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# Factors Contributing to Household Food Insecurity in a Rural Upstate New York County

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## Abstract

In order to identify factors that contribute to household food insecurity in a rural county in upstate New York, we conducted two personal interviews with 193 women who were between the ages of 20 and 40 years, had less than 16 years of education, and had children living at home. Data were collected on sociodemographic characteristics, risk factors for food insecurity, food program participation, and the Radimer/Cornell hunger and food insecurity measures; in addition, each household's food supplies were inventoried. Regression analyses and tree-based partitioning were used to identify the risk factors. The variables significantly ($p < 0.05$) contributing to food insecurity were being a single parent, lack of savings, larger household size, having unexpected expenses, adding $50 or more to food stamps to purchase sufficient food, and having low food expenditures. The variables contributing to low levels of household food supplies were low educational level, low food expenditures, not vegetable gardening, and not receiving free milk, eggs, and meat.

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## INTRODUCTION

Food insecurity is now a recognized public policy concern for food-rich countries such as the United States, as well as for poorer countries around the world (Maxwell and Frankenberger 1993; USDA and USDHHS 1994). Furthermore, the American Institute of Nutrition's (AIN) definition of food insecurity as "whenever the availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain" (Anderson 1990) is becoming widely used for policy-relevant nutrition research in the United States and is consistent with the definition of food insecurity used in this paper.

Using both qualitative and quantitative research methods, Radimer and colleagues have developed a definition of food insecurity, a conceptual framework, and the Radimer/Cornell hunger and food insecurity measures relevant for food-rich countries (Radimer 1990; Radimer, Olson, and Campbell 1990; Radimer, Olson, Greene, Campbell, and Habicht 1992). The validity of these measures for identifying groups of households experiencing food insecurity is now established (Kendall, Olson, and Frongillo 1995). Very recent research indicates that the household-level food insecurity measure has a sensitivity of 89 percent and a specificity of 63 percent, which can be improved to 71 percent by eliminating one item in the measure (Frongillo, Rauschenbach, Olson, Kendall, and Colmenares 1995). Thus, the household-level food insecurity measure correctly identifies 89 percent of the truly insecure households as insecure and correctly identifies 71 percent of the secure households as secure.

Given the previous lack of a validated measure of household-level food insecurity, it is not surprising that few studies have examined the factors contributing to food insecurity in populations living in relatively food-rich countries. Recently, Campbell (1991) elaborated a conceptualization of food insecurity and its risk factors. She defined risk factors for food insecurity as anything that limits

household resources (money, time, information, health, etc.) or the proportion of those resources available for food acquisition. Campbell's conceptual framework outlines the relationship of household resources to food acquisition and food insecurity. Our study draws on this conceptualization and examines social and demographic characteristics that influence a household's level of resources, as well as its level of financial or economic resources in relation to food insecurity. We also examine variables that measure aspects of food acquisition by the household.

For this study, we selected a rural population because, as Deavers and Hoppe (1993) point out, the *overall* poverty rate is higher in rural than urban areas. Since 1980, the rural poor have fared relatively badly, as the economic performance of rural areas has lagged behind the rest of the nation. In 1993, when the study reported here was conducted, the nonmetropolitan poverty rate was 17.2 percent while the metropolitan poverty rate was 14.6 percent (U.S. Bureau of the Census 1995).

Morris, Neuhauser, and Campbell (1992) have examined three factors that may limit food acquisition and thereby contribute to food insecurity in rural areas: limited number of supermarkets, limited availability of food items, and higher relative costs of the USDA Thrifty Food Plan (TFP) market basket of foods. Using a random sample of persistently poor rural counties, the investigators found 3.8 supermarkets per county in the rural United States versus 29 in urban areas. Supplies of fresh fruits, vegetables, and meats were very limited in the small and medium-size grocery stores that are more common in rural areas. The average cost of the TFP market basket was $102 in small and medium stores versus $81 in rural supermarkets. The picture that emerges from these findings is one of limited access to supermarkets and, as a consequence, decreased availability of fresh foods, an increased cost of food, and ultimately an increased risk for food insecurity.

Additional factors may contribute to food insecurity in rural areas. Rank and Hirschl (1993) have shown that qualified families in rural areas are much less likely than their urban counterparts to participate in food assistance programs such as food stamps. These researchers found adverse attitudes

toward welfare and lack of accurate information as two of the underlying mechanisms explaining low food stamp participation rates in rural areas. These studies indicate that food acquisition may be constrained in rural areas and that these constraints may increase households' risk of food insecurity.

Thus, the objectives of the research reported here were: (1) to identify the social, demographic, and economic characteristics of households that contribute to food insecurity; (2) to identify the food-acquisition characteristics of households which contribute to food insecurity; and (3) to analyze the relationships between these two sets of factors, as well as the use of coping tactics by food-insecure households. This research aimed to increase the general understanding of food insecurity in order to improve the targeting of interventions to food-insecure population subgroups and to facilitate the development of more effective interventions.

## METHODS

### Population

We conducted this study in a rural upstate New York county with a population of 60,517 in 1990 (Eberts 1994). Nearly 77 percent of this county's population live in places with fewer than 2,500 people. In 1990, the county unemployment rate was 5.8 percent; per capita income was $15,503; and the percentage of families in poverty was 12.6 percent. This county was below both the mean unemployment rate and the poverty rate for similar counties in upstate New York.

### Sample Selection

From January to July 1993, we surveyed women with children living in their household. Because previous research found statistically significant relationships between risk factors and food insecurity with a sample size of 189 (Radimer et al. 1992), we sought a sample of approximately 200 women. The sampling frame was a 1989 health census of the county which had a participation rate of

86 percent. Women over the age of 40 and those with 16 or more years of education were excluded, resulting in 3,433 women eligible for the study. Because we anticipated that the county's population had changed since the health census was completed, we selected a pool of 639 women from the census.

Six strata were formed based on the demographic characteristics (available from the census) most strongly associated with low socioeconomic status: first, whether potential subjects did or did not have a telephone, and then whether they had private health insurance, Medicaid insurance, or no health insurance. Each of the six strata was further stratified into five age groups: 15–19, 20–24, 25–29, 30–34, and 35–39 years.

Fifty-two percent of the women (331) could not be located within the county despite intensive efforts to find them. The remaining 308 women were contacted by telephone or, for those with no phones, at their homes to request their participation and to set up interviews. Two hundred women agreed to participate in the survey. Refusal rates were 18 percent in the strata presumed to be the lowest income group (those having no telephone and either Medicaid or no health insurance), 40 percent in the fifteen intermediate strata, and 32 percent in the five highest strata (those with a telephone and private health insurance). Because only seven of the 200 women fell into the 15–19 age category, they were dropped from the analysis.

Data Collection

Each respondent was interviewed twice in her home. During the first interview, trained field workers administered a questionnaire and inventoried household food supplies. The questionnaire sought information on sociodemographic characteristics, methods of obtaining food, food program participation, household expenditures, and the Radimer/Cornell hunger and food insecurity items. At the second interview, approximately three weeks later, the household food inventory was repeated.

The survey instrument was pretested in a sample of 20 low-income women and afterward a number of categories on the food inventory instrument were revised to better differentiate household

food supplies. After the study protocol was approved by the Cornell University Human Subjects Committee, all the respondents gave their informed consent prior to participation in the study. Each respondent received twenty dollars as compensation for participation.

Measurement of Dependent Variables

This study used two dependent measures of food insecurity. The first was the previously validated Radimer/Cornell hunger and food insecurity measures (Kendall, Olson, and Frongillo 1995). Since household-level food insecurity was the focus of this study, any household that had a positive response to one or more of the questions was defined as insecure. The remaining households were defined as food secure.

The second dependent measure of food insecurity was household food supplies as measured by the household food inventory. Food supplies are potentially a physical measure of food insecurity. Since in this population only 9 percent of all food expenditures are for food eaten outside of the home, household food supplies seem to reasonably represent the food available for consumption. The instrument used to measure household food supplies was based on methods used by Sanjur et al. (1979) and Crockett, Potter, Wright, and Bacheller (1992). Field workers coded the presence of 51 food items in the household into one of four categories, with zero indicating none of the food was present and three indicating a large amount was present. Item-specific response categories were determined based on the weight or volume of each item as purchased and judgments of differences that would be meaningful and that would differentiate those with depleted food supplies from those with replete food supplies. These scores were then summed over the 51 items and the two inventories were averaged to create a measure of food supplies that could range from 0 to 153. The food inventory had a sample mean of 71.06.

Measurement of Contributing Factors

Table 1 lists the sociodemographic and economic risk factors contributing to food insecurity considered in this analysis: annual income, whether income in the past year was less than usual, whether income dropped over the year, presence of monthly variation in income, household size (number of people eating from the same food supply), respondent's educational level, whether the household was headed by a single parent, employment status of respondent and spouse, presence of savings, and home ownership. The food acquisition variables were: receipt of food stamps; adding more than $50 to food stamps; total household expenditures (sum of rent/mortgage; school and real estate taxes; utility payments; car payments and repair, insurance, and gasoline expenses; daycare expenses; medical insurance and other medical expense; and food expenses for food eaten at home and away from home); food, housing, and car expenditures (each expressed separately as a dollar amount and as a percentage of total household expenditures; presence of unexpected expenses within the last year; presence of medical expenses (other than insurance) within the last year; limits on store choice because of transportation and/or store proximity; use of a food-buying club; whether food was obtained from vegetable gardening and hunting or fishing; the frequency of receipt of free milk, eggs, or meat; and frequency of shopping. The coping strategies considered were the frequency of borrowing money for food, of eating with friends and relatives, of food being brought by friends and family to the respondent's household, and of using a food pantry, and whether commodity foods were used.

Statistical Analysis

We first compared the food insecure and food secure households on each of the independent variables. Chi-square analysis was used for categorical variables and t-tests for continuous variables.

Next, logistic stepwise regression was used to select the best predictors from each of the following groups: (1) the social, economic, and demographic variables; (2) the food acquisition

**TABLE 1**

**Characteristics of Food Secure and Food Insecure Households**

| | Food Secure (% or mean) N = 90 | Food Insecure (% or mean) N = 103 | *p*-value |
|---|---|---|---|
| *Sociodemographic and Economic Factors* | | | |
| Income | | | <0.001 |
| <$5,000 | 4 | 10 | |
| $5,000-10,000 | 7 | 27 | |
| $10,000-15,000 | 12 | 14 | |
| $15,000-20,000 | 9 | 11 | |
| $20,000-25,000 | 17 | 12 | |
| >$25,000 | 51 | 25 | |
| Income last year less than usual | 16 | 26 | <0.05 |
| Income dropped in year | 33 | 48 | 0.01 |
| Income same monthly | 23 | 38 | 0.005 |
| Household size | 4.37 | 4.30 | <0.10 |
| Education | | | <0.01 |
| Less than high school | 12 | 19 | |
| High school graduate | 40 | 46 | |
| Some college or technical training | 25 | 27 | |
| College graduate | 22 | 8 | |
| Single-parent household | 8 | 29 | <0.001 |
| Respondent employed | 71 | 59 | <0.05 |
| Spouse employed | 82 | 64 | <0.001 |
| Have savings | 69 | 28 | <0.001 |
| Own or buying home | 76 | 61 | <0.01 |

(table continues)

**TABLE 1, continued**

| | Food Secure (% or mean) N = 90 | Food Insecure (% or mean) N = 103 | *p*-value |
|---|---|---|---|
| *Food Acquisition Variables* | | | |
| Receive food stamps | 6 | 33 | 0.001 |
| Add $50 or more to food stamps | 2 | 20 | <0.001 |
| Household expenditures | $17,617 | $13,613 | <0.001 |
| Food expenditures | $4,657 | $3,881 | <0.01 |
| Housing expenditures | $6,435 | $5,438 | <0.05 |
| Car expenditures | $4,779 | $3,056 | <0.005 |
| Food, as percentage of total expenditures | 0.28 | 0.32 | <0.05 |
| Housing/total expend. | 0.38 | 0.41 | n.s. |
| Car/total expenditures | 0.25 | 0.20 | <0.01 |
| Unexpected expenses in last year | 44 | 56 | <0.05 |
| Medical expenses in last year | 82 | 65 | <0.001 |
| Shop at store because | | | |
| Only store in area | 19 | 20 | n.s. |
| No transportation | 3 | 8 | <0.05 |
| Belong to buying club | 15 | 16 | n.s. |
| Vegetable garden for food | 63 | 55 | n.s. |
| Hunt or fish for food | 53 | 53 | n.s. |
| Receive free eggs, milk, or meat | 27 | 21 | n.s. |
| Frequency of major grocery shopping | | | |
| Once a week or more | 34 | 23 | |
| Once every 2 weeks | 42 | 38 | |
| Once every 3 weeks | 6 | 8 | |
| Once a month | 17 | 29 | <0.05 |

(table continues)

**TABLE 1, continued**

| | Food Secure (% or mean) N = 90 | Food Insecure (% or mean) N = 103 | *p*-value |
|---|---|---|---|
| *Coping Strategies* | | | |
| Frequency of eating meals at home of friends or relatives | | | |
| Never | 11 | 14 | |
| Hardly ever | 30 | 33 | |
| Less than once a month | 18 | 8 | |
| Once a month | 22 | 22 | |
| More than once a month | 18 | 22 | n.s. |
| Frequency of relatives or friends bringing food | | | |
| Never | 56 | 48 | |
| Hardly ever | 28 | 32 | |
| Less than once a month | 7 | 7 | |
| Once a month | 6 | 3 | |
| More than once a month | 2 | 10 | 0.05 |
| Frequency of borrowing money for food from relatives or friends | | | |
| Never | 87 | 57 | |
| Hardly ever | 13 | 30 | |
| Less than once a month | 0 | 7 | |
| Once a month | 0 | 4 | |
| More than once a month | 0 | 3 | 0.001 |
| Frequency of using a food pantry | | | |
| Not applicable | 44 | 37 | |
| Never | 38 | 24 | |
| Hardly ever | 15 | 29 | |
| Less than once a month | 2 | 1 | |
| Once a month | 1 | 10 | 0.001 |
| Use surplus or commodity foods | 39 | 60 | 0.001 |

n.s. = $p > 0.10$

variables; and (3) all variables combined. Variables were selected if they met the criterion of an F-statistic significant at the .05 level to be added and stay in the model. A variable selected in any of the three analyses was included in the final models. Likewise, we used linear stepwise regression to select a subset of the best predictors of household food supplies. Any variable chosen by the stepwise analyses for food insecurity or household food supplies was included in the final models for both dependent variables.

In the variable selection analyses, household financial resources were operationalized as income and total household expenditures, since in low-income families expenditures may more accurately characterize financial resources than income (Senauer, Asp, and Kinsey 1991). When the total household expenditure variable was chosen for inclusion in the model, income was not included. Similarly, the food expenditure variable was operationalized as total annual food expenditures and as a proportion of total household expenditures. When food expenditures as a proportion of all household expenditures were included in the model, total food expenditures were not included. The final models presented here include income and total annual food expenditures. Income level and household size were included in the final models even if these variables did not survive the selection procedure.

To address the objective of analyzing the interrelationships among subsets of variables, four models were estimated for each of the dependent variables (food insecurity and household food supplies) using the variables selected by the stepwise procedure: (1) the subset of sociodemographic and economic variables alone; (2) the subset of food acquisition variables alone; (3) the sociodemographic, economic, and food acquisition variables together; and (4) the variables in model 3 with the addition of the coping strategies.

To identify characteristics of households that contribute to food insecurity, results from logistic regression model 3 are expressed as odds ratios (OR) with associated 95 percent confidence intervals (CI). An odds is a measure of association and indicates the probability that a household with a certain

characteristic (or value on the independent variable) will be food insecure divided by the probability that it will not be food insecure (Kahn and Sempos 1989). The ratio resulting from logistic regression analysis compares the odds for two different values of the independent variable and can take on any value from 0 to infinity, with a value greater than 1 indicating that the risk of being food insecure is greater when the household has the characteristic (positive association). A value between 0 and 1 indicates that the risk of being food insecure is less when the household has the characteristic (negative association). An OR was considered statistically significant if 1 was not in the CI. Results from linear regression model 3 are expressed as regression coefficients with 95 percent CIs. The coefficient resulting from linear regression can take on a value from negative to positive infinity. Negative values indicate an inverse or negative association and positive values indicate a positive association of the variable with household food supplies. A coefficient is significant if 0 is not in the CI.

To provide insight into possible interactions among the most useful variables for distinguishing food secure and insecure households and for predicting food supplies, we used the tree-based partitioning analysis S-Plus (Venables and Ripley 1994). Tree-based partitioning is particularly useful when complicated interactions that cannot be modeled by usual regression methods are expected. This statistical procedure selects variables in a sequence, at each step choosing the independent variable that can be divided into two groups that best distinguish the class of a categorical dependent variable (classification tree analysis) or the level of a continuous variable (regression tree analysis). An independent variable can be included in the tree more than once and may use different cutoff points each time. After the tree is constructed, it can be pruned using various criteria to create a simpler, more easily interpretable and more generalizable tree. We used classification tree analysis to construct a tree for food insecurity and regression tree analysis to create a tree for household food supplies. We considered only the independent variables included in the final logistic and linear regression models in

our original tree construction. In this paper, we show the trees down to the level of variables found to be statistically significant in the final models of the logistic and linear regression analyses.

## RESULTS

Table 1 shows the characteristics of food secure and insecure households for each of the independent variables in this study. On the sociodemographic and economic factors, the two groups differed significantly in the expected direction on all independent variables. For the food acquisition variables, the two groups again differed in the expected direction on many of the variables. For example, food insecure households were more likely to receive food stamps and to add $50 or more per month to their food stamps to buy food for the household, but their annual dollar expenditures for food were less than those of food secure households. The two groups did not differ from each other on several strategies for acquiring food at low cost (e.g., belonging to a food buying club, vegetable gardening, hunting and fishing, and receiving free eggs, milk, and meat from friends or relatives or as in-kind pay for agricultural work). Interestingly, approximately 20 percent of both groups reported they shopped where they did because it was the only store in the area; although transportation constraints on food shopping were reported by substantially fewer respondents, the two groups differed significantly on this variable. Food insecure households made significantly more frequent use of all coping strategies except eating meals at the homes of friends and family. Food insecure households were significantly more likely to have used surplus or commodity foods than food secure households.

Table 2 presents the results of the food insecurity models that included various subsets of variables. The model with the subset of the sociodemographic and economic variables had an area

**TABLE 2**

**Proportion of Variance Accounted for by Models with Various Subsets of Variables**

| | Food Insecurity Area under ROC curve | Food Supplies $R^2$ |
|---|---|---|
| Sociodemographic factors | 0.77 | 0.26 |
| Food acquisition variables | 0.74 | 0.31 |
| Sociodemographic and food acquisition | 0.81 | 0.41 |
| Sociodemographic, food acquisition, and coping strategies | 0.83 | 0.43 |

under the receiver operating characteristic (ROC) curve of 0.77. (The area under an ROC curve can be interpreted like an $R^2$.) The ROC area ranges from 0.5 (i.e., chance) to 1.0 and refers to the probability that the logistic regression model correctly orders pairs of food secure and insecure households. When the selected food acquisition variables were considered separately, the area under the ROC curve was 0.74 and with both sets of variables the value was 0.81. The addition of the selected coping strategies resulted in an area under the ROC curve of 0.83, not a substantial increase. Sociodemographic and economic factors contributed almost the same as the food acquisition variables and the two sets taken together did not account for considerably more of the variation in food insecurity.

Table 2 also presents the results from the linear regression analysis for household food supplies. The subset of sociodemographic and economic variables explained 26 percent of the variance in food supplies and the food acquisition variables explained 31 percent of the variance. When both subsets of variables were included, more of the variance was explained, 41 percent, than when each was considered separately. Because including coping strategies added only two percentage points to the explained variance, they were left out of the final models.

Table 3 presents the odds ratios with 95 percent CIs for the sociodemographic and economic factors as well as the food acquisition variables associated with food insecurity. These were derived from the multivariate logistic regression analysis of model 3 using the Radimer/Cornell measure of food insecurity as the dependent variable. Among the sociodemographic and economic factors, women with savings were much less likely than those without to report food insecurity (OR=0.32, CI=0.17, 0.61). Women in single-parent households were more likely to be food insecure (OR=3.71, CI=1.36, 10.14), as were women in larger households (OR=1.36, CI=1.03, 1.8). Among the food acquisition variables, those women who added $50 or more to food stamps were more likely to be food insecure (OR=6.33,CI=1.46, 27.4), as were women whose households experienced unexpected

**TABLE 3**

**Odds Ratios and 95 Percent Confidence Intervals for Factors Contributing to Food Insecurity**

| Variable | Odds Ratio | Confidence Limits Lower | Upper |
|---|---|---|---|
| *Sociodemographic and Economic Factors* | | | |
| Income[a] | 0.988 | 0.788 | 1.238 |
| Savings | 0.321 | 0.168 | 0.611* |
| Own/buy home | 1.103 | 0.550 | 2.212 |
| Income same in year | 1.202 | 0.635 | 2.277 |
| Education[a] | 0.849 | 0.609 | 1.182 |
| Single parent | 3.707 | 1.355 | 10.139* |
| Household size | 1.363 | 1.027 | 1.810* |
| Respondent employed | 0.894 | 0.465 | 1.716 |
| *Food Acquisition Variables* | | | |
| Receives food stamps | 0.646 | 0.181 | 2.308 |
| Add $50 to food stamps | 6.333 | 1.464 | 27.400* |
| Medical expenses | 0.771 | 0.345 | 1.723 |
| Unexpected expenses | 2.317 | 1.269 | 4.231* |
| Vegetable gardening | 0.918 | 0.477 | 1.767 |
| Free milk/eggs | 0.862 | 0.433 | 1.715 |
| Food expenditures | 0.973 | 0.957 | 0.990* |

[a]Treated as continuous variables in the analysis.
*Statistically significant at $p < 0.05$

expenses within the previous year (OR=2.32,CI=1.27, 4.23). Food expenditures were lower in food insecure households (OR=0.97, CI= 0.96, 0.99).

Table 4 presents the regression coefficients (RC) and 95 percent CI for household food supplies. Education was the only social, demographic, or economic factor associated with food supplies. Women with more education had significantly larger food inventories (RC=4.13, CI=1.37, 6.90). Among the food acquisition variables, those women who spent more on food (RC=0.24, CI=0.11, 0.37), had vegetable gardens (RC=8.16, CI=2.67, 13.6), or received free milk, eggs, or meat (RC=8.80, CI=2.98, 14.61) had larger household food inventories than those without these characteristics. Several other variables approached statistical significance ($p > 0.05 < 0.10$). Having savings and owning a home approached significance as factors related to greater food supplies. Women who added $50 to food stamps had smaller household food supplies than those who did not do so.

The interactions between the independent variables as well as their relative importance is indicated in the results from the tree analysis. Figure 1 presents the classification tree for household food insecurity. Only a portion of the full tree is presented. (The full tree is available from the authors.) The tree had an overall misclassification rate of 16 percent. This degree of misclassification allowed for the production of a tree that was understandable and acceptably accurate. As can be seen, if the household had savings, it was much less likely to be food insecure than if it didn't (31 percent vs. 71 percent). Among the group with no savings, adding $50 or more to food stamps was the next variable selected. Ninety-five percent of those who added this amount of money or more to their food stamps to feed their family for the month were food insecure, whereas 65 percent of those who didn't were insecure. Among both of these groups, the next variable selected was annual food expenditures. Generally, lower food expenditures were associated with greater food insecurity. To continue on

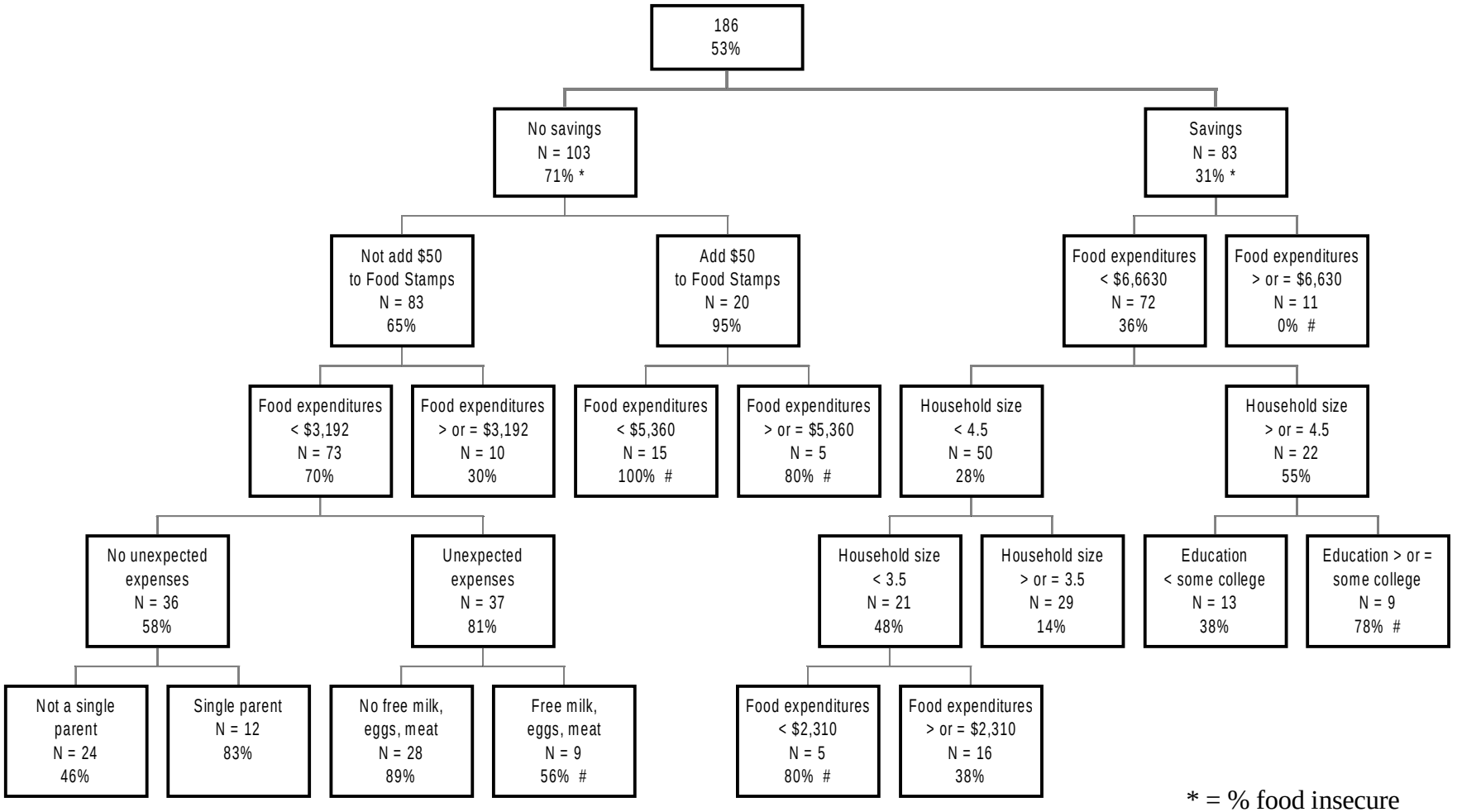
**TABLE 4**

**Regression Coefficients and 95 Percent Confidence Intervals for Factors Contributing to Household Food Supplies**

| Variable | Regression Coefficient | Confidence Limits Lower | Upper |
|---|---|---|---|
| *Sociodemographic and Economic Factors* | | | |
| INTERCEPT | 35.9359 | 19.9878 | 51.8841 |
| Income | 0.3644 | -1.5417 | 2.2705 |
| Savings | 5.6096 | -0.0992 | 11.3184 |
| Own/buy home | 5.6927 | -0.1804 | 11.5659 |
| Income same in year | 1.2853 | -4.1703 | 6.7409 |
| Education | 4.1336 | 1.3681 | 6.8991* |
| Single parent | 4.9805 | -2.9471 | 12.9081 |
| Household size | 1.4214 | -0.8559 | 3.6987 |
| Respondent employed | -0.6386 | -6.1127 | 4.8355 |
| *Food Acquisition Variables* | | | |
| Received food stamps | 2.9694 | -7.9057 | 13.8445 |
| Add $ to food stamps | -7.7695 | -16.5704 | 1.0314 |
| Medical expenses | 5.2351 | -1.3551 | 11.8252 |
| Unexpected expenses | -0.2933 | -5.3420 | 4.7554 |
| Vegetable gardening | 8.1538 | 2.6690 | 13.6387* |
| Free milk/eggs | 8.7985 | 2.9851 | 14.6119* |
| Food expenditures | 0.2439 | 0.1140 | 0.3739* |

*Statistically significant at $p < 0.05$

**FIGURE 1**
**Classification Tree for Food Insecurity (Radimer/Cornell Measure)**



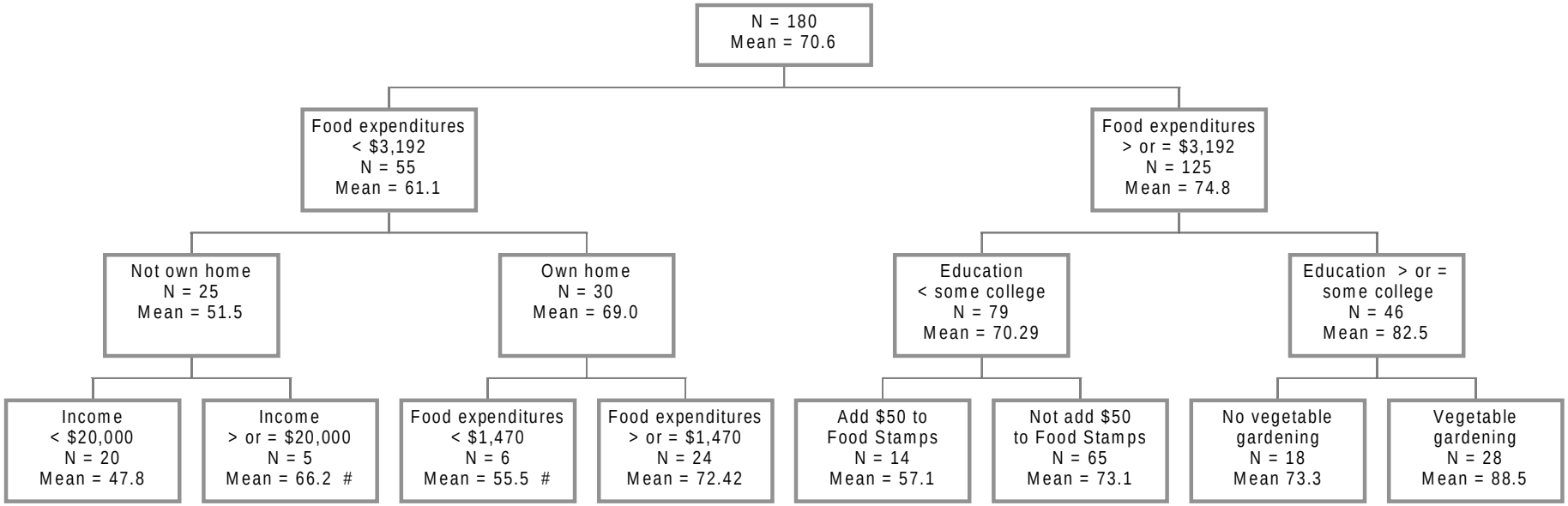

* = % food insecure
# = terminal node

down the tree, among those who did not add $50 or more to food stamps and had annual food expenditures of less than $3,192, and had unexpected expenses, 81 percent were food insecure.

To move to the other side of the tree and examine those who had savings and were food insecure, annual food expenditures was the first variable selected. Among those with annual expenditures less than $6,630, 36 percent were food insecure whereas among those with greater expenditures, no one was food insecure. In the group with expenditures less than $6,630, 55 percent of those with a household size greater than 4.5 were insecure. And following along those in this group, among those with some college or greater education, 78 percent were insecure.

Regression tree analysis was used to identify the characteristics of households with higher food supplies (see Figure 2). The first variable selected was annual food expenditures. Fifty-five of 180 households spent less than $3,192 annually on food and had a mean inventory score of 61.05, compared to a score of 74.78 for those who spent more than that amount. Overall, the important variables in predicting household food supplies among those with annual food expenditures of less than $3,192 were home ownership and income level. Owning a home and having an income above $20,000 were consistently associated with larger food supplies, 69.03 vs. 51.48 and 66.20 vs 47.80 respectively. Among the food insecure with food expenditures greater than $3,192, educational level of the respondent, whether she added $50 or more to food stamps to feed the family for the month, and whether the household had a vegetable garden were the important variables. Those respondents with greater than some college had a mean food inventory score of 82.52 versus 70.29 among those with less education. Among those with less education, respondents who added $50 or more to their food stamps had a mean inventory score of 57.14 versus 73.12 for those who didn’t. Among those with more education, respondents who did not have a vegetable garden had a mean score of 73.28 versus 88.46 for those who did.

**FIGURE 2**
**Regression Tree for Household Food Supplies**



## DISCUSSION

This paper is among the first to examine factors contributing to food insecurity using a validated direct measure of food insecurity, as well as a physical measure of food insecurity, household food supplies. The descriptive results in Table 1 are similar to those in a recent paper by Rose, Basiotis, and Klein (1995) describing the correlates of food insufficiency from USDA's 1989–91 Continuing Survey of Food Intake by Individuals (CSFII). They found higher rates of food insufficiency among households with these characteristics: low income, renting a home, single head of household, low educational level, six or more people in the household, and minority race or ethnicity. These authors carefully point out that their results are descriptive and do not control for underlying factors.

A positive aspect of the multivariate logistic and linear regression analyses presented in this paper is the controlling for underlying factors. When this was done, a fairly consistent picture of the factors contributing to food insecurity emerges across the two dependent measures. Measures of wealth, such as having savings and owning a home, were related to decreased risk of food insecurity. Economic insecurity and limited income earning potential operationalized as being in a single-parent household and having a lower educational level were related to increased risk of food insecurity. Lower levels of food expenditures and having unexpected expenses were consistently associated with increased risk of food insecurity. The latter finding indicates that both the level of household financial resources and the certainty of having financial resources are important for food security.

Senauer, Asp, and Kinsey (1991: 218) write, "Lack of food security and inadequate diets among the poor are primarily a direct result of inadequate income to buy sufficient food." Income, operationalized as a variable with six categories, was not significant in the regression analysis. We believe this may have happened for two reasons: First, food expenditures are a more immediate (proximal) predictor of food insecurity and the level of food expenditures is determined by income. So when the food expenditure variable is in the model, it may mask any effect of income on food

insecurity. Second, this finding may be a result of the way income was measured in this study. When total household expenditures were used to operationalize the concept of household financial resources, this variable was significant ($p < 0.05$) and food expenditures as a proportion of total expenditures were not significant. Senauer, Asp, and Kinsey (1991) note that total consumer expenditures may be a better indicator of a household's permanent income than current annual income, especially in low-income households. So household income clearly is an important influence on household-level food insecurity even if it was not significant in the multivariate analyses shown in this paper.

Among the food acquisition variables examined, that of total annual food expenditures was strongly and consistently associated with food insecurity and food supplies. Food insecure households spent about 83 percent of what food secure households spent on food. Food expenditures accounted for 32 percent of total household expenditures for food insecure households compared to 28 percent for food secure households. In analyzing food expenditures from 1980 to 1988, USDA analyst James Blalock (as quoted in O'Neill 1992) has shown that food expenditures among the poorest one-fifth of Americans declined by 13.1 percent while among the wealthiest one-fifth of the population, food expenditures grew by 2.7 percent. During this time period, growth in annual income level was stagnant for the poorest quintile, so that in 1990 this group was spending 42 percent of their income for food, compared to 14 percent for the average household (Kinsey 1994). The food insecure households in this study might well be spending as much as they can afford to on food, an amount insufficient to make them food secure.

Lino (1996) recently found food stamps to be the most common income source among poor families with children. In his study, 69 percent received food stamps and the program provided one-fifth of these households' annual income. Lino states, "Probably more than any other program, food stamps provides a safety net for poor households" (1996: 12). Although participation in the program is very low in this study, Lino's contention is supported by the consistent association of the insufficiency

of food stamps for meeting family food needs and food insecurity. In this sample, among households who received food stamps, those who added $50 or more in cash to their food stamps to buy food for the household for the month were more likely to be food insecure and to have lower household food supplies. We are inclined to evaluate this finding as real not only because of the consistency in the result across the two methods but also because we did the analysis with the independent variable operationalized as "whether food stamps lasted the whole month" and found the same result.

An interesting finding from this study that may be relevant only to food access in rural areas is the positive association of vegetable gardening with household food supplies. Likewise, receiving milk, eggs, and meat free or as in-kind payment for agricultural labor had a positive association with household food supplies. This finding points to the importance of household production in food security. However, Shotland and Loonin (1988) note that family gardens may have only limited potential for solving problems of food insecurity in this population subgroup because of the limited land available for gardening and the high cost of inputs such as seed, fertilizer, and insecticides. Poor families may be reluctant to risk their limited financial resources on a garden.

In addition to identifying factors contributing to food insecurity, this research aimed to understand how these factors interrelate, thus providing insight into the nature of food insecurity. Results from both the staged regression analysis and the tree analysis provide useful insights. Clearly, the sociodemographic and economic characteristics of households explain a substantial proportion of the variance in food insecurity measured both ways. These characteristics will be helpful in identifying segments of the population to target for interventions. But the results also show that food acquisition factors explain additional variance, particularly in household food supplies. Two food acquisition variables, food expenditures and having to add $50 or more to food stamps, appear to be particularly important because they enter the tree analysis near the top of the tree.

Coping strategies did not add substantially to the proportion of variance explained in either dependent variable when the other two groups of variables (sociodemographic factors and food acquisition variables) were in the model. Thus coping tactics appear to be coincident with food insecurity rather than factors that contribute to or protect against food insecurity. More research on how coping tactics relate to both food insecurity and its risk factors and consequences is warranted.

The tree analysis indicates that with information on only a very few variables, the majority of the food insecure households could be identified. Ninety-five percent of the households that had no savings and added $50 or more to food stamps were food insecure. Furthermore, the tree analysis offers insight into the relative importance of a variable such as single parenthood, which was identified as significant in the regression analysis. Although being a single parent is a risk factor for food insecurity, it is most important for those who have no savings, who don't add $50 or more to their food stamps, who have low food expenditures, and who have no unexpected expenses. It does not appear to be a risk factor for those households with savings and higher levels of food expenditures.

The results found here are applicable to rural counties in the northern half of the United States with a predominantly white population and some agricultural production. Further research of this type with an urban population is needed.

## CONCLUSION

This study identified factors contributing to food insecurity in a rural population. These include lack of savings, low educational level, low income, unexpected expenses, having to add $50 or more to food stamps to feed the household, and lower levels of food expenditures. Households with these characteristics should be given priority in intervention programs that address food insecurity. Furthermore, interventions should be designed to address these and other factors influencing food acquisition.

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