Urban-Rural and Regional Variability in the Prevalence of Food Insecurity: the Survey of the Health of Wisconsin

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ABSTRACT

Background: Food insecurity is a public health concern estimated to affect 18 million American households nationally, which can result in chronic nutritional deficiencies and other health risks. The relationships between food insecurity and specific demographic and geographic factors in Wisconsin are not well documented. The goals of this paper are to investigate sociodemographic and geographic features associated with food insecurity in a representative sample of Wisconsin adults.

Methods: This study used data from the Survey of the Health of Wisconsin (SHOW). SHOW annually collects health-related data on a representative sample of Wisconsin residents. Between 2008-2012, 2,947 participants were enrolled in the SHOW study. The presence of food insecurity was defined based on the participant's affirmative answer to the question "In the last 12 months, have you been concerned about having enough food for you or your family?"

Results: After adjustment for age, race, and gender, 13.2% (95% CI, 10.8%-15.1%) of participants reported food insecurity, 56.7% (95% CI, 50.6%-62.7%) of whom were female. Food insecurity did not statistically differ by region ($P = 0.30$). The adjusted prevalence of food insecurity in the urban core, other urban, and rural areas was 14.1%, 6.5%, and 10.5%, respectively. These differences were not statistically significant ($P = 0.13$) and, for urban core and rural areas, persisted even when accounting for level of economic hardship in the community.

Conclusions: The prevalence of food insecurity is substantial, affecting an estimated 740,000 or more Wisconsin residents. The prevalence was similarly high in all urbanicity levels and across all state public health regions in Wisconsin. Food insecurity is a common problem with potentially serious health consequences affecting populations across the entire state.

INTRODUCTION

Food insecurity is a complex economic and public health issue. Defined as "limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways,"[1] food insecurity has a variety of health implications. It is associated with chronic diseases and poor metabolic control,[2,3] decreased mental health and cognitive performance,[4-6] medication underuse and cost-related nonadherence,[7,8] and less healthful eating.[9]

Food insecurity is a public health concern nationally and across different regions of the United States. It is estimated that 18 million American households have experienced food insecurity.[10] In 2006, the United States Department of Agriculture (USDA) introduced new language defining the severity ranges of food insecurity.[11] Old labels of food security and food insecurity with and without hunger were replaced by high, marginal, low, and very low food security (Table 1). According to 1999-2006 estimates from the National Health and Nutrition Examination Survey (NHANES), about 21.5% of Americans were characterized as having marginal, low, or very low food security.[12] The relationships between food insecurity and specific demographic and geographic factors in Wisconsin have not yet been investigated.

In order to take on a focused research effort on these issues in Wisconsin, it is important to first investigate characteristics of the state's food insecure population and the prevalence of food insecurity in different geographic areas and urbanicity levels across the state. We used data from the 2008-2012 waves of the Survey of the Health of Wisconsin (SHOW) to investigate sociodemographic and regional differences in food insecurity. We hypothesized that the prevalence of food insecurity would be similar across state public health regions and would be different across various levels of urbanicity within the state (ie, higher in urban areas). No previous study, of which we are aware, has directly investigated differences in food insecurity between areas of varying urbanicity and geography within a particular state, and such results could be key components in future attempts to develop

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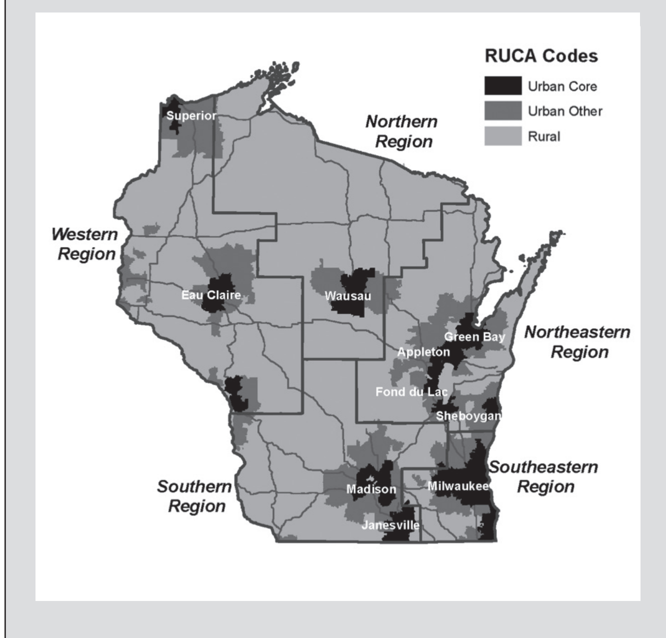
Table 1. Definitions of Food Security from the United States Department of Agriculture

Current Label[a]	Previous Label	Definition
High food security	Food security	Household had no problems or anxiety about consistently accessing adequate food.
Marginal food fecurity	Food security	Household had problems or anxiety at times about accessing adequate food. These problems did not limit the quality, quantity or variety of food intake.
Low food fecurity	Food insecurity	Household reduced the quality or variety of food intake without hunger, but the quantity was not substantially disrupted.
Very low food fecurity	Food insecurity with hunger	Household altered eating patterns of one or more members because the household lacked money and other resources for food.

[a]Current labels were adopted in 2006 after guidance from the Committee on National Statistics of the National Academies.[11]

Figure 1. Rural-Urban Classification of Census Block Groups in Wisconsin



targeted policies and address food insecurity in Wisconsin and elsewhere.

METHODS

Data Collection

The SHOW is an examination-based health survey that between 2008 and 2012 recruited a representative sample of 2,947 Wisconsin residents. The SHOW study rationale and methods have been previously described.[13] Briefly, a 2-stage cluster sampling method was used to randomly select census block groups and households in order to recruit study participants age 21-74 years. Participants were surveyed about their health, demographics, behaviors, and lifestyle. Participants also completed a physical exam measuring anthropometrics and blood pressure, and provided blood and urine samples for future analyses.

Food Insecurity

The presence of food insecurity was defined based on the participant's affirmative answer to the question "In the last 12 months, have you been concerned about having enough food for you or your family?" This question is aligned with items included in the USDA Food Security Survey Module used in NHANES to estimate individuals with low and very low food security. After excluding those participants who did not answer this food security question, the sample size for the analyses reported here was 2,552.

Predictors and Covariates

Participants were assigned into 5 public health regions of the state according to the categorization used by the Wisconsin Department of Health Services. They also were assigned into 3 urbanicity categories based on the University of Washington Rural-Urban Commuting Area (RUCA) Code corresponding to their census block group.[14] Urban core describes a location in or very near the center of a largely populated area, while urban other describes a location that is suburban and distinct from a primarily rural or urban core area. All other RUCA code groups were placed into a single rural category. This resulted in a 3-category classification including urban core, urban other, and rural (Figure 1).

In order to characterize the socioeconomic level at the census group level, US Census 2000 data was used to calculate the "economic hardship index (EHI)."[15-17] A standardized value from 0 to 100 for every Wisconsin census block group was computed for each of the following 6 indicators: unemployment, dependency, education, income, crowded housing, and poverty. The EHI was calculated as the average of these 6 scores. The tertiles of the EHI were used to classify census block groups in thirds of economic hardship (low, medium, and high).

Sociodemographic information collected from participants included highest level of education completed, household income, type of health insurance, and race and ethnicity. Educational level was assessed based on the participant's reported years of education completed and categorized into a binary variable by comparing the participants who received up to a high school diploma or equivalent to all other participants. Income was classified into 4 categories: those who earned $<200\%$, between 200%-299%, between 300%-499%, and $\geq 500\%$ of the federal poverty line (FPL). Income was also analyzed as a binary variable by comparing the population who earned less than 200% of the FPL to all other participants. The various types of health insurance used by participants were categorized into private, public Medicaid, and

public Medicare. Participants who had no insurance in the previous 12 months were considered to have no health insurance.

Information on participants' general health included derived measures of self-reported health, diabetes, and hypertension. Participants were asked to describe their health status as excellent, very good, good, fair, or poor. Health status was made into a binary variable by comparing participants who rated their health as fair or poor to all other participants. Diabetes was defined based on hemoglobin A1C ≥ 6.5% or self-reported physician-diagnosed diabetes. Hypertension was identified in participants with systolic pressure ≥ 140 mmHg, diastolic pressure ≥ 90 mmHg, or who reported currently taking an antihypertensive medication.

Data Analysis

SAS version 9.3 software (SAS Institute, Cary, North Carolina) was used to conduct data analyses. All statistical analyses accounted for the complex survey design used by the SHOW study. Logistic regression models (PROC SURVEYLOGISTIC) were used to estimate crude and adjusted odds ratios (OR) and 95% confidence intervals (CI) of food insecurity according to level of urbanicity, health region, and other sociodemographic variables. The adjusted prevalence of food insecurity by urbanicity further stratified according to levels (tertiles) of economic hardship index was also calculated. Direct standardization to the Wisconsin population using US census data was used to obtain Wisconsin sociodemographic adjusted prevalences.

RESULTS

Table 2 provides the gender, age, and race-adjusted characteristics of SHOW participants who answered the food security item. A total of 13.2% (95% CI, 10.8%-15.1%) of respondents reported food insecurity, 56.7% (95% CI, 50.6%-62.7%) of whom were female. Those reporting food insecurity were younger on average (mean age 41.1) than those who were food secure (mean age 46.1). This difference was statistically significant ($P < 0.0001$). The proportion of minority racial groups among those reporting food insecurity (24.2%) was higher than among those who did not (10.0%, $P < 0.001$). Mean body mass index (BMI) was about 1 kg/m^2 higher in food insecure than in food secure participants, but the difference was not statistically significant ($P = 0.12$). Likewise, diabetes prevalence was almost 80% higher among food insecure (10.2%) than among secure subjects (5.7%), but the difference was only borderline statistically significant ($P = 0.07$). Participants reporting food insecurity had significantly lower socioeconomic status as reflected by a lower educational level ($P = 0.002$) and lower income ($P < 0.001$), as well as worse self-reported health status ($P < 0.001$).

Table 3 shows the gender-, age-, and race-adjusted prevalence of food insecurity for each of the 5 Wisconsin health regions. The percentage of those participants assigned to the Southeast, South, West, North, and Northeast health regions who reported food insecurity was 13.8%, 9.5%, 9.5%, 8.7%, and 14.1% respectively. These differences were not statistically significant ($P = 0.30$). The adjusted prevalence of food insecurity in the urban core, urban other, and rural areas of Wisconsin was 14.1%, 6.5%, and 10.5% respectively. These differences also were not statistically significant ($P = 0.13$). Age-, gender-, and race-adjusted pairwise analysis, comparing urban and rural areas also showed no statistically significant differences in the prevalence of food insecurity ($P = 0.18$). The prevalence of food insecurity did not vary significantly within either urban core or rural areas when stratified according to level of economic hardship at the census block group (Table 3). Within other urban (mostly suburban) areas, however, the prevalence of food insecurity was significantly higher with increasing level of economic hardship ($P < 0.001$).

Table 2. Characteristics of Eligible SHOW Participants by Food Security Status, Survey of the Health of Wisconsin 2008-2012[a]

	Secure n=2,246	Insecure n=306	*P*-value
Female (%)	49.4	56.7	0.04
Age, mean years	46.1	41.1	<0.001
Self-reported race			
White, non-Hispanic (%)	90.0	75.8	<0.001
BMI, mean kg/m^2	29.5	30.6	0.12
Diabetes[b] (%)	5.7	10.2	0.07
Hypertension[b] (%)	29.4	23.8	0.1
Education			
High school diploma or less (%)	24.9	35.9	0.002
Income			
<200% federal poverty level (%)	25.5	60.1	<0.001
No health insurance[b] (%)	5.7	16.1	<.0001
Self-reported health status			
Fair or poor (%)	8.6	22.3	<0.001

[a] Estimates adjusted for age, gender, and race.
[b] Diabetes: Hemoglobin A1C>6.5 or self-reported diabetes; hypertension: systolic blood pressure ≥140 mmHg, diastolic blood pressure ≥90 mmHg, or currently taking antihypertensive medication; no health insurance: no health insurance at any time in the previous 12 months.

The results of multivariate logistic regression analyses on the relation between urbanicity and the odds of food insecurity are presented in Table 4. The age-, gender-, and race-adjusted odds ratio of food insecurity was about 33% higher in participants from urban areas compared to rural areas (a not statistically significant odds ratio, 95% CI, 0.9-2.1). In the full model that also included both education and income levels, food insecurity was still elevated in urban areas, but this elevation was not statistically significant. In the full model only low income level was a significant predictor of food insecurity. Participants reporting household income < 200% and 200%-299% of the FPL had significantly increased odds of reporting food insecurity compared to participants reporting household income > 500% of the FPL even after adjusting for all the other covariates in the model.

Table 3. Regional Variation of Food Insecurity, Survey of the Health of Wisconsin 2008-2012[a]

	Number	Food insecure[a](%)	*P*-value
Health Region			
Southeast	701	13.8	
South	543	9.5	
West	398	9.5	
North	374	8.7	
Northeast	543	14.1	0.30
Urbanicity (RUCA)			
Urban core	1210	14.1	
Other urban	384	6.5	
Rural	965	10.5	0.13
Urbanicity Stratified According to Tertiles of Economic Hardship Index at the Census Block Group Level			
Urban Core			
Low economic hardship	537	13.3	
Middle economic hardship	227	15.7	
High economic hardship	391	15.2	0.17
Other Urban			
Low economic hardship	132	0.0	
Middle economic hardship	200	6.3	
High economic hardship	51	19.7	< 0.001
Rural			
Low economic hardship	186	10.4	
Middle economic hardship	389	10.9	
High economic hardship	389	8.4	0.63

[a]Estimates adjusted for age, gender, and race.

DISCUSSION

Our results show that more than 1 in every 10 Wisconsin residents (about 13%) surveyed between 2008 and 2012 reported being "concerned about having enough food" for the family sometime in the previous year before the survey. This result may be underestimating the true prevalence of food insecurity if that is defined more broadly to include individuals with potentially limited food access, ie, what the USDA and other national studies consider "marginal food security" (see also Table 1).[1,11,18]

Our findings are consistent with another recent Wisconsin telephone-based survey that reported a 15.8% prevalence of food insecurity that also used a similar 1-question proxy to the 18-question USDA Household Food Screener to estimate food insecurity.[18] The USDA Household Food Security Questionnaire was added to the SHOW survey in 2012. Using SHOW data from 2012, we estimate that 26.5% of Wisconsin residents have marginal, low, or very low food security (95% CI, 20.1%-32.9%). This measure is more comparable to the 21.5% estimate obtained by NHANES that also used the USDA Household Food Security Questionnaire and reported on the percentage of respondents with marginal, low, and very low food security.[1,18] The 21.5% estimate was obtained using 1999-2006 data, so additional adjustment to account for the economic recession likely would make these estimates more comparable. The more stringent food insecurity measure used in this study highly correlates with low and very low food security definitions used by the USDA ($r = 0.93$).

Notably, the prevalence of food insecurity was not significantly different across the 5 designated public health regions of Wisconsin, suggesting that this is a concern throughout the entire state. Although slightly higher in urban areas, the difference in prevalence of food insecurity between rural and urban areas was not statistically significant across the state. To our knowledge, only one other study has directly compared food insecurity prevalence between urban and rural populations within a particular geographical area in Texas, and results of that study suggested that the rural populations had a greater prevalence of food insecurity compared to urban populations.[19] These results contribute to this ongoing field of study by demonstrating that, rather than exclusively an urban problem, rural areas also are affected extensively by poverty and food insecurity.

A particularly important contribution of this study is the inclusion of the other urban, or suburban, category. While a number of studies have reported the prevalence of food insecurity in rural and urban populations, most have failed to report information on suburban populations. Although hunger in suburban families has very often been overlooked, our results suggest that food insecurity in suburban areas, although less prevalent than in urban or rural areas, is present (affecting about 6.5% of suburban residents overall and almost 1 of every 5 residents in "other urban" areas with high economic hardship). This is probably a reflection of the changing demographic landscape and potential move of more affluent younger individuals into urban cores. In fact, in this study there were no statistically significant differences between urbanicity levels, suggesting the problem is pervasive regardless of geography. Findings are consistent with a previous study conducted in 2010 that estimated 6.2 million suburban households were food insecure.[18] It will be important to continue to study all populations regardless of urbanicity level in future studies of food insecurity.

One potential limitation of our study is that, because urbanicity levels were defined using RUCA codes, a significant level of heterogeneity within each assigned urbanicity group may exist. For example, a close scrutiny of the map in Figure 1 will reveal that "urban core" areas in our study included not only inner city Milwaukee (low SES, high proportion of non-white minority population) but also parts of Ozaukee and Waukesha—some of the wealthiest "urban" areas of the state—as well as areas of Superior or Eau Claire in the North. In order to address this potential limitation, we conducted analyses stratified according to the level of economic hardship as calculated from US census data at the census block group level. The results of these analyses (Table 3) revealed that, with the exception of "other urban" areas, the prevalence of food insecurity

did not vary significantly across different levels of economic hardship within strata of urban or rural areas.

Results from our analyses of the correlates of food insecurity in Wisconsin (Table 2) confirm those previously shown in national studies and local studies in other parts of the United States. A greater percentage of food insecure compared to secure participants were female, in agreement with results from a longitudinal national sample of young adults showing that food insecurity is more common among women than men.[20] There was a greater percentage of non-Hispanic African-American and Hispanic participants among the food insecure compared to food secure population, which has been a trend in previous studies.[2,3,21] Socioeconomic characteristics including less education and lower income have been associated with food insecurity previously.[2,3,21] Similarly, results of this analysis indicated that a greater percentage of the food insecure population earned up to a high school diploma or equivalent and had an income that was less than 200% of the federal poverty line. In addition, a greater percentage of food insecure SHOW participants reported fair or poor health and had worse mental health compared to food secure participants. Lower health status and mental disorders previously have been associated with food insecurity.[4,22-24] There are discrepancies in the literature regarding the relationships between food insecurity, age, and BMI. Results from this analysis indicate that the food insecure population was younger in age and had a non-statistically significant greater BMI than the food secure population, which confirms several studies with similar results.[2,3,20,21,25,26]

Table 4. Odds Ratios and 95% Confidence Intervals for Food Insecurity Adjusted by Various Sets of Covariates, Survey of the Health of Wisconsin 2008-2012

	Adjusted for demographics[a]			Fully Adjusted[a]		
	OR	**95% CI**	***P*-Value**	**OR**	**95% CI**	***P*-Value**
Urbanicity						
Urban	1.33	0.85-2.08		1.57	0.94-2.65	
Other urban	0.57	0.24-1.38		0.73	0.29-1.86	
Rural	1	Reference	0.13	1	Reference	0.14
Age (1 year increase)	0.97	0.96-0.99	<0.001	0.99	0.97-1.00	0.08
Gender (female vs male)	1.34	1.00-1.79	0.05	1.31	0.96-1.79	0.09
Race						
White, non-Hispanic	1	Reference		1.00	Reference	
African American, non-Hispanic	3.52	2.02-6.11		1.88	0.86-4.10	
Hispanic	3.10	1.61-5.97		3.10	1.32-7.28	
Other race	1.35	0.50-3.65	<0.001	1.12	0.46-2.77	0.06
Education						
<High school diploma				1.38	0.64-2.98	
High school diploma or equivalent				1.50	0.84-2.69	
Some college				1.58	1.00-2.49	
≥4 year college				1	Reference	0.26
Poverty Income Ratio						
<200% FPL				13.39	7.06-25.42	
200-299 %FPL				9.53	5.14-17.69	
300-499% FPL				2.02	0.92-4.42	
≥500% FPL				1.0	Reference	<0.001

[a]Demographic variables: age, gender, and race; fully adjusted model added socioeconomic variables (education, income).

Over the last decade there has been increasing attention to the social and economic environment where individuals live as an important determinant of their mental and physical well-being. Given the potentially serious health consequences of food insecurity, health care organizations—especially those providing primary health care—might consider screening for food security as part of standard care.[27] Adding a simple screening question such as the one used in this study ("[are you sometimes] concerned about having enough food for you or your family?") could be of value not only to better understand the patient's social circumstances but also to identify the possible need for referral to a social worker or other social services for assistance. Importantly, because the problem appears to be pervasive across all geographical areas of the state as suggested by our data, this recommendation should not be limited to residents in certain locations.

CONCLUSION

Demographic associations with food insecurity in Wisconsin are consistent with those found in national surveys. Interestingly, there were no significant differences in food insecurity prevalence across public health regions or varying levels of urbanicity (urban, suburban, or rural). Perhaps counter to perceptions that food security is only an urban-poor problem, the prevalence of food insecurity was similarly high (non-statistically different) across all urbanicity levels. Overall, food insecurity is a common problem with potentially serious health consequences affecting more than an estimated 740,000 Wisconsin residents—or close to 1.5 million—if a less stringent definition that includes "marginal" food insecurity were used. Consideration of routine screening for food insecurity as part of standard care could be considered in primary health care settings.

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