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# **Food Insecurity and Healthy Food Availability in the State of Ohio**

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Scholarship in Medicine Final Report

**By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission**

## **Abstract**

*Objective:* This research study aims to determine the impact of food insecurity and healthy food availability in the state of Ohio. It investigates how food insecurity in Ohio has changed between 2016 and 2020. It also investigates how food insecurity correlates with education level by looking at high school graduation rates. It also investigates how Ohio, a state with a high level of food insecurity, compares to California which has low levels of food insecurity. This study also compares how food insecurity differs in rural and urban counties throughout the state of Ohio.

*Methods:* ANOVA with posthoc will be conducted to show how food insecurity rates changed in Ohio between 2016 and 2020. Unpaired t-tests will be used to compare the levels of food insecurity in rural and urban counties in Ohio. They will also be used to compare food insecurity and healthy food availability in Ohio and California. A Pearson correlation will be conducted to

determine if a correlation exists between food insecurity and high school graduation rates in the state of Ohio. A stepwise linear regression will be used to determine how previous food insecurity rates can predict variance in food insecurity rates in Ohio.

*Results:* ANOVA with posthoc demonstrated multiple significant differences in food insecurity rates between 2016-2020. A Pearson correlation demonstrated a negative correlation of -0.659 with a p value < .001 between high school graduation rates and food insecurity rates in 2020. An unpaired t-test demonstrated a significant difference between food insecurity and healthy food availability between Ohio and California in the year 2020 with a p value < .001. Another unpaired t-test showed no statistical difference between food insecurity rates in rural vs. urban Ohio counties in 2020. A linear regression demonstrated that 97.8% and 97.7% of the variance in Ohio food insecurity rates in 2020 can be accounted for by 2016 and 2019 food insecurity rates.

Key Words: Food Insecurity, Healthy Food Availability, Upstream Factors, Education Levels, High School Graduation Rate, Ohio, California , Urban, Rural

## **Introduction/Literature Review**

Food security is defined as the inability to afford nutritionally adequate and safe foods.<sup>1</sup> 11.3 percent or 14.3 million U.S households reports food insecurity during the year 2018 according to USDA statistics.<sup>2</sup> While this trend declined from the year 2017, that still leaves many households with some food insecurity. These household are often headed by single parents, include children, and are low income. This data also demonstrated that Ohio had a higher than average level of food insecurity compared to other U.S. states in 2018.<sup>2</sup> Food insecurity has been

shown to be associated with chronic diseases including hypertension and diabetes in the nonelderly population. It is also associated with inadequate glycemic control in those that are already diabetic.<sup>1</sup>

While some people may not be food insecure, the food available to be purchased may not be healthy. Healthy food availability is also a very important factor that can determine dietary habits and health outcomes. This is the concept of food deserts, or areas that lack access to food sources that are healthy.<sup>3</sup> Healthy food availability varies by location and the makeup of the population living in them. Many studies have shown that food stores often vary by socioeconomic status and that small urban stores often make up important food sources for low socioeconomic families.<sup>4</sup> This is especially true for minorities as one study demonstrated more convenience stores in neighborhoods with high a high percentage of Hispanic and African American residents.<sup>5</sup> These stores greatly differ in quantity and quality of healthy food available. In one study encompassing four large urban cities, only 50% of all stores had one or more fresh fruits or vegetables available.<sup>6</sup>

Ohio has much less research in the realm of food insecurity and healthy food availability. I only found one study based in Ohio comparing two USDA-designated food deserts in two neighborhoods in Ohio for healthy food availability in different sized stores. It demonstrated that many of the healthy options in stores were limited canned vegetables, 100% juice and diet soda.<sup>7</sup> It also demonstrated that stores that were larger were more likely to carry other healthy items. However, only one-third sold fresh vegetables, lean meat, or low-fat baked goods.<sup>7</sup> This singular study reveals a large gap in the literature concerning healthy food availability and food insecurity in the state of Ohio. Research in this realm is vital for the overall health of Ohio as these factors are related to increased healthcare costs and increased incidence of chronic illnesses.

It is important to look at Ohio and analyze how food insecurity and food availability are impacting the health of the population. Studying these factors and seeing what is affecting the health of Ohio residents is an important step in identifying areas that need improvement. It is also important to see how they compare to education levels in Ohio. Education can often be a big determinant of health as it leads to higher paying jobs, increased income, and higher rates of insurance coverage. These are all benefits that can affect the health of an individual and impact their dietary intake. It is also important to compare Ohio to other states. While the midwestern states tend to have food insecurity rates that are higher than the national average, states like California have much lower rates.<sup>2</sup> It would be beneficial to compare the rates of food insecurity and healthy food availability in Ohio against those found in California. While Ohio is much smaller in land mass, both states rank in the top 10 of the nation for largest populations.<sup>8</sup> By looking into all this information, it will allow us to find areas that need improvement in the realms of food insecurity and healthy food availability. Both factors lead to chronic illnesses, increased healthcare costs, and decrease the overall health of a population. By improving these factors, Ohio can lower rates of chronic illness, spend less on healthcare, and improve the overall health of the state.

### **Research Questions**

**RQ1:** Was there a significant change in food insecurity in the state of Ohio between 2016-2020?

**RQ2:** Is there a correlation between food insecurity in the state of Ohio compared to high school graduation rates in the year 2020?

**RQ3:** Is there a statistically significant difference in food insecurity and healthy food availability between Ohio and California in 2020?

**RQ4:** Is there a statistically significant difference in food insecurity between urban and rural counties in Ohio in the year 2020?

**RQ5:** How can previous food insecurity rates account for variance in the current year in Ohio?

## **Methods**

### *Context/Protocol*

I used data collected by the website [www.countyhealthrankings.org](http://www.countyhealthrankings.org). This data is for the state of Ohio and the state of California. I used four different variables. These included the percent of people with food insecurity, the percent of limited access to healthy foods, and high school graduation rates.

The percentage of people with food insecurity was obtained through statistical modeling. The model used information from a variety of sources including the Bureau of Labor statistics, the American Community survey, and the Community Population Survey. The numerator was the number of people who did not have adequate access to food in the past year and the denominator was the total county population.

The percent of the population who had limited access to healthy food was calculated by taking the number of low-income people in the population that do not live close to a grocery store and dividing it by the 2010 US census population. A distance of ten miles in rural areas

and one mile in non-rural areas was used to determine the population that lived too far from a grocery store. Low income was defined as two hundred percent of the federal poverty threshold or less for a particular family size.

The percentage of high school graduation was defined as the percentage of 9<sup>th</sup> graders who complete high school in four years. National and state-specific graduation data was used to obtain this percentage. It was calculated by taking number of 9<sup>th</sup> graders who graduated in 4 years and dividing that by the total number of 9<sup>th</sup> graders during those 4 years. Transfers in and out were accounted for. Deaths were also accounted for and were included in the denominator. Data from 2014-2018 was used for this calculation.

### *Data Collection*

I used data from Ohio from the years 2016, 2017, 2018, 2019, and 2020. This included data from all 88 counties in Ohio. I also used data from California from the year 2020 that included data from 58 counties. Each county was a data point for each variable. I used four different variables. These included the percent of people with food insecurity, the percent of limited access to healthy foods, and high school graduation rates.

I used the variables to compare the changes in food insecurity in Ohio between 2016 and 2020. I also compared education levels to levels of food insecurity in Ohio in the year 2020. Food insecurity and healthy food availability in Ohio was compared to the levels in the state of California in 2020. I also compared food insecurity in different sized counties in the year 2020. Counties were defined as urban if they contained more than 50,000 people and rural if they contained less than 50,000 people according to the United States Census Bureau.<sup>9</sup>

Data that was missing from each of these variables was excluded.

*Data Analysis:*

For RQ1, I used an ANOVA with posthoc to compare food insecurity in the state of Ohio for the years 2016, 2017, 2018, 2019, and 2020. I also compared each year to each other. For RQ2, I used a Pearson correlation to determine if there was a correlation between food insecurity and education levels in Ohio. I used the percentage of food insecurity and the high school graduate rates in Ohio from 2020. This was used to determine if food insecurity levels are at all related to high school graduation rates or if they do not play a role. For RQ3, I used an unpaired t-test to compare food insecurity rates and healthy food availability rates between California and Ohio in the year 2020. This allowed me to compare these to variables to each other and see if they are statistically significant. For RQ4, I also used an unpaired t-test to compare food insecurity between rural and urban counties in Ohio. This allowed me to see if there is any difference in rates due to the size of the counties. Urban counties were defined as having more than 50,000 people and rural counties were defined as having less than 50,000 people by the United States Census Bureau. RQ5 used a stepwise linear regression to determine how previous rates of food insecurity can account for variance in 2020 rates in Ohio.

**Results**

**RQ1:** Was there a significant change in food insecurity in the state of Ohio between 2016-2020?

An ANOVA analysis determined there was a significant difference in the percentage food insecurity in the state of Ohio during the years 2016 to 2020 ( $p < .001$ ). Posthoc tests determined

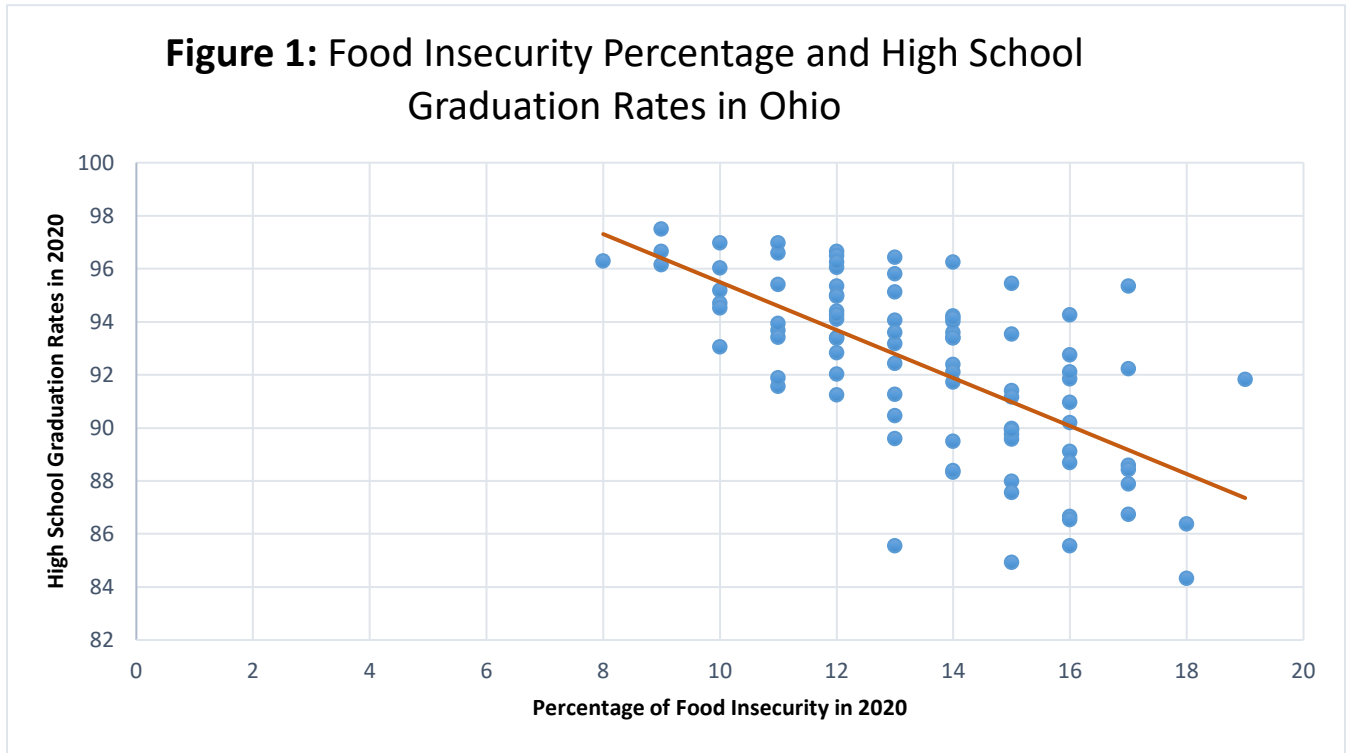


that the percentage of food insecurity in 2016 was significantly higher than in 2018 ( $p < .05$ ), 2019 ( $p < .05$ ), and 2020 ( $p < .001$ ) (Table 1). The percentage of food insecurity in 2017 was also significantly higher than 2020 ( $p < .05$ ) (Table 1). No other years demonstrated a statistically significant difference.

<b>Table 1: Percentage of Food Insecurity in Ohio Between 2016-2020</b>			
<b>Year</b>	<b>N</b>	<b>Mean</b>	<b>SD</b>
2016	88	15.398	2.158
2017	88	14.575	2.236
2018	88	14.099 <sup>a</sup>	2.393
2019	88	13.69 <sup>a</sup>	2.484
2020	88	13.477 <sup>a,b</sup>	2.378
Abbreviation: SD, standard deviation <sup>a</sup> : Indicates significant difference from the year 2016 at the $p < .05$ level. <sup>b</sup> : Indicates significant difference from the year 2017 at the $p < .05$ level.			

**RQ2:** Is there a correlation between food insecurity in the state of Ohio compared to high school graduation rates in the year 2020?

A Pearson correlation showed a statistically significant correlation between high school graduation rates and percentage of food insecurity by Ohio county in 2020 ( $r = -0.659$ ,  $p < .001$ ). As the percentage of food insecurity increases, graduation rates decrease (Figure 1).



**RQ3:** Is there a statistically significant difference in food insecurity and healthy food availability between Ohio and California in 2020?

Unpaired t-tests demonstrated statistically significant differences between Ohio and California in 2020 in the percentage of food insecurity and healthy food availability. California has significantly less food insecurity ( $p < .001$ ) and more healthy food availability ( $p < .001$ ) compared to Ohio (Table 2).

<b>Table 2: Percentage of Food Insecurity and Limited Access to Healthy Foods in Ohio and California during 2020</b>			
	<b>N</b>	<b>Mean</b>	<b>SD</b>
<b>Food Insecurity in Ohio</b>	88	13.477	2.378
<b>Food Insecurity in California</b>	58	12.389 <sup>a</sup>	2.514
<b>Healthy Food Availability in Ohio</b>	88	6.035	3.846
<b>Healthy Food Availability in California</b>	58	6.210 <sup>a</sup>	4.464

Abbreviation: SD, standard deviation  
<sup>a</sup>Statistically significantly different from Ohio ( $p < .001$ )

**RQ4:** Is there a statistically significant difference in food insecurity between urban and rural counties in Ohio in the year 2020?

When comparing rural and urban counties in Ohio during the year 2020 with an unpaired t-test, there was no significant difference between groups ( $p < .341$ ) (Table 3).

<b>Table 3: Food Insecurity Percentage in Urban and Rural Counties in Ohio for 2020</b>			
<b>County Type<sup>a</sup></b>	<b>N</b>	<b>Mean</b>	<b>SD</b>
<b>Urban</b>	49	13.69	2.443
<b>Rural</b>	39	13.21	2.296
<b>Total</b>	88	13.48	2.378

Abbreviation: SD, standard deviation  
<sup>a</sup>Rural and Urban definition from the Unites States Census Bureau<sup>9</sup>

**RQ5:** How can previous food insecurity rates account for variance in the current year in Ohio?

A step wise linear regression was done with the food insecurity rates from Ohio from 2016-2019 trying to account for the variance observed in the amount of food insecurity in 2020. The best fitting model used both the 2016 and 2019 rates. Model 1, using only 2019 data, could account for 97.7% of the variance in 2020 ( $r^2 = .977$ ). Model 2 was the best fitting model and added 2016 data. The best fitting model indicated that 97.8% of the variance in 2020 food insecurity rates in Ohio counties can be accounted for by the 2019 and 2016 food insecurity rates in that county, respectively ( $r^2 = .978$ ).

## Discussion

Ohio as a state has higher than average level of food insecurity than the rest of the country.<sup>1</sup> Although rates are high, the findings listed above do show a significant difference between the percentage of food insecurity in the year 2016 and the year 2020. While not all years have a statistically significant difference with each other, this shows that rates are decreasing in Ohio as expected. Food insecurity can be caused by numerous factors including employment and community resources. It is not surprising that rates from year to year only vary slightly as seen in Table 1. However, a statistically significant decrease is an encouraging sign as nutrition is a vital part of keeping a population healthy. This analysis also showed a significant negative correlation with food insecurity rates and high school graduation rates. This shows that as high school graduation rates decrease, food insecurity increases. This is in line with my original hypothesis. This correlation is easily visible in Figure 1. My next research question focused on the differences in food availability and food insecurity between Ohio and California. California has a lower than average level of food insecurity when compared to Ohio.<sup>1</sup> The statistical analysis did show a statistically significant difference between the two states as originally predicted. This analysis also demonstrated that rural and urban counties in Ohio showed no meaningful difference in the percentage of food insecurity. This is contrary to my original prediction. For the final research question, data from 2016 and 2019 accounted for over 97% of the variance in 2020 food insecurity rates. This demonstrates there is not a significant change in food insecurity over time per county. Data collection between 2016-2020 did not change according to [countyhealthrankings.org](http://countyhealthrankings.org). Statistical analysis demonstrated that previous years of food insecurity are the biggest predictors for future food insecurity rates in Ohio counties. The percentage not accounted for by previous rates of food insecurity can be from many different sources. More

work needs to be done to determine how to lower these rates and what else can impact food insecurity rates in Ohio.

Only very limited studies have been done in Ohio concerning healthy food availability in stores and food insecurity. Virtually no studies have been done on the state of Ohio as a whole. This makes studying food insecurity and availability very important along with their predisposing factors. One small study in Ohio showed that the type of food available is dependent of the location and size of the store.<sup>7</sup> Convenience stores were among those surveyed and they often contained inadequate amounts of healthy food. Another study demonstrated more convenience stores in neighborhoods with high a high percentage of Hispanic and African American residents.<sup>3</sup> These are all factors that influence food insecurity and healthy food availability. However, studies have not been conducted in Ohio that encompass more than two small neighborhoods. Many studies have been conducted on the state of California that look at a variety of factors including food insecurity and healthy food availability. It is interesting that a larger state with many more people has a lower rate of food insecurity and a higher rate of healthy food availability. It would be interesting to analyze the factors that play a part in this difference.

Food insecurity and healthy food availability are two big issues in the state of Ohio. These are important factors to investigate in order to improve the nutrition of our population. These factors not only impact nutrition, but also impact the rate of chronic illnesses, healthcare costs, and the overall health of our population. Ohio needs to lower the rates of food insecurity and promote healthy food availability in order to improve the overall health of the people living in this state.

## Conclusion

The main limitation in this study was the lack of previous research on this topic. The data used is also only available for certain factors and few of them involve nutrition and food availability. This lack of previous research is a perfect opening for more research in this area, especially in the state of Ohio. The next step would be to implement solutions that target the lack of healthy food in communities and the lack of access to food in general. Researching what could possibly combat these issues is the next step in eliminating them. The health of a population relies on numerous factors, studying them is the only way to specifically target problem. Solving these issues is the only way to improve the health of populations all over the country including that of Ohio.

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