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AN ANALYSIS OF THE DETERMINANTS OF FOOD INSECURITY WITH SEVERE HUNGER IN SELECTED SOUTHERN STATES¹

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ABSTRACT

This study predicts food insecurity with severe hunger versus food insecurity with moderate hunger among low-income households with children and without children. Data for the study was generated from a survey of the clients of nonprofit food assistance agencies in selected southern states. The questionnaire incorporated the 18 core questions for assessing food insecurity, as well as the socio-demographic characteristics of users. A two-stage process involving the application of the Rasch measurement scale and the Logit model was employed to analyze the data. Results indicate that for both households with children and households without children, income was a significant predictor of food insecurity with severe hunger. However, the food stamp recipient variable was an equally important predictor of severe food insecurity among households with children. State and rural-urban differences were also analyzed.

Evidence indicates an increase in the demand for food from nonprofit food assistance agencies such as the food banks, soup kitchens, shelters, and other programs. Duffy, Hallmark, Molnar, Claxton, Bailey, and Mikloucich (2002), Tiehen (2002), and Nord, Andrews, and Carlson (2003, 2005) have noted an increase in the demand for food from both private and nonprofit food assistance agencies. According to Nord et al. (2005), 88 percent of U.S. households were food secure in the year 2004, while the remaining households were food insecure at least some time during that year. Furthermore, the incidence of food insecurity rose from 11.2 percent of households in 2003 to 11.9 percent in 2004, while the prevalence of food insecurity with hunger increased from 3.5 percent to 3.9 percent during the same period. The term food insecurity means not always having access to enough food for an active, healthy life for all household members.

Although the prevalence of food insecurity among U.S. households was only 11.9 percent in 2004, the rate of food insecurity varied considerably among households of different types. Nord et al. (2005) revealed that the rates of food insecurity were substantially higher for households with incomes below the Federal

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poverty line, households headed by single women with children, and, black and Hispanic households. When it comes to food insecurity, the most vulnerable were single females, single males, and children (Nord et al., 2003). Weinreb, Wehler, Perloff, Scott, Hosmer, Sagor, and Gundersen (2002), in a study of children and mental health, found that preschool and school-aged children who experience severe hunger have higher levels of chronic illness, anxiety and depression, and internalizing behavior problems than children with no hunger. Geographically, the incidence of hunger was more prevalent in central cities and rural areas than in suburbs and, in the South and the West than in other areas of the Nation (Nord et al. 2005). Therefore, the South presents a unique opportunity for a better understanding of factors affecting severe food insecurity among low-income households and the resulting social consequences.

The objective of this study was to determine factors that differentiate household food insecurity with severe hunger from household food insecurity with moderate or no hunger, among households with children and those without children. Henceforth, these two groups are called severe food insecurity and moderate food insecurity. These factors will provide insights into the causes and prevalence of severe food insecurity among low-income households. The information generated will be useful in formulating policies to mitigate severe food insecurity among low-income households overall, and low-income households in the Southern region in particular. The next section presents a review of related literature, followed by a description of the data used, a discussion of the method of analysis, and definitions of the variables. Results of the analysis are then presented. The last sections offer a summary discussion and concluding remarks.

Review of Literature

Although a large amount of literature exists on food security and low-income households, very little attention has been paid explicitly to factors causing severe food insecurity among households that participate in nonprofit food assistance programs. Gundersen and Oliveira (2001) suggest examining the informal food assistance agencies like the soup kitchens and food banks to assess their effects on food insufficiency, hence the focus on the clients of nonprofit food assistance agencies. Households with limited resources facing hunger generally turn to federal food assistance programs or the emergency food providers for assistance. Following years of decline, participation in the food stamp program has been on the rise for nearly four years (Liobrera 2004). In May 2004, approximately 24 million people participated in the food stamp program with the rate of participation increasing by 7.1 million or 42 percent since 2000. While determining what caused the increase in participation from data collected in this study is not possible, Liobrera (2004)

argues that it is likely that most of the increase can be attributed to the recent economic downturn, which resulted in lost employment and income, making more families eligible for the food stamp program.

The U.S. Conference of Mayors (2000), Duffy et al. (2002), Tiehen (2002) and Briefel, Jacobson, and Tiehen (2003) have all noted an increase in the demand for private and public food aid. Consequently, with the growing demand for food from nonprofit food assistance agencies, there is a growing concern about the efficacy of the safety net in meeting the food needs of low-income populations.

Furthermore, government agencies, advocacy groups and non-government organizations such as the Second Harvest and the Urban Institute have all conducted food security studies based on national surveys. These national level studies showed that food insecurity and hunger are comparatively more significant among households with children, the elderly living alone, homeless persons, those residing in rural areas and among Blacks and Hispanics, Rowley (2000), Tiehen (2002), and Nord et al. (2003, 2005). Also, Rowley, (2000) and more recently Nord et al., (2005) among others, indicated that food insecurity among households in the south has consistently been above the national average since 1995.

Data Description

The data for this study were collected using a survey designed to ascertain pertinent information from households using the nonprofit food assistance agencies in selected southern states. Urban and rural counties in the proximity of the four principal investigators (teams) were selected for the study due to extremely limited budget. The states involved were Alabama (two teams – one rural, one urban), North Carolina (one team), and Tennessee (one team). Lists of the food banks' distribution centers near the identified rural and urban counties were secured. From these six lists, three rural and three urban, sample distribution centers were systematically selected with a random start in proportion to their client size. One hundred and fifty questionnaires (156 for North Carolina) were administered by each of the four teams. The number of questionnaires administered within each selected distribution center was in proportion to the average number of clients for each center. Finally, to approximate random selection of respondents within each of the six samples, the respondents were surveyed over a three-month period on different days and times during the week. Care was also taken to avoid duplicate respondents. A total of 300 urban (150 from Alabama) and 306 rural (150 from Alabama) questionnaires were completed for this study.

Information relating to the household's feeding habits and meals, including household size were solicited. The survey incorporated the 18 core questions used to assess the food security of households in the CPS food security survey (USDA-

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FCS, 1997 and Nord et al., 2003), as well as information on the demographic and socioeconomic characteristics of the households (see appendix for the 18 core questions).

Although, the selection of the states and counties involved in this study was not random, the sample distribution centers and the client households were systematically selected with random starts. To adjust for any bias due to the selection of counties within each state, state dummy variables were included in the analysis. While differences between these dummy variables cannot be interpreted to represent estimates of differences between states, biases in the multivariate analysis due to state sample differences are adjusted. Hence, the results and implications of this study are tentatively generalized.

Method of Analysis

A two-stage process involving the Rasch measurement scale and the logit model was employed to analyze the data. First, the 1998 standard metrics scale values for analyzing household food security derived by the ERS using the Rasch software was used to summarize the data. To permit the application of the metric scale values, the households were classified into two groups: households with children and households without children. Based on the number of responses to the items in the “18 core-questions” included, the two groups of households were classified into four food security statuses: food secure, food insecure without hunger, food insecure with moderate hunger, and food insecure with severe hunger. However, only two households among the group without children were food secure. As a result, the food secure category was eliminated from the analysis. The remaining three categories in both groups were then collapsed into two: severe food insecure and moderate food insecure (comprising food insecure with moderate hunger and food insecure without hunger), for application of the logit model.

Gundersen and Oliveira (2001) have noted the possibility of a simultaneous decision about program participation and food insufficiency. Households that are more likely to participate in the program are more likely a priori to be food insufficient, complicating the analysis. Using a simultaneous equation model with two probits to account for possible endogeneity between food stamp participation and food insufficiency, they found no significant relationship between food stamp participation and food insufficiency. Similarly, Butler and Raymond (1996) observed that even when models were properly specified, food stamp usage did not improve nutrition in households with elderly needs. However, Bhattarai, Duffy, and Raymond (2005), found a negative relationship between higher food security status and the probability of food stamp participation or pantry use when used as an exogenous variable. To correct for possible endogeneity, theory suggests the use

of instrument variables. However, to provide consistent estimates, the instruments must be highly correlated with the independent variable but not with the dependent variable (Wooldridge 2002; Bhattarai et al. 2005), therefore, accounting for possible endogeneity of food stamp usage would likely result in bias from weak instruments (Staiger and Stock 1997).

Consequently, due to these findings that suggested a one-way causality between food security and program participation, we treat food stamp participation in this model as exogenous following Bhattarai et al. (2005) and estimate a logit model.

Specifically, the logit is the natural logarithmic value of the odds in favor of a positive response (here, severe food insecurity with hunger). The estimable logit model after transformation is given as:

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \beta_0 + \sum \beta_i X_i,$$

where, L_i is the natural log of the odds of households being food insecure with hunger severe (called the logit), X_i represents explanatory or independent variables, P_i is the conditional probability of household being food insecure with hunger, severe given X_i , and β_i denotes parameters to be estimated.

Definition of Variables

Tables 1 and 2 present the descriptive statistics and definitions of variables used in the logit analysis for both households with children and households without children. The basis for the selection of variables to examine empirically severe food insecurity was the previous studies (Olson, Rauschenback, Frongillo, and Kennell 1997; Nord and Andrews 2002; Morton et al. 2005; Gundersen and Oliveira 2001). Based on these studies, expected signs were also hypothesized for the selected variables. The dependent variable (food insecurity) for the two models is a dichotomous variable of severe food insecurity or moderate food insecurity. A value of 1 was assigned for severe food insecurity, and zero was given for moderate food insecurity. About 56 percent of the households (338) had children, while 44 percent (268) had no children. Of these, 282 households with children and 223 households without children were analyzed due to missing data. For the households with children, about 65 percent were severely food insecure, while 42 percent of the households without children were severely food insecure.

Eight dummy variables were created to facilitate the analysis. The dummy variable SEX was used to distinguish between male (=1) and female (=0) heads of households. RACE was also represented by a dummy variable with white = 1 and other races = 0. The "other" race groups comprised blacks and other minority

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Table 1. DEFINITIONS OF VARIABLES USED IN THE MODEL FOR HOUSEHOLD WITH CHILDREN (N = 338).

VARIABLES	DEFINITION	MEAN	STANDARD DEV.	EXPECTED SIGN
Dependent Variable				
Food Insecurity	1 = Food insecure with severe hunger; 0 = Food insecure with moderate hunger	.65	.48	
Independent Variables				
SEX	1 = male; 0 = female	.25	.43	?
RACE	1 = white; 0 = other	.30	.46	?
EDUCATION	1 = high school or above; 0 = less than high school	.59	.49	-
AGE	mean age (in years)	32.88	14.23	-
INCOME	Income / 1000	9.00	7.57	-
HMOWNER	1 = own; 0 = other	.21	.41	-
HHMEMBWORK	# of working household members	.87	1.07	-
FOOD STAMPS	1 = yes; 0 = no	.40	.49	-
URBAN	1 = urban; 0 = rural	.56	.50	-
ALABAMA	1 = yes; 0 = no	.43	.50	?
N. CAROLINA	1 = yes; 0 = no	.31	.46	?
TENNESSEE	1 = yes; 0 = no	.26	.44	?

Table 2. DEFINITIONS OF VARIABLES USED IN THE MODEL FOR HOUSEHOLD WITHOUT CHILDREN (N = 338).

VARIABLES	DEFINITION	MEAN	STANDARD DEV.	EXPECTED SIGN
Dependent Variable				
Food Insecurity	1 = Food insecure with severe hunger; 0 = Food insecure with moderate hunger	.42	.49	
Independent Variables				
SEX	1 = male; 0 = female	.43	.50	?
RACE	1 = white; 0 = other	.29	.46	?
EDUCATION	1 = high school or above; 0 = less than high school	.57	.50	-
AGE	mean age (in years)	45.95	19.69	-
INCOME	Income / 1000	8.70	7.87	-
HMOWNER	1 = own; 0 = other	.25	.44	-
HHMEMBWORK	# of working household members	.64	.83	-
FOOD STAMPS	1 = yes; 0 = no	.28	.45	-
URBAN	1 = urban; 0 = rural	.49	.50	-
ALABAMA	1 = yes; 0 = no	.58	.49	?
N. CAROLINA	1 = yes; 0 = no	.19	.40	?
TENNESSEE	1 = yes; 0 = no	.23	.42	?

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groups. EDUCATION was also a dummy variable with (1) for high school education or above, and (0) for less than high school education, and it was hypothesized that households with a head that has at least a high school education will be less likely to be severely food insecure. Other dummy variables include: HMOWNER, with own or buying home = 1, and renting or others = 0, and it was hypothesized that those people who own or are buying their homes were less likely to be severely food insecure; FOOD STAMPS, with receiving food stamps = 1, and not receiving food stamps = 0, and it was hypothesized that households receiving food stamps will be less likely to be severely food insecure; URBAN, with urban residence = 1, and rural residence = 0, and this was hypothesized to be negatively related to severe food insecurity. In addition, state dummy variables were included for ALABAMA and N. CAROLINA to adjust for the differences between the sample locations. Again no state relationships are hypothesized.

The other variables were AGE, a continuous variable with mean 33 years for households with children and 46 years for households without children, and INCOME, continuous with mean \$9.00 for households with children and \$8.69 for households without children. The income variable was divided by 1000 because of the large values. Also, HHMEMBWORK is a continuous variable indicating the number of people working in the household. Each of these three variables was hypothesized to relate negatively with severe food insecurity.

Results

Table 3 presents the results of the logistic regression model for households with children including the maximum likelihood estimated coefficients, Wald test statistics, and the changes in probability as well as the statistical results for the likelihood ratio test, Nagelkerke R², and the model's prediction success. Measures of goodness of fit indicate that the model fits the data fairly well. The likelihood-ratio test, which measures the significance of the logit function, was significant with a score of 311.9, suggesting a relationship between severe food insecurity and the suggested explanatory variables. Although the R² value is low, which is normal in logistic regression (Hosmer and Lemeshow, 2000), the model correctly predicted 69 percent of the responses, 38 percent more than due chance alone.

The estimated results of the logit model were interpreted using the change in probability (P_i) following Bell et al. (1994) and Pindyck and Rubinfeld (1976):

$$\Delta P_i = \beta_j P_i (1 - P_i),$$

where P_i is the estimated probability of household being severely food insecure evaluated at the mean, β_j is the estimated coefficient of the j^{th} variable. The (ΔP_i) varies with the probability, and when multiplied by 100 gives the percentage change in the probability of the event occurring given a change in the variable, all things being equal.

As reported by the results in Table 3 for households with children, FOOD STAMPS and INCOME were negatively significant with severe food insecurity with hunger at the 5 percent level, while the two state dummy variables; ALABAMA and N. CAROLINA were positively significant with severe food insecurity at the 5 percent level. URBAN residence was positive and significant with severe food insecurity at the 10 percent level. Inclusion of the state dummies did not change the coefficients significantly, but improved the model fit.

Regarding food stamp receipts, the change in probability (last column in Table 3) suggests that recipient households were 21 percent less likely to be severely food insecure with hunger. With income, for each \$1,000 increase in income, households were about 1.4 percent less likely to be severely food insecure. In contrast, urban households were about 11 percent more likely to be severely food insecure. The state dummy variables indicate that households in Alabama were about 15 percent more likely to be severely food insecure with hunger, while North Carolina households were about 18 percent more likely to be severely food insecure with hunger than Tennessee households. The other variables in the equation were not significant although homeowners (HMOWNER) and the number of working household members (HHMEMBWORK) had the expected negative signs with severe food insecurity with hunger. Contrary to expectation, education did not have the expected negative relationship with severe food insecurity, although it was not significant.

Similarly, Table 4 presents the parameter estimates and the statistical relationships for the model with households without children. Again, measures of 'goodness of fit' show that the model fits the data fairly well. The likelihood-ratio

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Table 3. PARAMETER ESTIMATES AND STATISTICAL RELATIONSHIPS OF DETERMINANTS OF SEVERE FOOD INSECURITY FOR HOUSEHOLDS WITH CHILDREN (N = 282)

VARIABLES	B	STD. ERROR	WALD	SIG. LEVEL	CHANGE IN PROBABILITY
MALE	-0.10	0.33	0.09	0.771	-0.023
WHITES	0.55	0.34	2.57	0.109	0.116
HMOWNER	-0.47	0.36	1.67	0.196	-0.115
AGE	0.01	0.01	0.37	0.542	0.002
FOOD STAMPS**	-0.95	0.31	9.33	0.002	-0.213
INCOME**	-0.06	0.02	7.80	0.005	-0.014
URBAN*	0.52	0.31	2.83	0.093	0.112
ALABAMA**	0.82	0.36	5.21	0.023	0.153
N. CAROLINA**	1.66	0.39	18.29	0.0001	0.182
EDUCATION	0.03	0.29	0.01	0.933	0.006
HHMEMBWORK	-0.12	0.14	0.72	0.395	-0.030
Constant	0.28	0.67	0.18	0.676	0.000

Log-likelihood ratio test statistics = 311.9

Nagelkerke R^2 = 0.251

Model prediction success = 69% (38% greater than chance)

**Significant at 5% level, *Significant at 10% level

test was significant with a score of 281.45, suggesting there was a relationship between the independent variables and severe food insecurity with hunger. The Nagelkerke R^2 was .102, and the model correctly predicted 61.9 percent of the responses. Again, inclusion of the state dummy variables did not significantly alter the results, but improved the model fit. As shown in Table 4, WHITES and INCOME were positively and negatively significant with severe food insecurity with hunger, respectively at the 5 percent level. AGE was negatively significant

Table 4. Parameter Estimates and Statistical Relationships of Determinants of Severe Food Insecurity for Households Without Children (N=223)

VARIABLES	B	STD. ERROR	WALD	SIG. LEVEL	CHANGE IN PROBABILITY
MALE	-0.21	0.30	0.01	0.944	-0.005
WHITES**	0.70	0.34	4.13	0.042	0.154
HMOWNER	-0.47	0.38	1.52	0.218	-0.113
AGE*	-0.02	0.01	2.68	0.101	-0.004
FOOD STAMPS	0.38	0.35	1.21	0.271	0.092
INCOME**	-0.05	0.02	4.39	0.036	-0.011
URBAN	0.04	0.31	0.15	0.902	0.009
ALABAMA	0.74	0.39	3.62	0.057	0.160
N. CAROLINA	0.91	0.48	3.56	0.059	0.184
EDUCATION	-0.01	0.31	0.00	0.985	-0.002
HHMEMBWORK	-0.02	0.19	0.01	0.908	-0.005
Constant	0.03	0.66	0.00	0.978	0.000

Log-likelihood ratio test statistics = 281.45

Nagelkerke R^2 = 0.102

Model prediction success = 61.9% (23.8% greater than chance)

**Significant at 5% level, *Significant at 10% level

with severe food insecurity at the 10 percent level, while ALABAMA and N. CAROLINA were again both positive and significant with severe food insecurity with hunger at the 10 percent level. The change in probability suggests a 15 percent increase in the incidence of severe food insecurity with hunger among whites. With income, for each \$1,000.00 increase in income, households were about 1.1 percent less likely to be severely food insecure. Also, for each unit increase in the age of the household's head, households were 0.3 percent less likely to be severely food insecure with hunger.

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Again, the two state dummy variables indicate a 16 and 18 percent more likelihood of severe food insecurity with hunger for Alabama and North Carolina, respectively. The remaining variables; males, home ownership, food stamp receipts, urban residence, education, and number of working household members were not significant, although home ownership, education, and number of working household members had the expected signs. Education may not be significant because its effects are largely mediated through the income variable (Morton et al., 2005).

Discussion and Conclusions

This study examined factors that affect severe food insecurity among low-income households in selected southern states using data generated from the clients of nonprofit food assistance agencies. For households with children, food stamp receipts, income, urban residence plus the state adjustment dummy variables were significant predictors of severe food insecurity. For households with no children, whites, age, and income again with the state dummy variables were the significant predictors.

As for households with children, those that receive food stamps were less likely to be food insecure with severe hunger compared with those that do not receive food stamps. This result is in contrast to the findings of Gundersen and Oliveira (2001) and may be due to how food insecurity was classified in this study. The present study takes into consideration different levels of food insecurity, consequently participating in food stamps may move people from a more severe category of food insecurity to a less severe category. For each thousand dollar increase in income, households with children were less likely to be severely food insecure with hunger. In contrast, households with children in urban areas were more likely to be severely food insecure than households in rural areas. While the state adjustment dummy variables are significant, no interpretation is appropriate except to acknowledge that these were the estimated differences in severe food insecurity between the conveniently selected counties as a group for each of the two states (Alabama: +15.3 percent and North Carolina: +18.2 percent) and the

constant (28.1 percent) representing the third state (Tennessee). These results regarding food insecurity with severe hunger underscore the importance of food stamp receipts and income to low income households with children.

In households without children, whites, age, income, and the two state dummy variables were significant indicators of severe food insecurity with hunger. White households without children were more likely to be severely food insecure than nonwhite households without children. An increase in the age of the head of the household results in lesser incidence of severe food insecurity, suggesting that older householders may have learnt to mitigate severe food insecurity better than younger householders. They may use food stamps, food banks, meals-on-wheels, and other food improvement strategies, while low income white households without children may be generally more reluctant to use these services. Likewise, as income increases, the prevalence of severe food insecurity decreases, suggesting that higher income mitigates food insecurity among low-income households.

The changes in probability in the states dummy variable are very similar in both models as well as the coefficients for male sex, white race, homeowner, income, food stamp receipt, and the number of household members working. This further validates the models.

The results of this study underscore the importance of food stamp receipts and income in mitigating severe food insecurity among low-income households. For households with children, food stamp receipts and income significantly reduce severe food insecurity with hunger, while for households with no children, income, as well as the age of the head of households were the most important variables in reducing the incidence of severe food insecurity with hunger. Therefore, to lessen severe food insecurity among lower income households, especially for households with children, qualified households should be encouraged to take advantage of the food stamp program. Furthermore, programs to enhance household incomes should be designed and encouraged.

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Appendix

Questions Used To Assess the Food Security of Households in the CPS Food Security Survey (Nord et al. 2003, 2005).

1. We worried whether our food would run out before we got money to buy more. Was that often, sometimes, or never true for you in the last 12 months?
2. The food that we bought just didn't last and we didn't have money to get more. Was that often, sometimes, or never true for you in the last 12 months?
3. We couldn't afford to eat balanced meals. Was that often, sometimes, or never true for you in the last 12 months?
4. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (Yes/No)
5. (If yes to Question 4) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
6. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food? (Yes/No)
7. In the last 12 months, were you ever hungry, but didn't eat, because you couldn't afford enough food? (Yes/No)
8. In the last 12 months, did you lose weight because you didn't have enough money for food? (Yes/No)

9. In the last 12 months, did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?
(Yes/No)
10. (If yes to Question 9) How often did this happen—almost every month, some months, but not every month, or in only 1 or 2 months? Questions 11 – 18 are asked only if the household included children age 0 – 18.
11. We relied on only a few kinds of low-cost food to feed our children because we were running out of money to buy food. Was that often, sometimes, or never true for you in the last 12 months?
12. We couldn't feed our children a balanced meal, because we couldn't afford that. Was that often, sometimes, or never true for you in the last 12 months?
13. The children were not eating enough because we just couldn't afford enough food. Was that often, sometimes, or never true for you in the last 12 months?
14. In the last 12 months, did you ever cut the size of any of the children's meals because there wasn't enough money for food (Yes/No)
15. In the last 12 months, were the children ever hungry but you just couldn't afford more food? (Yes/No)
16. In the last 12 months, did any of the children ever skip a meal because there wasn't enough money for food (Yes/No)
17. (If yes to Question 16) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
18. In the last 12 months, did any of the children ever not eat for a whole day because there wasn't enough money for food? (Yes/No)