

High Prevalence of Food Insecurity and Hunger in Households in the Rural Lower Mississippi Delta

The Lower Mississippi Delta Nutrition Intervention Research Consortium^{1, 2}. (Note 1)

ABSTRACT: *Context:* Residents of the Lower Mississippi Delta of Arkansas, Louisiana, and Mississippi are at risk for food insecurity since a high proportion of the population live in households with incomes below the poverty level and have reduced access to food and decreased availability of a variety of foods. However, the magnitude of the problem is unknown because presently only nationwide and state estimates of food insecurity are available. *Purpose:* This study was conducted by the Lower Mississippi Delta Nutrition Intervention Research Consortium to determine the prevalence of household food insecurity, identify high-risk subgroups in the Lower Delta, and compare to national data. *Methods:* A 2-stage stratified cluster sample representative of the population in 36 counties in the Lower Delta was selected using list-assisted random digit dialing telephone methodology. A cross-sectional telephone survey of 1662 households was conducted in 18 of the 36 counties using the US Food Security Survey Module. *Findings:* Twenty-one percent of Lower Delta households were food insecure, double the 2000 nationwide rate of 10.5%. Within the Lower Delta, groups with the highest rates of food insecurity were households with income below \$15,000, black households, and households with children. The prevalence of hunger in Delta households with white children was 3.2% and in households with black children was 11.0%, compared to nationwide estimates of 0.3% and 1.6%. *Conclusions:* The Lower Mississippi Delta is characterized by a high prevalence of food insecurity and hunger. Future efforts to identify the household and community determinants of food insecurity to reduce its high prevalence are indicated.

were uncertain of having, or were unable to acquire adequate food sufficient to meet basic needs . . . due to inadequate household resources for food.”¹⁻⁶ There is evidence to suggest that the ability to acquire adequate food is limited in poor, rural areas, such as the Lower Mississippi Delta of Arkansas, Louisiana, and Mississippi. In a recent study of 36 rural Delta counties and parishes in these 3 states, poor rural households were found to use smaller grocery stores than urban households, to have reduced access to food, and to have decreased availability of a variety of foods. Overall, prices in rural food stores were 4% higher than prices in urban food stores.⁷ These factors and others, such as

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Despite the expansion of the US economy and strength of the nation's nutrition safety net, many households do not always have enough to eat. The most recent estimate by the US Department of Agriculture (USDA) shows that in the year 2002, 11.1% of US households were food insecure.¹ Food insecurity, as defined by expert consensus, means that “at sometime during the previous year, these households

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inadequate resources to cover housing and fuel costs, suggest that the prevalence of food insecurity and hunger could be expected to be higher in the Lower Mississippi Delta region than in the rest of the United States.⁸ This predominantly rural, traditionally agricultural region has high rates of poverty, unemployment, and low educational attainment.^{9,10} The rates of many nutrition-related chronic diseases also are higher in the Delta than in the rest of the United States.^{11,12}

State-level data provide the nearest estimates of the magnitude of the problem of food insecurity and hunger in the Lower Mississippi Delta. In 1996–1998, Arkansas, Louisiana, and Mississippi were ranked among the 6 states with the highest proportion of households that were food insecure: 12.6%, 12.8%, and 14%, respectively.⁴ The corresponding state-level statistics for food insecurity with hunger were 4.6%, 4.4%, and 4.2%. More recent 2000–2002 state-level estimates for food-insecure households in these 3 states are not statistically different from initial 1996–1998 levels.¹ Because the population sampled in the present study consisted of a large proportion of poor households, the prevalence of food insecurity is expected to be higher than state levels.

Recognizing the need for regional assessments of nutrition and health, the US Congress established the Lower Mississippi Delta Nutrition Intervention Research Initiative (Delta NIRI) to collect data on the nutritional health of Delta residents and to develop and evaluate sustainable nutrition interventions.¹³ This consortium of 6 academic institutions in Arkansas, Louisiana, and Mississippi and the USDA Agricultural Research Service has selected 36 Delta counties and parishes for nutrition intervention research (hereafter referred to as Delta NIRI counties) on the basis of poverty and geographic criteria.

The Foods of Our Delta Study 2000 (FOODS 2000) is 1 part of the comprehensive research plan to assess the nutrition and health status of a representative sample of the population in the 36 Delta NIRI counties. This report describes the prevalence of household food insecurity and hunger in the Delta NIRI counties and compares these findings with national data; it also identifies subgroups in the population in the Delta at risk for food insecurity.

Methods

FOODS 2000 was a baseline cross-sectional telephone survey of a representative sample of the population 3 years of age and older and was conducted between January and June 2000. A stratified cluster sampling plan was used to assign 36 Delta NIRI counties to 9 strata according to percentage urban,⁹

percentage black, and percentage living below the federal poverty level. Eighteen counties (2 from each stratum) were selected with probability proportional to size to represent the stratum in the telephone sample. List-assisted random digit dialing¹⁴ methodology was used to select a random sample of telephone numbers from the eligible blocks of numbers in these 18 counties; nonresidential and nonworking numbers were identified and removed.

A computer-assisted telephone interview was conducted to determine the eligibility of the household. An eligible household was one that had at least 1 member 18 years of age and older, the telephone number was not for business use only, and the household was located in 1 of the 18 Delta NIRI sample counties. During this initial interview, all members of the household were enumerated, and 1 adult per household was selected randomly using Kish's tables.¹⁵ Sample persons reported age, sex, race/ethnicity, and educational level. A second, nonscheduled telephone call was made to collect dietary information using a 2-part questionnaire.

Approximately 1–2 weeks after the dietary interview, a follow-up interview was conducted with the adult in the household who had completed the dietary interview. This interview included the 18-question US Food Security Survey Module and also had questions about participation in nutrition assistance programs and income.

Study Variables. Total household income for the previous 12 months was self-reported in increments of \$5,000 or \$10,000, ranging from less than \$5,000 to \$50,000 or more. For the present study, the income categories were stratified into 3 categories: \$0–\$14,999, \$15,000–\$29,999, and \$30,000 and higher. Households were considered to be participating in nutrition assistance programs if any members of the household were receiving benefits from any of the following: Special Supplemental Nutrition Program for Women, Infants, and Children (WIC); the National School Lunch Program; School Breakfast Program; Food Stamp Program; Summer Food Service Program; Nutrition Program for the Elderly; and the voluntary organizations supporting the Meals on Wheels.

The responses to the 18-item food security survey module were used to construct the 12-month food security scale and to classify households into 3 categories of food security status according to the US food security scale.^{16,17}

- Food secure: Households show no or minimal evidence of food insecurity.

- Food insecure without hunger: Food insecurity is evident in the household concerns and in adjustments to household food management, including reduced quality of diets. Little or no reduction in household members' food intake was reported.
- Food insecure with hunger: The food intake for adults and children in the household has been reduced to the extent that they have repeatedly experienced the physical sensations of hunger.

The children's food security scale was used to estimate the food security status of children.¹⁸ The scale is calculated from 8 questions in the 18-item food security survey module and measures the severity of hunger among the children living within the household as opposed to measuring food security status of households where children live.

Fifteen interviewers administered the questionnaire from the Telephone Research Center at Westat in Rockville, Maryland. FOODS 2000 was approved by the institutional review boards at each of the Delta NIRI partner institutions. Verbal consent was obtained from all adult participants during the initial contact.

Analysis. A household base weight equal to the inverse of the probability of selection was assigned to each sampled telephone number. Data were adjusted to compensate for telephone numbers with unknown residential or eligibility status, the number of residential telephone numbers in the household, and nonresponse to the screener interview. For the food security interview, weights were produced for household estimates as well as for person estimates. Finally, estimates were calibrated to US Census Bureau (1990) estimates of the total households by state.

Standard error adjustment factors were generated using SUDAAN (RTI International, Research Triangle Park, NC).¹⁹ The standard errors of the estimates generated by WesVar (Westat, Rockville, Md)²⁰ were then applied to the standard error adjustment factor calculated for each question. Data were analyzed using either χ^2 or Cochran-Mantel-Haenszel tests of associations as appropriate to determine differences in proportions. SAS (SAS Institute Inc., Cary, NC)²¹ was used to calculate the food security scores according to the algorithm described by Bickel et al.¹⁷ Logistic regression analyses were conducted with food security as the dependent variable and the following independent variables: income, race, children in the household, state, and number of persons in the household. State, number of persons in the household, and first-order interaction terms were not significant and were dropped from the model. To compare FOODS 2000 data to national Current Population Survey data,⁵ 95% confidence

intervals based on Z scores were calculated. SUDAAN version 7.5 was used to compute summary statistics and to conduct statistical tests and logistic regression.¹⁹

Results

There were 9,113 telephone numbers selected for the FOODS 2000 study. Of these, initial screening prior to data collection determined that 2,066 were either non-residential or nonworking numbers. During the data collection, an additional 2,670 numbers were nonresidential or nonworking numbers, and no one answered at 581 households. Of the remaining 3,796 available households, 166 were ineligible for this study (eg, not in the Delta NIRI counties), 1,293 refused to participate, and 175 were unable to participate due to language or other problems (eg, too sick). A total of 2,162 households agreed to participate for a response rate of 58.6%. Of the 1,754 adults who were eligible for the food security interview, 19 refused to complete the interview, and 73 could not be located or were not available during the study period (eg, because of ill health or being out of the country). There were 1,662 completed interviews for a response rate of 95%.

The demographic characteristics of the sample are similar to the 2000 US Census Bureau data for the total population of the 36 Delta NIRI counties: 49% of the sample households were black, 32% had incomes of less than \$15,000, 40% had children present, and 35% participated in nutrition assistance programs.²²

The sample numbers shown in Tables 1 and 2 are unweighted and percentages weighted. Of the 1,662 households in the survey, 1,297 (78.9%) were food secure, and 365 (21.1%) were food insecure, and of those who were food insecure, 111 (6.5%) were food insecure with hunger (Table 1). The proportion of households that were food insecure was nearly 2 times as great in households with incomes of less than \$15,000 compared to households with incomes of \$15,000–\$29,999 (41.2% versus 20.1%). There was a threefold increase in the proportion of households with incomes of less than \$15,000 that reported food insecurity with hunger compared to those households with incomes between \$15,000 and \$30,000 (14.3% versus 3.9%).

Table 1 also describes the food insecurity rates according to race, state, nutrition assistance program participation, and presence of children in the household. Black households were more than 3 times as likely (34.6% versus 10.4%) to be food insecure as white/other households. The prevalence of food insecurity was similar among the 3 states, with the highest proportion of food-insecure households in Mississippi (Table 1). Of the 565 households that reported that they were participating in nutrition assistance programs such as food stamps, school lunch programs, and WIC, 39.4%

Table 1. Prevalence of Food Insecurity in the Delta Nutrition Intervention Research Initiative Counties by Income, Race, State, Nutrition Program Participation, and Presence of Children in the Household, FOODS 2000

Characteristic*	Food Secure n (%)	Food Insecure			P‡
		Total† n (%)	Without Hunger n (%)	With Hunger n (%)	
Income					
\$0–\$14,999	295 (58.8)	202 (41.2)	130 (26.9)	72 (14.3)	.0001
\$15,000–\$29,999	329 (79.9)	97 (20.1)	79 (16.2)	18 (3.9)	
\$30,000+	587 (94.7)	37 (5.3)	28 (4.0)	9 (1.3)	
Unknown	86 (73.1)	29 (26.9)	17 (14.3)	12 (12.6)	
Race					
White/other	747 (89.6)	91 (10.4)	64 (7.3)	27 (3.1)	.0001
Black	536 (65.4)	271 (34.6)	188 (23.7)	83 (10.9)	
Unknown	14 (84.7)	3 (15.3)	2 (10.1)	1 (5.2)	
State					
Arkansas	405 (79.5)	101 (20.5)	72 (14.5)	29 (6.0)	.03
Louisiana	242 (83.8)	49 (16.2)	38 (11.9)	11 (4.4)	
Mississippi	650 (75.0)	215 (25.0)	144 (16.6)	71 (8.4)	
Participation in nutrition assistance programs					
Yes	338 (60.6)	227 (39.4)	156 (26.5)	71 (12.8)	.0001
No	959 (88.2)	138 (11.8)	98 (8.4)	40 (3.3)	
Households with children					
Yes	465 (71.9)	193 (28.1)	142 (20.6)	51 (7.5)	.0005
No	832 (83.5)	172 (16.5)	112 (10.6)	60 (5.9)	
Total	1,297 (78.9)	365 (21.1)	254 (14.6)	111 (6.5)	

* Sample numbers are unweighted and percentages weighted.

† Because of rounding errors, the food insecure with hunger and the food insecure without hunger may not add up to the food insecure total.

‡ Tests of significance were calculated comparing food secure, food insecure without hunger, and food insecure with hunger by income, race, state, participation in nutrition assistance programs, and the presence of children in the household.

were food insecure, including 12.8% that were food insecure with hunger. Households with children had a higher prevalence of food insecurity and hunger than those without children.

In the 658 households with children, there was a marked difference in the prevalence of food insecurity across race and income groups, with black and low-income households at greater risk (Table 2). Of the 368 households with children that reported they were participating in nutrition assistance programs, 60.3% were food secure (Table 2). The estimates for the prevalence of hunger in households with white children and households with black children in the Delta were, respectively, 3.2% and 11.0% (Table 2), which exceeds the comparable nationwide 2000 estimates of 0.3% and 1.6%.⁵ In the lowest income tertile, Delta children experienced hunger at least 1.5 times higher than their US counterparts.⁵ According to the children’s food security scale,¹⁸ 1.9% of all Delta children (1.2% of white

and 2.5% of black children) were actually hungry; these estimates were twice those of corresponding nationwide estimates of 0.7% of all children (0.5% of white non-Hispanics and 1.3% of black non-Hispanics). As shown in Table 3, logistic regression analysis confirmed the independent effects of income, race, and presence of children in households on food insecurity.

A comparison of the data from this study with comparable national statistics shows that households in the Delta were significantly more likely to experience food insecurity (see the Figure). The prevalence was 2 times greater in the Delta than in the national group.⁵ A similar pattern is seen for the prevalence of food insecurity with hunger in Delta households.

Discussion

One of the objectives of this study was to determine the overall prevalence of food insecurity in the Delta

Table 2. Prevalence of Food Insecurity in Households With Children by Income, Race, State, and Nutrition Program Participation, Delta Nutrition Intervention Research Initiative Counties, FOODS 2000

Characteristic*	Food Insecure				P‡
	Food Secure n (%)	Total† n (%)	Without Hunger n (%)	With Hunger n (%)	
Income					
\$0–\$14,999	92 (48.7)	92 (51.3)	63 (35.7)	29 (15.5)	.0001
\$15,000–\$29,999	119 (69.5)	64 (30.5)	52 (24.0)	12 (6.5)	
\$30,000+	234 (90.4)	27 (9.6)	19 (7.0)	8 (2.7)	
Unknown	20 (64.9)	10 (35.1)	8 (28.6)	2 (6.5)	
Race					
White/other	232 (87.5)	35 (12.5)	26 (9.3)	9 (3.2)	.0001
Black	229 (58.6)	156 (41.4)	115 (30.4)	41 (11.0)	
Unknown	4 (64.9)	2 (35.1)	1 (19.0)	1 (16.1)	
State					
Arkansas	145 (74.3)	47 (25.7)	36 (19.1)	11 (6.6)	.2
Louisiana	88 (77.9)	28 (22.1)	23 (17.7)	5 (4.4)	
Mississippi	232 (66.2)	118 (33.8)	83 (23.6)	35 (10.2)	
Participation in nutrition assistance programs					
Yes	215 (60.3)	153 (39.7)	110 (28.2)	43 (11.4)	.0001
No	250 (86.3)	40 (13.7)	32 (11.2)	8 (2.6)	
Total	465 (71.9)	193 (28.1)	142 (20.6)	51 (7.5)	

* Sample numbers are unweighted and percentages weighted.

† Because of rounding errors, the food insecure with hunger and the food insecure without hunger may not add up to the food insecure total.

‡ Tests of significance were calculated comparing food secure, food insecure without hunger and food insecure with hunger by income, race, state, and participation in nutrition assistance programs and the presence of children in the household.

and to compare these findings to national data. In the Delta, 21.1% of the households were food insecure. This is in sharp contrast to national data showing that 10.5% of all households in the United States were food insecure sometime during 2000. Another striking finding of the study was that Delta households experienced food insecurity with hunger at double the rate for US households. In nearly one-third of the food insecure households, food shortages were more serious or prolonged, and food intake was curtailed to the extent that household members repeatedly experienced hunger. If the household prevalence of food insecurity or food insecurity with hunger from this study is generalized to the 36 Delta NIRI counties, approximately 59,000 households were food insecure, and more than 18,200 households were estimated to have experienced hunger during the 12 months preceding the survey.

The health consequences of food insecurity and hunger may impact persons of all ages but may be

particularly severe in households with children. Findings from this study are consistent with those from the national surveys that also found higher-than-average rates of food insecurity in households with children.²³ Undernutrition in children has been shown to be associated with health problems^{23,24} and impaired growth²⁵ as well as with long-term impairments in cognition and social development.²⁶⁻³² Children from food-insecure households also are more likely to show behavioral, emotional, and academic problems than children who live in food-secure households.³³⁻³⁵ In adults, reported adverse consequences of food insecurity include increased risk for obesity,³⁶⁻³⁸ more complications in the control of diabetes,^{39,40} and a significant decrease in food and nutrient intake.⁴¹⁻⁴⁵

The second objective of this study was to identify subgroups of the Delta population where food insecurity was high. The highest prevalence of food insecurity was seen in black households, households with incomes less than \$15,000, and households with

Table 3. Adjusted Odds Ratios (From Multi-variate Analysis) of Independent Predictors of Food Insecurity in Households in Delta Nutrition Intervention Research Initiative Counties, FOODS 2000*

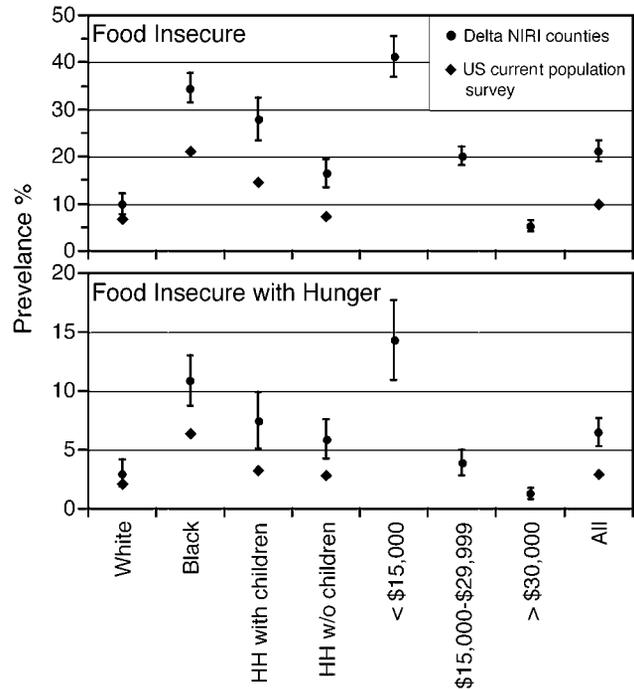
Predictor	Adjusted Odds Ratio (95% CI)
Income	
\$0-\$14,999	10.26 (6.3, 16.7)
\$15,000-\$29,999	3.94 (2.27, 6.84)
\$30,000+	1.00
Race	
Black	2.29 (1.69, 3.11)
White	1.00
Children in household	
Yes	2.24 (1.41, 3.56)
No	1.00

* 1495 observations used (blacks and whites only; others deleted).

children. For each of these high-risk subgroups, the prevalence of food insecurity was approximately 2 times greater in the Delta than the corresponding group nationwide. In the Delta, the rate of food insecurity for black households was significantly higher (34.6%) than in the United States overall (20.5%). The results from the logistic regression demonstrated that after adjusting for income and the presence of children in the household, black households were still twice as likely to be food insecure as white households. As shown in other research, participation in nutrition assistance programs is no guarantee against food insecurity but helps prevent overt hunger. According to the USDA Food and Nutrition Service, 50% of participants in the Food Stamp Program, the nation's largest nutrition assistance program, experience some level of food insecurity.⁴⁶ Perhaps individuals who "self-select" participation have the most severe food deficits or financial emergencies.

Urban/rural, regional, and state-level patterns in food security provide additional references to assess the magnitude of food insecurity in the Delta. Overall, in 1998 the national prevalence of food insecurity for nonmetro and metro regions was similar (11.8%).⁴⁷ On a regional basis, nonmetro rates for food insecurity were highest in the West and South (14.4% and 14.1%, respectively), and within the South the nonmetro rate (14.1%) was higher than the metro estimate (12.3%). Since the sample in this study represented a rural population, the Delta prevalence is most comparable to

Point estimate and ±95% confidence interval for prevalence of food insecurity (upper) and food insecurity with hunger (lower) by race, households with children, income level, and total for Delta Nutrition Intervention Research Initiative (NIRI) counties, FOODS 2000, compared to US Current Population Survey estimates, 2000.⁵



the nonmetro estimate. In the Delta counties, the prevalence was double the overall US nonmetro estimate and 1.5 times the Southern nonmetro estimate.⁴⁷ In the Delta region of each state, the prevalence of food insecurity was greater than for the entire state. Food insecurity in the Delta region of Arkansas, Louisiana, and Mississippi was 20.5%, 16.2%, and 25.0% respectively, compared to the corresponding state-level estimates of food insecurity of 12.6%, 12.8%, and 14.0%.⁴

Conclusion

This study documents the extent of food insecurity in a rural population and demonstrates that there is greater overall prevalence of food insecurity in a representative sample from 36 counties in the Lower Mississippi Delta region of Arkansas, Louisiana, and Mississippi than in the United States as a whole. This is not due only to the region having a larger proportion of

its population in high-risk groups than in the United States overall. Even within the high-risk groups (households with children, black, and low-income households), the prevalence is 1.5 to 2 times greater than similar levels reported in these same groups nationwide. This study also demonstrated the importance of regional surveys to identify regional populations and groups within the region at high risk for health and nutrition problems⁴⁸ and for future nutrition intervention research. Since non-telephone households were not included in this survey, it is possible that the prevalence of food insecurity and hunger within the Delta was underestimated. However, the validity of telephone methodology to collect comparable nutritional data from telephone and non-telephone households has been previously demonstrated in this population.⁴⁹ In addition, random digit dialing⁵⁰ is recommended as the preferred method to select a representative population-based sample, although others have described limitations to this methodology. As a next step, the Delta NIRI Consortium plans to collaborate closely with Delta communities⁵¹ to plan community-based participatory nutrition intervention research. This new phase will enable these partners to use additional measures to evaluate community and household food security to supplement current findings and provide additional insight into the factors that contribute to food insecurity.

Notes

1. This research was conducted by the Lower Mississippi Delta Nutrition Intervention Research Consortium. Executive Committee and Consortium partners included: Margaret L. Bogle, Ph.D., R.D., Executive Director, Delta NIRI, Agricultural Research Service, USDA, Little Rock, AR; Ross Santell, Ph.D., R.D., Alcorn State University, Lorman, MS; Patrick H. Casey, M.D., Arkansas Children’s Hospital Research Institute, Little Rock, AR; Pippa Simpson, Ph.D., Delta NIRI Data Analytical Center, Little Rock, AR; Donna Ryan, M.D., Pennington Biomedical Research Center, Baton Rouge, LA; Bernestine McGee, Ph.D., R.D., Southern University and A & M College, Baton Rouge, LA; Edith Hyman, Ph.D., University of Arkansas at Pine Bluff, Pine Bluff, AR; Kathleen Yadrick, Ph.D., R.D., University of Southern Mississippi, Hattiesburg, MS.

References

1. Nord M, Andrews M, Carlson S. *Household Food Security in the United States*, 2002. Washington, DC: Food and Rural Economics

Division, Economic Research Service, US Dept of Agriculture; 2003. Food Assistance and Nutrition Research Report FANRR-35.

2. Anderson SA. Core indicators of nutritional state for difficult-to-sample populations. *J Nutr.* 1990;120S:1559-1600.

3. Bickel GW, Carlson S, Nord M. *Household Food Security in the United States 1995-1998: Advance Report*. Alexandria, Va: Office of Analysis, Food and Nutrition Service, US Dept of Agriculture; 1999.

4. Nord M, Jemison K, Bickel G. *Prevalence of Food Insecurity and Hunger by State, 1996-1998*. Washington, DC: Food and Rural Economics Division, Economic Research Service, US Dept of Agriculture; 1999. Food Assistance and Nutrition Research Report 2.

5. Nord M, Kabbani N, Tiehen L, Andrews M, Bickel G, Carlson S. *Household Food Security in the United States, 2000*. Washington, DC: Food and Rural Economics Division, Economic Research Service, US Dept of Agriculture; 2002. Food Assistance and Nutrition Research Report 21.

6. Nord M, Andrews M, Carlson S. *Household Food Security in the United States, 2001*. Washington, DC: Food and Rural Economics Division, Economic Research Service, US Department of Agriculture; 2002. Food Assistance and Nutrition Research Report 29.

7. Kaufman PR. Rural poor have less access to supermarkets, large grocery stores. *Rural Development Perspectives.* 1999;13:19-26.

8. Nestle M, Guttmacher S. Hunger in the United States: Rationale, methods, and policy implications of state hunger surveys. *J Nutr Educ.* 1992;24:18S-22S.

9. US Department of Commerce, Economic and Statistics Administration, Bureau of Census. *1990 Census of Population and Housing Summary Tape File*. Washington, DC: US Government Printing Office; 1990.

10. Thornton A. Demographic, social, and economic characteristics. In: Harrison G, ed. *Lower Mississippi Delta Nutrition Intervention Research Consortium. Nutrition and Health Status in the Lower Mississippi Delta of Arkansas, Louisiana, and Mississippi: A Review of Existing Data*. Rockville Md: Westat; 1997:18-22.

11. Harsha D, Thornton A. Health status of adults. In: Harrison G, ed. *Lower Mississippi Delta Nutrition Intervention Research Consortium. Nutrition and Health Status in the Lower Mississippi Delta of Arkansas, Louisiana, and Mississippi: A Review of Existing Data*. Rockville, Md: Westat; 1997:89-120.

12. Smith J, Lensing S, Horton JA, et al. Prevalence of self-reported nutrition-related health problems in the Lower Mississippi Delta. *Am J Public Health.* 1999;89:1418-1421.

13. Schwenk FN. History and overview of the Lower Mississippi Delta Nutrition Intervention Research Initiative. In: Harrison G, ed. *Lower Mississippi Delta Nutrition Intervention Research Consortium. Nutrition and Health Status in the Lower Mississippi Delta of Arkansas, Louisiana, and Mississippi: A Review of Existing Data*. Rockville, Md: Westat; 1997:1-3.

14. Waksberg J. Sampling methods for random digit dialing. *J Am Stat Assoc.* 1978;73:40-46.

15. Kish L. *Survey Sampling*. New York, NY: John Wiley and Sons; 1965.

16. Carlson SJ, Andrews MS, Bickel GW. Measuring food insecurity and hunger in the United States: development of a national benchmark measure and prevalence estimates. *J Nutr.* 1999;129:510S-516S.

17. Bickel G, Nord M, Price C, Hamilton W, Cook J. *Guide to Measuring Household Food Security. Revised 2000*. Alexandria, Va: Food and Nutrition Service, Office of Analysis, Nutrition, and Evaluation, US Dept of Agriculture; 2000.

18. Nord M, Bickel G. *Measuring Children’s Food Security in U.S. Households, 1995-99*. Washington, DC: Food and Economics

- Division, Economic Research Service, US Dept of Agriculture; 2002. Food Assistance and Nutrition Research Report FANRR25.
19. Shah BV, Barnwell BG, Bieler GS. *SUDAAN User's Manual, Release 7.5*. Research Triangle Park, NC: Research Triangle Institute; 1997.
 20. *WesVar Complex Samples 3.0 User's Guide*. SPSS; 1998.
 21. *SAS System for Windows*. Cary, NC: SAS Institute; 1999.
 22. US Department of Commerce, Economic and Statistics Administration, Bureau of Census. *2000 Census of Population and Housing Summary*. Washington, DC: US Government Printing Office; 2003.
 23. Alaimo K, Olson CM, Frongillo EA, Briefel RR. Food insufficiency, family income, and health in US preschool and school-aged children. *Am J Public Health*. 2001;91:781-786.
 24. Casey PH, Szeto K, Lensing S, Bogle M, Weber J. Children in food-insufficient, low-income families: prevalence, health, and nutritional status. *Arch Pediatr Adolesc Med*. 2001;155:508-514.
 25. Bogle M, Smith J. Health and nutritional status of infants, children, and adolescents. In: Harrison G, ed. Lower Mississippi Delta Nutrition Intervention Research Consortium. *Nutrition and Health Status in the Lower Mississippi Delta of Arkansas, Louisiana, and Mississippi: A Review of Existing Data*. Rockville, Md: Westat; 1997.
 26. Drotar D, Sturm L. Personality development, problem solving, and behavior problems among preschool children with early histories of non-organic failure-to-thrive: a controlled study. *J Dev Behav Pediatr*. 1992;13:266-273.
 27. Pollitt E, Eichler A. Behavioral disturbances among failure-to-thrive children. *American Journal of Diseases of Children* 1976;130:24-29.
 28. Listerick R, Christoffel K, Pace J, Chiaramonte J. Severe primary malnutrition in US children. *Am J Dis Child*. 1985;139:1157-1160.
 29. Greenspan SI, Lieberman AF. Infants, mothers, and their interaction. In: Greenspan SI, ed. *Infancy and Early Childhood*. Washington, DC: US Dept of Health; 1980.
 30. Parker L. *The Relationship Between Nutrition and Learning: A School Employee's Guide to Information and Action*. Washington, DC: National Education Association; 1989.
 31. Brown JL, Politt E. Malnutrition, poverty and intellectual development. *Sci Am*. 1996;274:38-43.
 32. Sherman LP. *Statement on the Link Between Nutrition and Cognitive Development in Children*. Medford, Mass: Tufts University School of Nutrition, Center on Hunger, and Nutrition Policy; 1995.
 33. Kleinman RE, Murphy JM, Little M, et al. Hunger in children in the United States: potential behavioral and emotional correlates. *Pediatrics*. 1998;101:e3. Accessed November 16, 2003. <http://pediatrics.aappublications.org/cgi/reprint/101/1/e3.pdf>
 34. Alaimo K, Olson CM, Frongillo EA. Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics*. 2001;108:44-53.
 35. Alaimo K, Olson CM, Frongillo EA. Family food insufficiency, but not low family income, is positively associated with dysthymia and suicide symptoms in adolescents. *J Nutr*. 2002;132:719-725.
 36. Townsend MS, Love B, Achterberg C, Murphy SP. Obesity among food insecure women: a paradox? *FASEB J*. 2000;14:A731.
 37. Townsend MS, Peerson J, Love B, Achterberg C, Murphy SP. Food insecurity is positively related to overweight in women. *J Nutr*. 2001;131:1738-1745.
 38. Olson CM. Nutrition and health outcomes associated with food insecurity and hunger. *J Nutr*. 1999;129:521S-524S.
 39. Nelson K, Cunningham W, Andersen R, Harrison G, Gelberg L. Does food insufficiency affect health status and health care utilization among diabetics? Data from NHANES III. *FASEB J*. 2000;14:A731.
 40. Nelson K, Brown ME, Lurie N. Hunger in an adult patient population. *JAMA*. 1998;279:1211-1214.
 41. Cristofar SP, Basiotis PP. Dietary intakes and selected characteristics of women ages 19-50 years and their children ages 1-5 years by reported perception of food sufficiency. *J Nutr Educ*. 1992;24:53-58.
 42. Rose D, Gundersen C, Oliveria V. *Socio-Economic Determinants of Food Insecurity in the United States: Evidence From the SIPP and CSFII Datasets*. Washington, DC: Food and Rural Economics Division, Economic Research Service, US Dept of Agriculture; 1998. Technical Bulletin 1869.
 43. Rose D. Economic determinants and dietary consequences of food insecurity in the United States. *J Nutr*. 1999;129:517S-520S.
 44. Dixon LB, Winkleby MA, Radimer KL. Dietary intakes and serum nutrients differ between adults from food-insufficient and food-sufficient families: Third National Health and Nutrition Examination Survey, 1988-1994. *J Nutr*. 2001;131:1232-1246.
 45. Klesges LM, Pahor M, Shorr RI, et al. Financial difficulty in acquiring food among elderly disabled women: results from the Women's Health and Aging Study. *Am J Public Health*. 2001;91:68-75.
 46. Food and Nutrition Service, Office of Analysis, US Department of Agriculture. Food stamp participants food security and nutrient availability: Final Report. 1999. Available at <http://www.ns.usda.gov/oane/MENU/Published/NutritionEducation/Files/nutrient.pdf>. Accessed November 16, 2003.
 47. Nord M, Winicki FS. Prevalence of hunger declines in rural households. *Rural Conditions and Trends*. 2000;11:80-86.
 48. Pheley AM, Holben DH, Graham AS, Simpson C. Food security and perceptions of health status: a preliminary study in rural Appalachia. *J Rural Health*. 2002;18:447-454.
 49. Bogle M, Stuff J, Davis L, et al. Validity of a telephone-administered 24-hour dietary recall in telephone and non-telephone households in the rural Lower Mississippi Delta region. *J Am Diet Assoc*. 2001;101:216-222.
 50. Orden SR, Dyer AR, Liu K, et al. Random digit dialing in Chicago CARDIA: comparison of individuals with unlisted and listed telephone numbers. *Am J Epidemiol*. 1992;135:697-709.
 51. Yadrick K, Horton J, Stuff J, et al. Perceptions of community nutrition and health needs in the Lower Mississippi Delta: a key informant approach. *J Nutr Educ*. 2001;33:266-277.