not enough. On average, the amount the SNAP that a family receives is about $240 per month in the fiscal year of 2019 and 2020. In

other words, this amount of money only means $121 per person per month and $1.4 per person per meal.

$1.4 per meal does not give people enough incentive to shop in proper supermarkets that are farther away than convenient places such as gas stations that provide unhealthy choices. It also does not enable anyone who can only afford junk food to buy a healthy meal.

Rural Population vs. Percentage Population with Low Access to Food

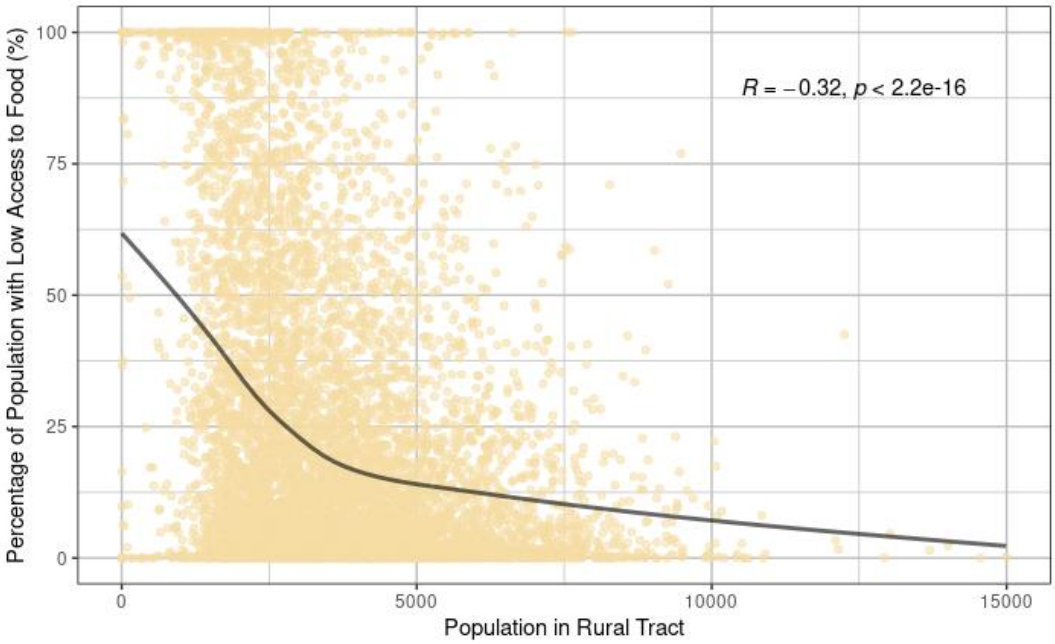

Figure 15. Relationship between Rural Tract Population and Low Access to Food.

As presented in the graph, for rural tracts, when the number of populations in the tract becomes smaller and smaller, the percentage of population with low access to food in that tract will correspondingly become larger. This negative correlation shows that when the population size decreases, there will be less supermarkets and healthy food resources available to the community (i.e., less supermarkets are open to small communities). This relationship seems to be reasonable since the primary aim to open a supermarket is to maximize the profit, while the smaller population size can only buy a limited amount of commodities, which makes companies less willing to invest in less-populated areas. To solve this issue, the government may need to

reduce tax rates or offer subsidies to supermarkets so that they can continue to make profits and are willing to manage the businesses in small communities.

Results and Recommendations

According to the profile, we suggest that several regulatory changes of governments such as food pricing, taxation, and business incentives are needed to fight the problem of food insecurity and to sustain the healthy life of U.S. citizens:

(1) Lower food pricing of supermarkets in poverty areas by reducing taxation.

(2) Run pop-up food banks or other forms of food transportation to rural communities.

(3) Increase the SNAP benefits as the receivers are also very likely to face the problem of food insecurity.

(4) Start a program that gives grocery store food benefits, which provides incentive for people to go to the grocery store and give them more available money on food.

(5) Offer subsidies to supermarkets to be open at less-populated areas.

(6) All suggested changes should be especially accommodated to the people of white and Native American ethnicity; further attention should be given to the seniors and children among these groups; it is suggested to carry out research on the reasons that cause these specific groups to be food insecure to better help these people in need.

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