Food Insecurity Determinants amidst the COVID-19 Pandemic: An Insight from Huntsville, Texas

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Abstract Food insecurity continues to affect a large number of the U.S households during the novel COVID-19 pandemic. The pandemic has indeed threatened the livelihood of people, making them vulnerable to severe hardship and has had an unanticipated impact on the U.S economy. While researchers have carried out studies in some cities in Texas to ascertain the degree of food insecurity in households, none has examined the status of food insecurity amongst the households in the city of Huntsville, following COVID-19. Thus, this study attempts to identify the food insecurity status of households and the determinants driving household food insecurity in Huntsville, Texas. Additionally, the research attempts to identify the mitigation measures adopted by households during the pandemic in the city. Therefore, a structured online sample survey was used to collect data, while household expenditures survey was utilized in evaluating the food security status of households. The data were subjected to a critical evaluation via descriptive statistics and logistic regression modeling. A logistic regression model was used to determine the factors responsible for food insecurity in the study area. The examination showed that COVID-19 had a practical effect on the lives and source(s) of income of majority of the respondents. However, most households in the study area were food secure, because a significant proportion were educated, and fully employed, while those who had part time jobs or unemployed were food insecure. Also, the provisions of the American Rescue Plan and economic impact payment enabled food security amongst the households in Huntsville, Texas. Overall, the research evinced that 63.13 % of households were food secure as a result of societal support from charitable organizations, while 36.87 were food insecure in the city of Huntsville, Texas.

Keywords: food insecurity, household expenditure survey, COVID-19, coping strategies, food pantry

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1. Introduction

An increasing level of food insecurity is faced within the country amidst the economic fallout from the novel coronavirus COVID-19 pandemic. The pandemic has exposed many economically challenged households and families to severe hardship, leaving them with difficulties in making ends meet for their livelihood [1].

The U.S Department of Agriculture (USDA) defines food insecurity as lack of constant access to enough food for an active and healthy life [2]. The overall level of food insecurity within the country has increased rapidly over the last year due to the economic shutdown to curb the spread of the virus. Subsequently, millions of Americans have experienced increasing unemployment and reduced incomes, and a probable increase in the rate of poverty throughout the country [3].

According to Fitzpatrick, Drawve and Harris [4], the hunger rate within the state of Texas has exceeded the national average. This is a direct result of increased unemployment within the state, which has hurt the financial viability of many families and households, and a consequent inability to afford food, shelter, and other basic needs. Besides, many charitable groups within the country are struggling to meet up with the demand in food assistance [5].

Prior to COVID-19, the recession in 2007 aggravated the level of hunger and a significant number of households could not have adequate access to quality food. The situation has now been worsened as a result of COVID-19 pandemic. In fact, Feeding America reported that because of the pandemic, up to 54 million people may experience food insecurity in 2020, including 18 million children [6]. Equally, Coleman-Jensen, Rabbitt, Gregory and Singh [7] reported that in 2018 one in nine Americans were food insecure, indicating that over 37 million Americans including 11 million children lived in a food insecure household. In its assessment, Feeding America also reported that over 4 million Texans were food insecure, with nearly 15% of the state’s population not having access to quality and nutritious food for healthy living [6].

Thus, it is patent that the prevalence of food insecurity across the state of Texas, evidenced the adverse effect of COVID-19 on the food distribution system during the
pandemic. The supply chain system experienced a dramatic shift in meeting the food demand from the farm to the grocery stores. The CEO of the Texas International Produce Association during a press conference affirmed that at the end of the Texas season this spring, farmers had 60% of their distribution channels completely destabilized overnight [8].

However, even though several research studies have been conducted on food insecurity in quite a few cities in Texas over the years [9,10,11], no study has actually focused on household food security in the city of Huntsville. Huntsville, TX is a regional hub located in East Texas, with its population heavily influenced by its role as seat of the Texas Department of Criminal Justice (TDCJ), and Sam Houston State University. Hence, the significance of this study, purposely designed to assess the food security status of households in Huntsville, Texas. In addition, this paper intends to identify both the determinant factors driving household food insecurity and the measures that have been adopted by households to cope with food insecurity problems during the pandemic.

2. Materials and Method

2.1. Overview of the Study Area

The study was conducted in the city of Huntsville, Texas, United State of America. The city is designated as the seat of Walker County, Texas with an approximate population of 42,395 [12]. The city is the 82nd largest city in Texas, situated 70 miles north of Houston at the junction of Interstate Highways 45, which runs between the cities of Houston and Dallas, and U.S. Highway 190, a major east-west corridor.

The city of Huntsville was founded in 1835 and is notably one of the oldest cities in Texas. Since its inauguration, the city has enjoyed enormous economic growth with the city been the home of Sam Houston State University, one of the fastest growing university in Texas. In addition, Huntsville became the site of the new Texas State penitentiary which was established in 1847 as the first state prison in Texas [12]. This has made the Huntsville economy to specifically depend on employment from the public sector due to the presence of Sam Houston State University and the Texas Department of Criminal Justice (TDCJ).

2.2. Data Source and Sampling Techniques

A structured household questionnaire was used as the research data collection instrument for this study. Data were collected using Google forms in an online survey, while email functioned as the primary method of connecting respondents to the survey instrument. Convenience sampling was used in selecting people for the survey because of its time effectiveness and ability to reach a larger sample population. The instrument was chosen because of its greater ability to reach a large population as well as requiring little cost and less effort to administer.
2.3. Method of Data Analysis

Descriptive statistics such as percentages, frequency counts, mean values, variance, and standard deviation were used to describe household socioeconomic characteristics and Household Food Security Status. The Statistical Package for Social Sciences (SPSS) was used to analyze the Binary Logistic Regression regarding the factors influencing household food insecurity in Huntsville. The Household Food Expenditure Survey was used to determine the food security nature of the household. Following Omonona and Agoi [13], and Oduniyi and Tekana [14], the HSFI was determined by calculating the per capita food expenditure of i-th household, divided by two-thirds of the mean per capita food expenditure of all households, over a period of one month. The value obtained represents a threshold, which was used to construct the Household Food Security Index (HFSI). A household expense for food above the threshold or HSFI was regarded as food secure, while otherwise or lesser than the threshold was regarded as food insecure.

\[
Fi = \left( \frac{\text{per capita food expenditure for the ith household}}{2/3 \ \text{mean per capita food expenditure of all household}} \right)
\]

where \(Fi\) is the HSFI of the ith household

Mathematically, when:

\(Fi \geq 1\) = the ith household is food secure

\(Fi < 1\) = the ith household is food insecure

Hence, any household with a per capita monthly food expenditure above or equal to two-thirds of the mean per capita food expenditure is food secure, while otherwise is food insecure.

2.3.1. Binary Logistic Regression Model

The Logistic regression model was used to identify the factors that determine the households’ food security (proxied by the HSFI variable). In the study, a respondent is considered 1 if food secure and 0 if otherwise. The model is stated thus:

\[
Fi = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \ldots + \beta_nX_n
\]

(2)

Where \(Fi\) is the binary variable with value 1 if respondent is food secure and 0 if otherwise, where \(\beta_0\) is the intercept (constant), and \(\beta_1, \beta_2, \beta_3, \beta_4, \beta_5\) and \(\beta_n\) are the regression coefficients of the predictor variables, \(X_1, X_2, X_3, X_4, X_5, X_6, X_7\) to \(X_{15}\) and \(X_n\). Binary logistic regression model is widely used to analyze data with dichotomous dependent variables [15,16,17,18]. Hence, it was considered a suitable model to use for this objective because the dependent variable was dichotomous in nature. In addition, it was necessary to create dummy variables to use the selected socio-economic determinants of food security status variables. The exogenous variables used in the analysis are shown below in Table 1:

| Independent Variables | Description |
|-----------------------|-------------|
| Gender                | 1 = male, 0 = female (Dummy) |
| Race                  | 1 if African American, 0 otherwise (Dummy) |
| Marital status        | 1 if single, 0 otherwise (Dummy) |
| Employment status     | 1 if employed, 0 otherwise (Dummy) |
| COVID-19 affected your life | 1 = if COVID-19 affected your life, 0 if otherwise (Dummy) |
| Household size        | Number of members of household (Continuous) |
| Household monthly income in $ | Total value in Dollars (Continuous) |
| COVID-19 affected your income | 1 = if COVID-19 affected your income, 0 if otherwise (Dummy) |
| COVID-19 affected your food consumption pattern | 1 = if COVID-19 affected your daily food consumption, 0 if otherwise (Dummy) |
| Meals per day         | Number of meal(s) eaten (Dummy) |
| Support from charitable organization | 1 = if received support from any charitable organization, 0 if otherwise (Dummy) |
| Received COVID-19 relief stimulus funds | 1 = if received the government relief fund, 0 if otherwise (Dummy) |
| Coping strategies used | 1 = if used any coping strategy, 0 if otherwise (Dummy) |
| Age                   | Number in years (Continuous) |
| Level of education    | Number in years (Continuous) |
Table 2. Summary Table of the Demographic characteristics of the participants (n=179)

| Household characteristics | Frequency | Percentage | Mean |
|---------------------------|-----------|------------|------|
| Gender                    |           |            |      |
| Male                      | 57        | 31.8       |      |
| Female                    | 122       | 68.2       |      |
| Race                      |           |            |      |
| African American          | 39        | 28.1       |      |
| White                     | 86        | 48         |      |
| Hispanic                  | 50        | 27.9       |      |
| Others                    | 4         | 2.2        |      |
| Marital status            |           |            |      |
| Single                    | 59        | 33         |      |
| Married                   | 103       | 57.5       |      |
| Widower                   | 3         | 1.7        |      |
| Separated                 | 14        | 7.8        |      |
| Age group                 |           |            |      |
| 18 – 35                   | 73        | 40.8       |      |
| 36 – 45                   | 44        | 24.6       |      |
| 46 – 55                   | 33        | 18.4       |      |
| 56 – 65                   | 20        | 11.2       |      |
| Above 65                  | 9         | 5.0        |      |
| Average household size    | 4         |            |      |
| Educational level         |           |            |      |
| Did not graduate from high school | 3 | 1.7         |      |
| High school, diploma or equivalent | 69 | 38.5        |      |
| Some college credit, no degree | 33 | 18.4        |      |
| Associates degree         | 18        | 10.1       |      |
| Bachelor’s degree         | 41        | 22.9       |      |
| Master’s degree           | 14        | 7.8        |      |
| PhD or similar (JD, EdD.) | 1         | 0.6        |      |
| Employment status         |           |            |      |
| Employed full-time.       | 54        | 30.2       |      |
| Employed part-time        | 64        | 35.8       |      |
| Self-employed             | 13        | 7.3        |      |
| Unemployed                | 27        | 15.1       |      |
| Retired                   | 17        | 9.5        |      |
| Independent contractor    | 4         | 2.2        |      |

3. Result and Discussion

3.1. Demographic Profile

Table 2 illustrates the demographic characteristics of households in the study area. This was analyzed using descriptive statistics. The sample is comprised of 179 households. The study shows that 31.8% of the respondents were male, while the remaining 68.2% were female. Furthermore, the result showed that majority of the respondents (57.5%) were married, while 33% were single.

The Figure 2 below shows the marital distribution of household head in the study area. The majority (57.5%) were married, 33% were single and about 10% were widow and separated. The fact that most of the households were married evidenced a sense of responsibility and the possibility of a willing volition on the part of the household heads to support their family members.

The Figure 3 below demonstrates the age distribution of household heads in the study area. Most of the respondents, that is, 40.8% were between the ages of 18 and 35 years; 24.6% of the respondents were from 36 – 45 years, while 18.4% of the respondents were between 46 and 55 years of age. This implies that most of the household head are still active and productive in the study area.

Furthermore, 38.5% had a high school diploma, whereas 31% of the respondents had completed a bachelor’s degree or higher. This could be expected, as Huntsville is the home of a regional state university. Education is very good for food insecurity, studies like Omotayo [19] and Omotayo [20] have shown that proper education enhances household’s food security.

With respect to employment status, 15.1% of the respondents reported that they were unemployed, while 35.8% were on part-time employment, and 30.2% avowed that they were fully employed. The finding can probably be attributed to the fact that the city is comprised primarily of three racial groups with majority of the respondents (48%) being white, 27.9% identified themselves as Hispanic, and 21.8% as African American. These is in line with a reported population proportion of 50.2%, 18.6%, and 26.6%, respectively [21].
Figure 3. Distribution of household head by Age group

Figure 4. Educational status of respondents

Figure 5. Racial distribution of respondent
3.2. COVID-19 Related Questions

Table 3 shows that 92.7% of the respondents indicated that COVID-19 pandemic had affected their lives, while 69.3% indicated that COVID-19 had affected their source of income, whereas 60.9% submitted that COVID-19 had affected their daily food consumption patterns. A high number of respondents in the study area (34.1%) turned to food pantries as rescue aid to augment their food expenditures, while most of the respondents reported that they were not receiving any support from charitable organizations. A small proportion, only 8.4%, indicated that they relied on government benefits such as SNAP (Supplemental Nutrition Assistance Program, aka food stamps) or WIC (program for pregnant or post-partum women, infants, and children supplemental food program).

Table 3. Distribution of respondents to selected COVID-19 questions

| Variables                                      | Category | Frequency | Percentage |
|------------------------------------------------|----------|-----------|------------|
| Believed that COVID-19 pandemic has affected your life | Yes      | 166       | 92.7       |
|                                                | No       | 13        | 7.3        |
| COVID-19 affects your income source?           | Yes      | 124       | 69.3       |
|                                                | No       | 55        | 30.7       |
| Received COVID-19 stimulus funds               | Yes      | 131       | 73.2       |
|                                                | No       | 48        | 26.8       |
| COVID-19 affected your daily food consumption pattern? | No      | 109       | 60.9       |
|                                                | Once     | 70        | 39.1       |
|                                                | Twice    | 94        | 52.5       |
| Daily eating times                             | Three times | 69 | 38.5 |
|                                                | Four times | 5   | 2.8  |
|                                                | Food pantry | 61  | 34.1 |
|                                                | SNAP     | 8        | 4.5        |
| Support from charitable organizations          | WIC      | 7        | 3.9        |
|                                                | Assistance from church | 3 | 1.7 |
|                                                | Other services | 4 | 2.2 |
|                                                | None     | 96       | 53.6       |

3.3. Negative Feelings Experienced during the Pandemic

Table 4 presents the mixed negative feelings experienced by the respondents in the study area. About 64.8% of the respondents admitted that they were nervous during the lockdown, 72.1% indicated that they were worried, 63.1% experienced a sad feeling, 46.9% were depressed and 78.8% of the respondents indicated that they were feeling bored due to the outcome of staying indoors.

| Variables                                      | Category | Frequency | Percentage |
|------------------------------------------------|----------|-----------|------------|
| Nervous                                        | Yes      | 116       | 64.8       |
|                                                | No       | 63        | 35.2       |
| Worried                                        | Yes      | 129       | 72.1       |
|                                                | No       | 50        | 27.9       |
| Sad                                            | Yes      | 113       | 63.1       |
|                                                | No       | 66        | 36.9       |
| Depressed                                      | Yes      | 84        | 46.9       |
|                                                | No       | 95        | 53.1       |
| Bored                                          | Yes      | 141       | 78.8       |
|                                                | No       | 38        | 21.2       |

3.4. Household Food Security Status and Coping Strategies Adopted

The study used Household Food Security Index as a proxy to identify the determinants of food security status of households. Table 5 clearly depicts that 63.13% of households in the study were food secure, while 36.87% were food insecure. This can be attributed to the fact that there was a lot of societal support from outside organizations, primarily charitable rather than governmental, during the pandemic, which thereby helped in reducing food expenses incurred by households. This is supported by the finding of Dowdell and Lesser [22], who opined that the effort to curtail the impact of the COVID-19 pandemic on households put a lot of strain on charity and non-profit organizations that provide emergency food aids to communities. In addition, the societal supports such as food pantries, SNAP, and the governmental economic relief stimulus packages played an essential humanitarian role that enabled households to have access and financial resources to purchase quality food.

As shown in Table 6, the minimum monthly household food expenditure was reported as USD 70, with USD 18.75 per capita food expenditure, while the maximum food expenditure USD 3000, with USD 900 per capita food expenditure, the low monthly household food expenditure during the pandemic also confirms the reality of the effort and support from charitable organizations during the lockdown. Moreover, Table 6 indicates that the minimum household monthly income of the respondents was USD 400, while the maximum per monthly income was USD 10,000. The average monthly income is calculated to be USD 2754; this illustrates a steady income cash flow in the study area during the pandemic. The average household size in the study area comprises of 3.3 members which translates into 4 members since we are reporting human research, with a minimum of one (1) person and a maximum of eleven (11) household members reported.

Table 4. Negative feelings experienced during the pandemic

| Variables                                      | Category | Frequency | Percentage |
|------------------------------------------------|----------|-----------|------------|
| Nervous                                        | Yes      | 116       | 64.8       |
|                                                | No       | 63        | 35.2       |
| Worried                                        | Yes      | 129       | 72.1       |
|                                                | No       | 50        | 27.9       |
| Sad                                            | Yes      | 113       | 63.1       |
|                                                | No       | 66        | 36.9       |
| Depressed                                      | Yes      | 84        | 46.9       |
|                                                | No       | 95        | 53.1       |
| Bored                                          | Yes      | 141       | 78.8       |
|                                                | No       | 38        | 21.2       |

Table 5. Food security status of household

| Food security status | Frequencies | Percentage |
|----------------------|-------------|------------|
| Food insecure        | 66          | 36.872     |
| Food secure           | 113         | 63.128     |
| Total                | 179         | 100        |

Table 6. Selected summary statistics of respondent’s food expenditure/income

| Socio-economic variables | Minimum | Maximum | Mean | Variance (n-1) | Standard deviation (n-1) |
|--------------------------|---------|---------|------|----------------|--------------------------|
| Household food expenditure ($) | 70.000  | 3000.000 | 495.615 | 107027.991 | 327.151 |
| Per cap food expenditure ($) | 18.750  | 900.000 | 173.171 | 18575.166 | 136.291 |
| Household monthly income ($) | 400.000 | 10000.000 | 2754.816 | 3847259.612 | 1961.443 |
| Household size | 1.000 | 11.000 | 3.318 | 2.218 | 1.489 |
Table 7 is a presentation of the coping strategies used by households during the pandemic to curb expenditures. Most of the respondents (64.2%) indicated that they controlled their daily expenses, 8.9% decided to reduce food consumption, 7.3% borrowed money from friends and family members, 5.6% pawned or sold assets to cover expenses, while 10.6% of the respondents indicated that the pandemic did not affect them financially.

Table 7. Coping strategies used

| Variables                        | Frequency | Percentage |
|----------------------------------|-----------|------------|
| Controlling expenses             | 115       | 64.2       |
| Borrowed money from friends and families | 13        | 7.3        |
| Pawned belongings                | 5         | 2.8        |
| Sought opportunity for cash      | 6         | 3.4        |
| Sale of assets                   | 5         | 2.8        |
| Cut down food consumption        | 16        | 8.9        |
| The pandemic did not affect me financially | 19        | 10.6       |

3.4. Determinant factors Driving Food Security in the Study Area

A Logit econometric regression model was used to identify the determinants of household food insecurity in the study area. Seventeen variables that were hypothesized to have influence on household food insecurity were included in the model. The result showed that household size and Income were significant at (p<0.01). Educational status of household was also found significant at (p<0.05). The remaining variables namely, gender, race, marital status, employment status, age, number of times eating daily, support from charitable organization, COVID-19 affected your life, COVID-19 affected income, received COVID-19 relief funds, COVID-19 affected food consumption, coping strategies used were not statistically significant (p>0.1). In view of the above summarized results, concise explanation for each significant variable is as follows:

The results in Table 8 shows that household size was associated and statistically significant (p<0.01) to the food security status with a negative coefficient of (-0.553). Household sizes reveal a strong negative relationship with food insecurity in the study area. This implies that the food security status of households in the study area have the probability to decrease with an increase in size of households. An increase in household size by one member is associated with probability of 55.3% increase in the odds of that household being food insecure. This translate into the fact that an increase in household size might lead to additional expenses on the household head since resources are limited during the pandemic, which might put additional pressure on the household head thereby affecting their food security status.

Furthermore, the results in Table 8 show that increases in household income are likely to improve the food security status of household. The result reported a strong significant association between monthly income of the household and food insecurity (p<0.01), with a positive coefficient of 0.100. This indicates that as income increases by one dollar, household food security status has the probability of increasing by 10%. This result corresponds to Wight, Kaushal, Waldfogel and Garfinkel [23] who reported that food insecurity decreases as income increases. As such, reduced income and job losses in the country during this pandemic have been mitigated by the prompt congressional response, through the provision of the American rescue plan and economic impact payments [24]. Thus, the rescue plan functioned as a needful support to struggling families and businesses during the pandemic [24].

Table 8. Socioeconomic determinants of household’s food security status

| Source                                         | Coef. | Marginal effect | Wald Chi-Square | Pr > Chi² | Odds ratio |
|------------------------------------------------|-------|-----------------|-----------------|-----------|------------|
| Gender                                        | -0.178| -0.034          | 0.160           | 0.689     | 0.837      |
| Race                                          | -0.266| -0.050          | 1.494           | 0.222     | 0.766      |
| Marital status                                | -0.255| -0.048          | 0.712           | 0.399     | 0.775      |
| Employment status                            | -0.163| -0.031          | 0.874           | 0.350     | 0.750      |
| COVID-19 affected your life                   | 0.942 | 0.178           | 1.239           | 0.266     | 2.565      |
| Household size                               | -0.553***| -0.104      | 10.989          | 0.001     | 0.575      |
| Income                                       | 0.100***| 0.000         | 10.379          | 0.001     | 1.001      |
| COVID-19 affected income                     | 0.769 | 0.145           | 1.792           | 0.181     | 2.157      |
| COVID-19 affected food consumption           | -0.229| -0.043          | 0.173           | 0.677     | 0.795      |
| How many times eating daily                  | 0.174 | 0.033           | 0.200           | 0.655     | 1.190      |
| Support from any charitable org              | -0.087| -0.016          | 0.036           | 0.849     | 0.917      |
| Receive COVID-19 stimulus funds              | -0.373| -0.070          | 0.584           | 0.445     | 0.689      |
| Coping strategies used                       | -1.426| -0.269          | 0.982           | 0.322     | 0.240      |
| Age group                                    | 0.089 | 0.017           | 0.156           | 0.693     | 1.094      |
| Education                                    | 0.439***| 0.083         | 6.184           | 0.013     | 1.552      |
| Constant                                     | 0.862 | 0.173           | 0.677           |           |            |

Number of observations = 179
LR chi2(14) = 71.27
Prob > chi2 = 0.0000
Pseudo R² = 0.3036
Log likelihood = -81.733964
Note ***Significant at 1%, ** Significant at 5%, * Significant at 10%
Finally, the educational status of household head was statistically significant (p<0.05) with a positive coefficient (0.439). This implies that respondents’ educational status has a strong positive probability with their food security status. In addition, the study further added that if the level of education of a household head increases by a degree, the household food security status has the probability of increasing by 44%. This is in line with the descriptive statistics finding of this study that about 31% of respondents in the study area were categorized as highly educated, having a college degree or higher. This means that households who have better education are more likely to be food secure compared to those who are less educated. Correspondingly, the finding is duplicated in Omotayo [19] and Omotayo [20].

4. Conclusion

This study assessed the current state of food insecurity in the city of Huntsville, Texas. It has also revealed the determinant factors driving food security in the study area and uncovered the coping strategies adopted by households to curb food insecurity during this unprecedented time. The finding from the research using a Household Expenditure Survey confirmed that the majority of the households (63.13%) in Huntsville are considered food secure, with the remainder (37.87%) classified as food insecure. Factors such as household size and income were found significant at (p<0.01) respectively. Also, education of household head was statistically significant (p<0.05). These three factors are the driving force behind the food security status of households in the study area. In a nutshell, majority of respondents disclosed that the COVID-19 pandemic has affected their lives and income. Consequently, most of the households necessarily turn to food pantries to supplement their food expenditures.

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Compliance with Ethical Standard

The authors declare that there are no conflicts of interest.

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