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Determinants of Food Insecurity in Huntsville, Alabama, Metropolitan Area

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Abstract

This paper attempts to examine the food insecurity situation and identify the determinants of food insecurity in the Huntsville, Alabama, metropolitan statistical area. The primary data source was the household food security and socioeconomic survey administered to 700 households in August and September 2016. The main tools of analysis include descriptive statistics and a tobit regression model. The tobit model result revealed that household income; age, gender, and education of household head; and presence of children in the household were significant determinants of food insecurity in the study area.

Keywords: food desert, food insecurity, tobit model, urban households

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Introduction

Food security, defined by Anderson (1990), is defined as "access by all people at all times to enough food for an active, healthy life and includes at a minimum: (a) the ready availability of nutritionally adequate and safe foods, and (b) the assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies)" (p. 1560). Food insecurity exists when such foods are unavailable or a person's ability to acquire them is limited. This paper investigates the determinants of food insecurity among low-income households in the Huntsville Metropolitan Statistical Area (HMSA). Located in north Alabama (Madison and Limestone Counties), the HMSA is one of the fastest growing and second largest urban areas in Alabama. Like other states in the southern United States, Alabama's household food insecurity rate is above the national average. Recent data (average of 2013–2015) from the U.S. Department of Agriculture's Economic Research Service (USDA/ERS) show that the prevalence of household food insecurity in Alabama is 17.6% compared to the national average rate of 13.7% (Coleman-Jensen et al., 2016). Local data also paint a similarly dismal picture, with household food insecurity rates of 15.5% in Madison County, 13.5% in Limestone County, and 16.1% in Congressional District 5 (Feeding America, 2014).

The paper adds to existing studies that have addressed food insecurity and hunger in urban areas in the United States. While most of these studies have focused on major urban areas, little is known about the determinants of food insecurity in relatively small and/or emerging urban areas, especially in the South, making it difficult for city authorities and local governments to broaden their strategies to quantify the challenges and proactively plan to reduce the prevalence of food insecurity.

Methodology

Data Sources and Sampling Technique

Primary data were collected through a household food security and socioeconomic telephone survey conducted between August 27 and September 17, 2016. The questionnaire was administered in 14 low-income neighborhoods located in a cluster of census tracts defined as a food desert.[1] These neighborhoods were chosen because they are typical in many ways of inner city communities in the southern United States. Their populations include a large proportion of minorities and female-headed households with incomes below the poverty line and high unemployment and crime rates, among other disparities.

[1] Low-income neighborhoods include Chelsea, West Huntsville, Huntsville Park, Brandontown, Oakwood, Rutledge Heights, Lakewood, Vaughn Corners, Rideout Village, Terry Heights, Brookhurst, Meadow Hills, Cavalry Hill, and Edmonton Heights. Food deserts are defined as parts of the country, usually found in impoverished areas, devoid of fresh fruits, vegetables, and other healthful whole foods. This is largely due to a lack of grocery stores, farmers' markets, and healthy food providers. (American Nutrition Association, 2010).

Within these neighborhoods, a three-stage cluster random sampling with probability proportion to size sampling technique was used to select a sample of 700 respondents. After cleaning the data for incomplete responses, the analyzed sample was reduced to 679 respondents. The household food security section of the survey adopted the standard six-item subset of the USDA/ERS core-module indicator questions (Bickel et al., 2000). The advantage of adopting the six-item subset is that the survey findings can be compared directly with national and state-level standard benchmark statistics published annually by the USDA and with many national or regional tabulations of population subgroups available in the USDA reports.

Data Analysis

The responses to the six items on the USDA/ERS Household Food Security survey were scored for each respondent and summed to generate each respondent's raw score (Figure 1). The raw scores (ranging from 0 to 6) were used to group the sample into food insecure and food secure households. Having identified the food insecure and food secure households, the next step was to examine the socioeconomic characteristics expected to be correlated with food insecurity.

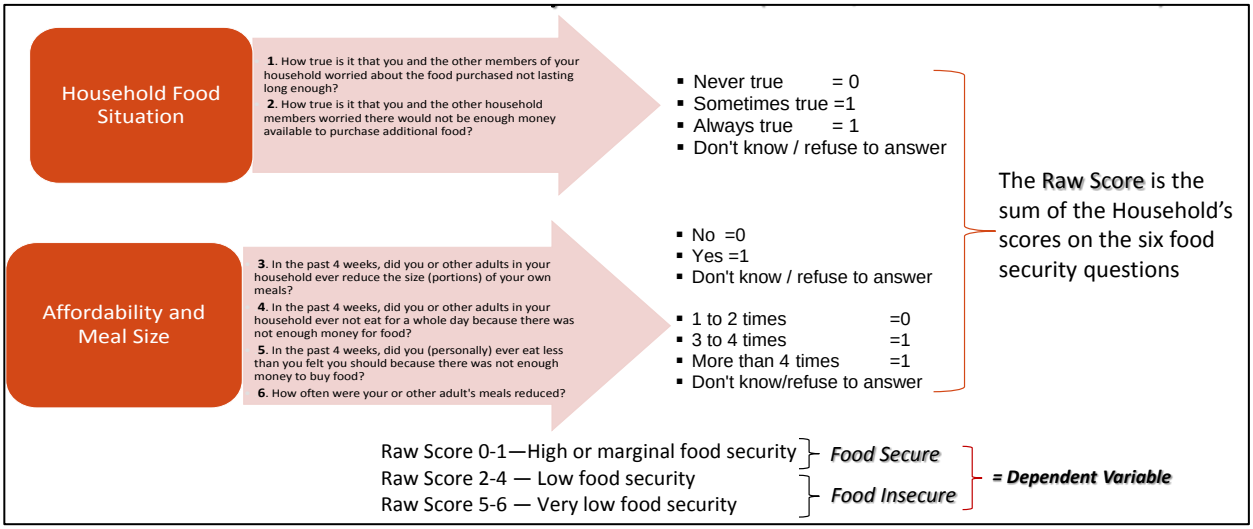

Figure 1. U.S. Household Food Security Questions (USDA/ERS Six-Item Module)
Source: Generated by author using information from Bickel et al., (2000).

To assess the factors that are expected to influence food security status among the food insecure part of the sampled population, a tobit regression model was adopted and estimated. The standard Tobit model can be defined as (Amemiya, 1984)

$$(1) \qquad y^{*} = \beta' X_i + e_i,$$

where

y^{*} = A latent variable that is unobserved for values <0 and >1.

X_i = An (nxk) matrix of the explanatory variables that includes factors affecting nutritional status among children.

β_i = A (kx1) vector of unknown parameters.

e_i = An independent normally distributed error term with zero mean and constant variance (σ^2); that is, $e_i \sim N(0, \sigma^2 I)$ and I = 1, 2… n, where n is number of observations.

Denoting y_i, the raw score of food insecurity status of the household, as the observed dependent (censored) variable, then

$$(2) \qquad y_i = \begin{cases} y_i \text{ if } y_i \le 0 \\ y^* \text{ if } 0 < y_i^* < 1 \\ 1 \text{ if } y^* \ge 1 \end{cases}.$$

Using the two-limit tobit, the food insecurity score was regressed against proxies for the explanatory variables hypothesized to influence the food security status of the household. The disturbance term of the tobit model is a function of the independent variables; therefore, attempting to estimate the functional form using the Ordinary Least Squares (OLS) method will produce biased and inconsistent estimates. If the unobserved y_i^* is assumed to be normally distributed, the estimation of the tobit model can be performed using the Maximum Likelihood Estimation (MLE) method. The likelihood function is expressed as

$$(3) \qquad \mathrm{L} = \prod_{y^* > T} (1 - G_1) \prod_{y^* \le T} \frac{1}{2\pi\sigma^2} e\left[-\frac{1}{2\sigma^2} (y_i - \beta X_i)^2 \right],$$

where G_i = the distribution function of T_i.

The resultant coefficients of the likelihood function are consistent, asymptotically efficient, unbiased, and normally distributed. Additionally, marginal effects were estimated to quantify the effects of each variables in the model. The actual estimated model was specified as

$$(4) \qquad \begin{aligned} INSECURITY = {} & \beta_0 + \beta_1 * AGE + \beta_2 * ETHINICITY + \beta_3 * GENDER + \beta_4 * EDUC4 \\ & + \beta_5 * INCOME4 + \beta_6 * MARITAL4 + \beta_7 * CHILDREEN + \beta_8 * HHSIZE + e \end{aligned}$$

Descriptions of the variables in equation 4 are provided in Table 1.

Results

Descriptive Analysis

The overall results (Table 1) show significant statistical differences between food secure and food insecure households. For example, age of the household head is as an important variable with an impact on household food security status. The mean difference test revealed significant differences in mean age of household head between the two samples. Previous studies have concluded that households with larger family size were more likely to be at risk of becoming food insecure. The survey result indicated some significant differences in mean family size between food secured and food insecure households. We found no significant differences between the two samples with regard to marital status (never married), ethnicity (African American), employment status, or income (between $25,000 and $40,000).

Table 1. Mean Differences between Food Secure and Insecure Households.

			Mean Difference		
Variable	**Description**	**Total Sample**	**Food Secure**	**Food Insecure**	***p-value***
AGE	Age of head of household	49.48	50.74	53.78	0.001
ETHINICITY	African American	0.55	0.53	0.57	0.129
GENDER	Female headed HH	0.76	0.72	0.84	0.000
EDUC1	High school or lower	0.34	0.27	0.47	0.000
EDUC2	Associate degree	0.08	0.05	0.12	0.000
EDUC3	College degree	0.38	0.49	0.31	0.000
EDUC4	Post graduate degree	0.17	0.16	0.09	0.069
MARITAL1	Single (never married)	0.43	0.44	0.47	0.313
MARITAL2	Divorced	0.06	0.05	0.09	0.000
MARITAL3	Separated	0.01	0.02	0.03	0.069
MARITAL4	Married	0.49	0.49	0.41	0.000
INCOME1	Less than $10k	0.15	0.13	0.29	0.000
INCOME2	Between $10k - $25k	0.24	0.29	0.34	0.029
INCOME3	$25k - $40k	0.20	0.18	0.19	0.742
INCOME4	More than $40k	0.32	0.30	0.13	0.000
CHILDREN	Household with children	0.10	0.06	0.20	0.000
HHSIZE	Household size	2.23	2.06	2.40	0.000
COMM	Food bank, Comm. garden	0.47	0.23	1.52	0.000
GOVT	SNAP and WIC assistance	0.15	0.06	0.45	0.000
UNEMPLOY	Unemployed	0.65	0.62	0.59	0.405

Econometric Model Analysis

Tobit regression was employed to examine the hypothesized determinants of household food insecurity. Before fitting the model, it was important to check whether serious problems of multicollinearity and association exist among explanatory variables. For this purpose, Variance Inflation Factor and contingency coefficient tests were used for the continuous and discrete variables, respectively. The choice of the final variables in equation 3 were best on the aforementioned analyses. The problem of heteroskedasticity was also checked using a Breuch-Bagan test. Table 2 presents the results showing that the model fitted the data reasonably. As specified, the model explained significant non-zero variations in factors influencing food insecurity among the respondents. The estimated coefficient of determination (Pseudo R-square) was fairly high, suggesting that 81% of the variation in food insecurity is explained by variations in the specified explanatory variables.

The estimated results show that educational status of household head is statistically significant at the 5% level and carries a negative sign. This result implies that households with household heads with relatively better education are more likely to be food secure than those headed by uneducated (illiterate) household heads. This finding is not surprising given that education is related to food security through proxies such as employment, household income, and decision making. These proxies have effects on the access, utilization, and availability dimensions of food security in an urban setting. Estimation of the marginal effects revealed that holding other variables constant, food insecurity decreases by a factor of 3.7% as education increases by one level.

Table 2. Estimated Tobit Model Results.

	Coefficient	Std. Error	z-Statistic	Prob.	Marginal Effects
	Primary Index Equation for Model				***∂E(y|x)/∂xk***
CONSTANT	-1.470	0.314	-4.683	0.000	
AGE	0.010**	0.004	2.248	0.025	0.0234**
ETHINICITY	-0.011	0.143	-0.074	0.941	-0.0006
GENDER	0.317*	0.184	1.722	0.085	0.0415*
EDUCATION	-0.262*	0.151	-1.742	0.082	-0.0365*
INCOME	-0.988***	0.195	-5.066	0.000	-0.1236***
MARITAL4	-0.117	0.161	-0.731	0.465	-0.0175
CHILDREN	0.695***	0.218	3.190	0.001	0.1246***
HHSIZE	0.016	0.061	0.262	0.793	0.0009
Observations	679				
Psedo R^2	0.813				
Log likelihood	-438.413				
Left censored observations at ratio <=0	536				
Uncensored observations	143				
Right censored observations	0				

Notes: Single, double, and triple asterisks (*,**,***) indicate significance at the 10%, 5% and 1% level.

Gender, as represented by female-headed household, has a positive and statistically significant coefficient, implying that female-headed household are more likely to experience food insecurity compared to male-headed households. As previous studies have noted, gender does not act in isolation to determine household food security but in conjunction with other variables such as education and access to well-paying jobs. Thus the result can be related to the survey responses, which indicated that more than half of female-headed households reported low educational attainment (high school or lower). Keeping other factors constant, food insecurity increases by a factor equal to 4.2% for female-headed household.

Although the estimated coefficient for age of household head was found to be statistically significant, it is contrary to the expected negative sign, suggesting that age has a positive and significant influence on household food insecurity. The plausible explanation could be that as a household head ages, the opportunities to engage in meaningful income-generating activities are minimized. This results reflects the survey responses, which showed that on average the respondents in the sample were 50 years old. Keeping other factors constant, food insecurity increases by 2.3% when the age of household head increases by one year.

For income, the survey results show a highly significant ($p < 0.01$) negative relationship between household income and food insecurity. Food insecurity, holding other variables constant, decreases by a factor of 12.4% as income increases by one level. This result corresponds with a prior expectation that income determines purchasing power of the household, so that households with higher daily income are less likely to become food insecure than low-income households.

As expected, the results show a positive and significant influence of presence of children on food insecurity of a household. As noted in the literature, the presence of children exerts more pressure on consumption than it contributes to production, and previous studies have shown that households with children have almost twice the rate of food insecurity as households without children (National Coalition for the Homeless, 2011). Holding other variables constant, food insecurity increases by 12.5% as the number of children increases by one level.

Other variables—including ethnicity, marital status, and household size—have only a weak correlation with food security and are not explored further.

Conclusions

The findings reveal that food insecurity exists severely in the selected low-income neighborhoods of the Huntsville Metropolitan Area. The key variables shown to have the strongest effect in determining household food security status were household income and presence of children. These results reflect findings in previous studies, which have noted that food insecurity is inherently intertwined with income. For instance, a report by the National Coalition for the Homeless (National Coalition for the Homeless, 2011) noted that “the low income population group is most likely to experience food insecurity, and also most affected by food insecurity because of the complexity of the interrelated issues they must overcome just to put a meal on the table.” The findings here concur with their conclusion that the most important policy to counter food insecurity, hunger, and food deserts is to even out income distribution so

that those at the bottom of the scale are more able to live on their own income. In summary, food insecurity is often geographically determined; as such, local and state governments must work together to do their own research and determine the best specific policies for their regions.

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