

Final Report: Investigating COVID-19's Impact on Food Insecurity Rates in North Carolina

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Background and Research Questions, and Data Sources

The persistent issue of food insecurity is a complex but important factor in a person's well-being and nutrition, and is an important social determinant of health. Food security is defined by the Food and Agriculture Organization of the United Nations as lack of "regular access to enough safe and nutritious food for normal growth and development and for an active and healthy life." There are a variety of factors that have the potential to impact food security, both generally and in the context of the COVID-19 Pandemic. These questions in North Carolina, a growing and diversifying state, are all the more relevant as hunger relief organizations and public officials alike have been working to tackle the pandemic's many lasting effects in society, one of these being food insecurity. With this in mind, it is worth taking a step back to assess, based on data from a variety of sources, the degree of statistical support to emphasizing various factors' impact on food security, including temporally and during the pandemic itself.

This project's motivating research questions are the following:

Does North Carolina County level data provide evidence to support that there has been a statistically significant change to food insecurity rates from 2019 to 2021, and if there is support, what is the magnitude of this change?

To what extent are the following variables able to predict North Carolinian food insecurity rates and the rate's change from 2019 to 2021: unemployment, meal price, education level, and degree of urbanization?

Our data directly related to food insecurity and employment, as well as employment, in North Carolinian Counties in 2019 (generally referred to as "pre-COVID") and 2021 (generally referred to as "post-COVID") was sourced from Feeding America, the United States' largest hunger relief organization, that compiles national, state, and local data on food insecurity as a part of the organization's "Map the Meal Gap" and "Coronavirus and Food Security" Research Initiatives. Feeding America Data was sourced from here: <https://www.feedingamerica.org/research/map-the-meal-gap/by-county>

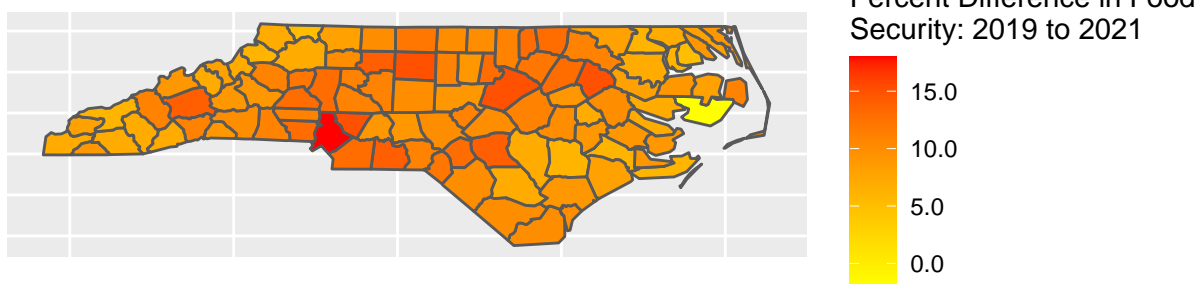
Our data related to education level and urbanization in North Carolinian counties was sourced from the USDA's Economic Research Service and the results of the American Community Survey from 2015 to 2019. USDA Economic Research Service Data was sourced from here: <https://www.ers.usda.gov/data-products/county-level-data-sets/download-data/>

The results for these variables for each North Carolinian county were combined into one Excel sheet and programmed for use in R.

Exploratory Data Analysis and Statistical Investigation Methodology

In order to investigate the first research question, a plot was constructed to determine the extent to explore the numerical, as well as geographic, distribution of the Percent Change in Food Insecurity in North Carolina, as well as the distribution of the Percent Change in Child Food Insecurity in North Carolina by county, both from 2019 to 2021.

Food Insecurity in NC Counties: 2019 to 2021



Note: NC Map Data sourced from <https://r-spatial.github.io/spdep/articles/sids.html>

Being able to explore the percent change in food insecurity for the counties in and around the Charlotte and Triangle area as opposed to the more rural Eastern and Western portions of the state reveal interesting results. For example, there was a rise in food security in the urban areas surrounding Charlotte, but not in Eastern North Carolina, and there was a county that appears to have decreased in food insecurity in the pandemic.

To investigate the differences in 2019 and 2021 Food Insecurity Percent Changes, a 1 Sample 2-Sided T-Test was run on two different variables: a paired variable that was the difference in 2021 from 2019 Food Insecurity Data per county, and a variable that calculated percent change per county from 2019 to 2021 based on the paired percent difference variable. A 95% Confidence Interval for the true percent difference and percent change in food insecurity rates for North Carolina counties will be obtained from running this test as well.

To further investigate the impact of other variables to food insecurity rates and change in food insecurity rates, a linear regression model was fit in order to model the following formula:

$$\hat{y}_i = \hat{\beta}_0 + \hat{\beta}_1(meal_i) + \hat{\beta}_2(urban_i) + \hat{\beta}_3(\Delta unemp_i) + \hat{\beta}_4(< hsdip_i) + \hat{\beta}_5(= hsdip) + \hat{\beta}_6(somecollege) + \hat{\beta}_7(degree)$$

T-test

Table 1: 1 Sample Paired 2-Sided T-Test Testing Null Hypothesis of a True Percent Difference from 2019 to 2021 Food Insecurity Rates for NC Counties = 0

estimate	statistic	p.value	parameter	conf.low	conf.high	method	alternative
0.01415	34.48568	0	99	0.0133358	0.0149642	One Sample t-test	two.sided

Table 2: 1 Sample 2-Sided T-Test Testing Null Hypothesis of a True Percent Change from 2019 to 2021 Food Insecurity Rates for NC Counties, Calculated from Feeding America = 0

estimate	statistic	p.value	parameter	conf.low	conf.high	method	alternative
9.706158	33.22406	0	99	9.126484	10.28583	One Sample t-test	two.sided

Linear Regression Investigation- 2021

Table 3: Main Linear Regression of Food Security in North Carolina Using Cost of Meal, Unemployment Change from 2019-21, Urban/Rural County Status, and Education Status of County Residents

term	estimate	std.error	statistic	p.value	conf.low	conf.high
(Intercept)	11.44307113	1.1426826	3.6411793	0.0004461	5.2023262	17.6838160
2019 Cost per Meal	-	0.6263193	-	0.5523612	-	0.8702131
	0.3735329		0.5963937		1.6172789	
Urban_catUrban	0.9260552	0.2568396	3.6055777	0.0005032	0.4160226	1.4360877
2019-2021 Unemployment Change	2.8772048	0.1627402	17.67974580	0.0000000	2.5540351	3.2003746
Less than HS Diploma, 2015-9, Percent	-	0.0415652	-	0.0035444	-	-
Only HS Diploma, 2015-9, Percent	0.1243792		2.9923847		0.2069195	0.0418389
	-	0.0308660	-	0.0312994	-	-
	0.0674841		2.1863553		0.1287778	0.0061903
Some College Education Completed, 2015-9, Percent	-	0.0350794	-	0.0439360	-	-
	0.0716486		2.0424685		0.1413094	0.0019878
College Degree Obtained, 2015-9, Percent	NA	NA	NA	NA	NA	NA

[1] 0.8601644

Table 4: Main Linear Regression of Food Security in North Carolina Using Cost of Meal, Urban/Rural County Status, and Percent of County Residents with Less than a High School Diploma

term	estimate	std.error	statistic	p.value
(Intercept)	0.1968006	0.0272384	7.225106	0.0000000

term	estimate	std.error	statistic	p.value
2019 Cost per Meal	-0.0191990	0.0071497	-2.685283	0.0085386
Urban_catUrban	-0.0070343	0.0033282	-2.113525	0.0371487
Less than HS Diploma, 2015-9, Percent	0.0018844	0.0004746	3.970117	0.0001387

[1] 0.4702632

Table 5: Interaction Linear Regression of Food Security in North Carolina Using Cost of Meal and Urban/Rural County Status to Percent of County Residents with Less than a High School Diploma

term	estimate	std.error	statistic	p.value
(Intercept)	0.1715796	0.0313620	5.470934	0.0000004
2019 Cost per Meal	-0.0111008	0.0087422	-1.269794	0.2072598
Urban_catUrban	0.0480913	0.0349328	1.376680	0.1718471
Less than HS Diploma, 2015-9, Percent	0.0019346	0.0004720	4.098687	0.0000875
2019 Cost per Meal:Urban_catUrban	-0.0178164	0.0112396	-1.585145	0.1162567

[1] 0.4784809

Table 6: Main Linear Regression of Food Security in North Carolina Using Cost of Meal, Urban/Rural County Status, and Percent of County Residents with a High School Diploma

term	estimate	std.error	statistic	p.value
(Intercept)	0.2041753	0.0314433	6.493441	0.0000000
2019 Cost per Meal	-0.0234294	0.0073522	-3.186705	0.0019422
Urban_catUrban	-0.0097856	0.0032731	-2.989673	0.0035473
Only HS Diploma, 2015-9, Percent	0.0011429	0.0003863	2.958248	0.0038956

[1] 0.43481

Table 7: Interaction Linear Regression of Food Security in North Carolina Using Cost of Meal and Urban/Rural County Status to Percent of County Residents with a High School Diploma

term	estimate	std.error	statistic	p.value
(Intercept)	0.1974935	0.0330708	5.9718327	0.0000000
2019 Cost per Meal	-0.0206333	0.0084708	-2.4358074	0.0167232
Urban_catUrban	0.0148626	0.0369048	0.4027283	0.6880529
Only HS Diploma, 2015-9, Percent	0.0010888	0.0003958	2.7512455	0.0071101
2019 Cost per Meal:Urban_catUrban	-0.0080189	0.0119588	-0.6705436	0.5041382

[1] 0.4315511

Logistic Regression

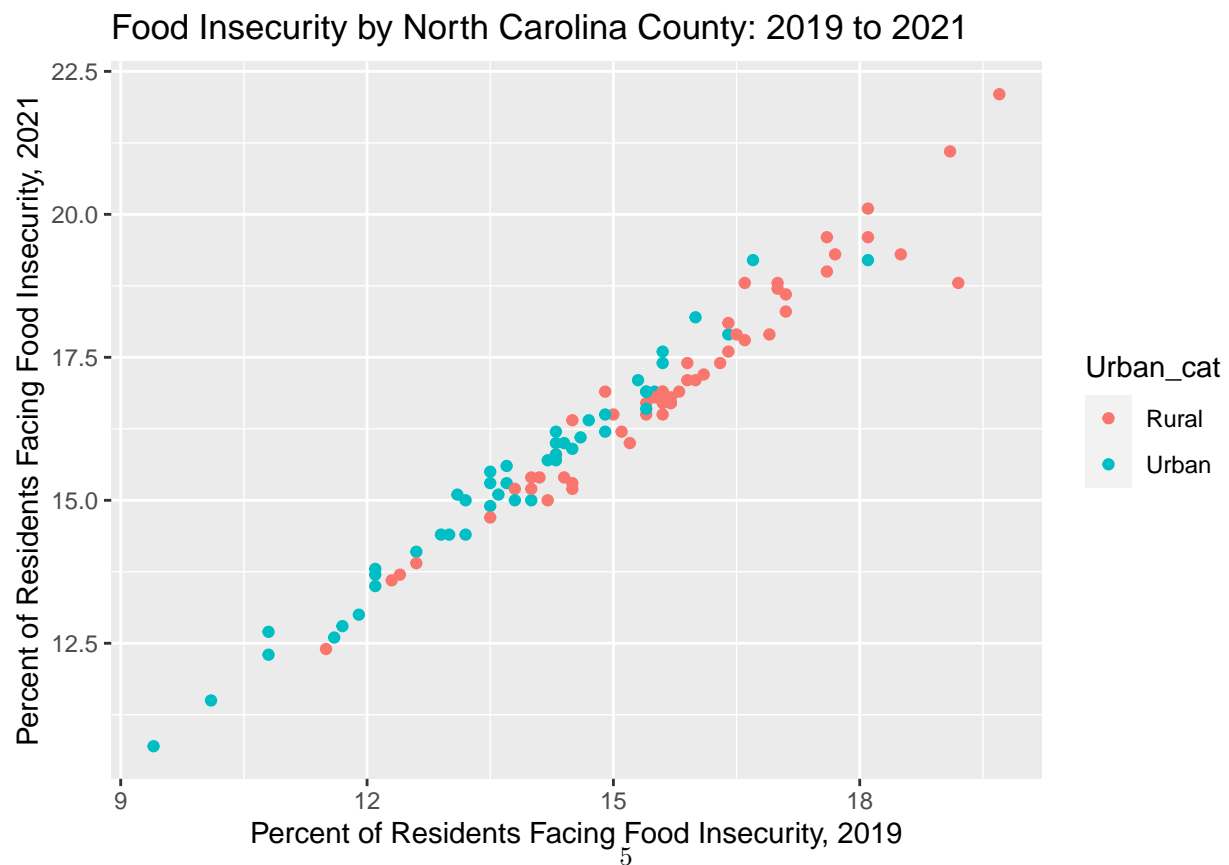
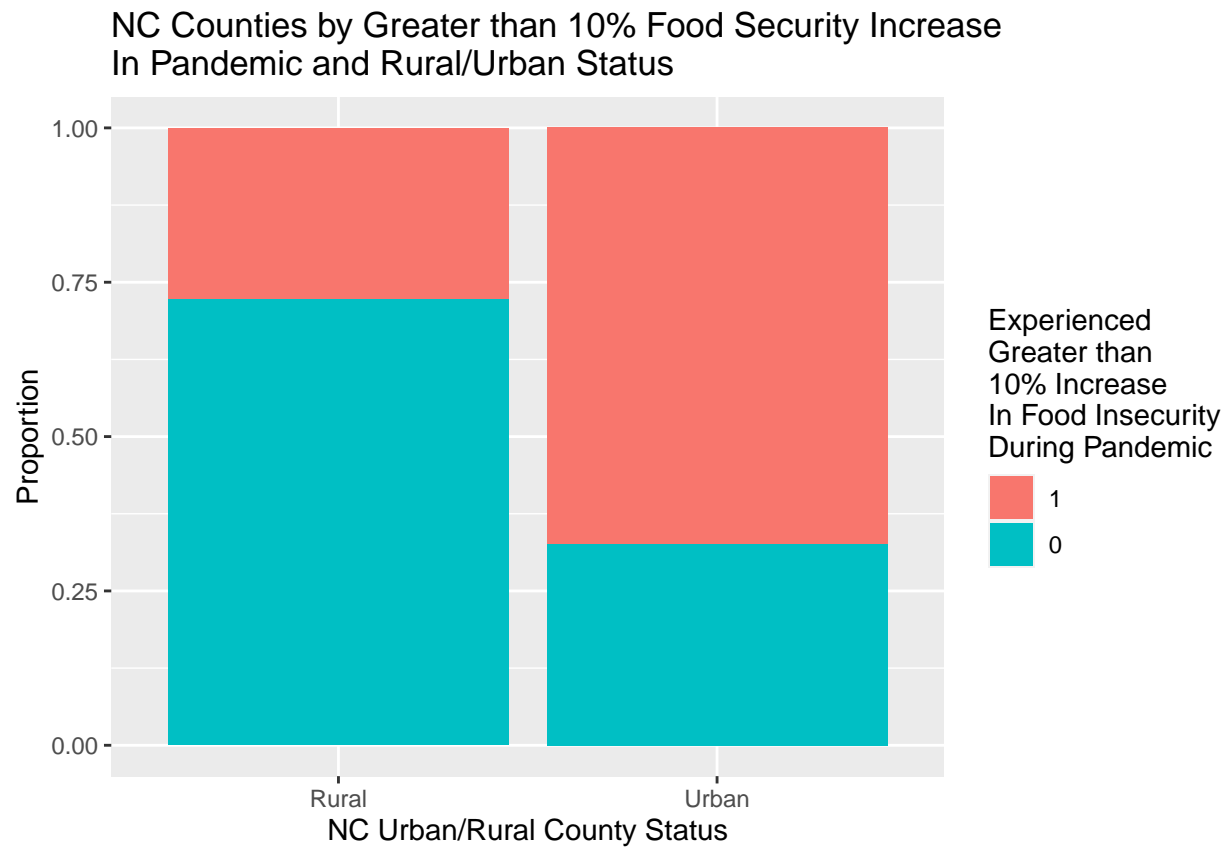


Table 8: Results of Logistic Regression Table Determining Odds of Food Security Change During Pandemic Greater than 10% by Urban-Rural Status

term	odds	p.value	conf.low.exp	conf.high.exp
(Intercept)	2.6000000	0.0016610	1.4649713	4.8656178
Urban_catUrban	0.1861042	0.0001205	0.0768245	0.4295243