The impact of food sufficiency on the health status: The case of households in the North Central Region

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Abstract

Food sufficiency is positively associated with self-evaluated health status, which is a matter of great concern for stakeholders and policymakers. In this study, we show the effect of food availability, accessibility, and food assistance programs on the self-evaluated health status of the respondents in the North Central Region. We employed an ordered probit regression analysis and used data from the NCR-Stat: Baseline Survey 2022. The study results imply that food availability and accessibility are significantly positively associated with respondents' self-reported health status. In addition, demographic factors, such as being married, having higher educational attainment, and having a higher income level, are positively related to better self-reported health. In contrast to other studies, White respondents are significantly less healthy than other racial groups. This study highlights the importance of food sufficiency for the population's health.

1. Introduction

The United States Department of Agriculture (USDA) data reveal that around 44.2 million people in the United States in 2022 lived in food-insecure households and lacked access to sufficient food to maintain an active and healthy lifestyle (USDA, 2022). Food insecurity affects health status negatively, making it a matter of great concern for researchers, community development practitioners, and policymakers. For instance, members of food-insecure households may experience worse physical and mental health, require longer recoveries from sickness, and need more frequent hospitalization. They may also have a greater risk of developmental and educational delays than those from food-secure households (Gundersen and Gurber, 2001).

Respondents from food-insecure households often report their inability to afford a balanced diet, interrupted food supply, a high rate of running out of food, and meal skipping. Also, living in a food-insecure household changes the dietary pattern of the household members, as evident from prior studies that suggest food insecurity decreases dietary variety and increases the consumption of energy-dense food, leading to adverse negative health consequences (Seligman et al., 2010).

Food insecurity[1] in the United States has declined over the past decades (ERS, 2019). However, different studies show that any catastrophic phenomenon, such as a weather-related disaster or a war conflict, causes a long-term negative impact on food security. For instance, food insecurity and food pantry usage increased significantly after Hurricane Katrina (Colten et al., 2008), and

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[1] More information about definitions of food security can be found at https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/definitions-of-food-security/.

the food insecurity rate in Louisiana and Mississippi states remained higher for several years than before (Clay et al., 2018).

Several federal food assistance programs have been introduced to fight food insecurity and ensure essential nutritious food for health and well-being. Some of these food assistance programs include the Food Stamp Program, Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), National School Lunch Program, School Breakfast Program, Child, and Adult Care Food Program (CACFP), Summer Food Service Program, WIC Farmers Market Nutrition Program, Meals on Wheels Program, Community Supplemental Food Program (CSFP), Emergency Food Assistance program (TEFAP) (Feeding America, 2019). In 2022, around $183 billion was allocated for USDA's food and nutrition assistance program (USDA ERS - Food Security and Nutrition Assistance, 2023). However, these programs do not ensure food security for the population in need (Carlson et al., 2021).

In this paper, we examine the impact of food availability, food accessibility, and food assistance programs on the self-evaluated health status of respondents in the North Central Region (NCR) using the data from NCR-Stat: Baseline Survey 2022 (Bednarikova et al., 2022).

2. Literature review

The relation between food security and health status

Several studies focus on the association between adverse health outcomes and food insecurity. For example, Seligman et al. (2010) examine the relationship between food insecurity and diet-sensitive chronic diseases (hypertension, hyperlipidemia, and diabetes) using clinical evidence. In their study, the population-based sample includes 5,094 poor adults who participated in the National Health and Nutrition Examination Survey. The results suggest participants from food-insecure households have a 21% higher risk of clinical hypertension and about 50% higher risk of clinical diabetes than their food-secure counterparts. The study also shows that household food insecurity is associated with low income, high tobacco usage, and low educational attainment.

Stuff et al. (2004) study the association between household food insecurity and the self-reported health status of adults in the lower Mississippi Delta region. Adults from food-insecure households are more likely to rate their physical and mental health as poor. Also, younger participants have better health than older participants. Stuff et al. (2004) suggest that a $10,000 increase in income per year would lead to health status changes from poor to good.

Blaylock and Blisard (1995) explore that food security significantly influences a woman's self-evaluated health status, using the USDA Continuing Survey of Food Intakes by Individuals between 1985 and 1986. The results show that a food-secure woman is 60% more likely to have an excellent health status than a food-insecure woman. In addition, food stamp recipients and Black Americans are more likely to be food insecure. Homeowners, suburban residents, and respondents with higher income and education are more likely to experience food security. Respondents from suburban areas, living in larger households, and having higher educational attainment, as well as White respondents are more likely to report better health. However, older respondents, those with a higher body mass index, smokers, unemployed, and food insecure respondents are more likely to indicate poor health.

Other determinants of food accessibility and availability, such as direct-to-consumer farm sales, per capita grocery stores, full-service restaurants, fast food restaurants, and convenience stores in metro and non-metro areas, are important to health outcomes (Ahern et al., 2011). Their study uses the Food Environment Atlas and the Center for Disease Control and Prevention data to estimate the relationship between food accessibility and health outcomes. The study shows that more per capita full-service restaurants, grocery stores, and direct-to-consumer farm sales are associated with positive health outcomes in metro and non-metro areas. In contrast, fast-food restaurants and convenience stores are associated with negative health outcomes.

Socio-economic and demographic factors of households

The study by Nicholas and Valerie (2003) identifies the socio-demographic factors of Canadian food insufficient households using the National Population Health Survey from 1996/1997. The study examines the association between food insufficiency and physical, mental, and social health (derived from the social support index measuring perceived social support) among households struggling with economic constraints. The study indicates that the respondents from food insufficient households are more likely to report poor or fair health. They also suffer from poor functional health, chronic health conditions, major depression, and distress and have poor social support. Respondents from food insufficient households are more likely to report heart diseases, diabetes, high blood pressure, and food allergies than the respondents from food sufficient households. The results also show that those who do not own a house, single-parent households, households from western Canada, and households reporting welfare, unemployment insurance, and workers' compensation as their primary source of income are more likely to report food insufficiency.

Women reported significantly poorer health than men in the study conducted by Boerma et al. (2016) using World Health Surveys 2002 - 2004 data from 59 countries. Women of all ages reported poorer health than same-age men. The observed gender gap in self-reported health status was caused by the higher prevalence of chronic conditions in women, such as arthritis, depression, cognitive loss, asthma, etc. Also, women had more risk factors for stroke (Boerma et al. 2016). A study conducted at the University of London in 2016 found that women make fewer visits to the general practitioner, receive less health monitoring, and take more potentially harmful medication. In contrast, another study (Oksuzyan et al., 2010) shows that men die younger than women, and they are more burdened by illnesses during their life. They fall ill at a younger age and have more chronic sicknesses than women.

A study conducted in Poland reveals that self-rated health status is associated with employment status. Unemployed men have more than three times higher risk of low self-rated health than employed men. On the other hand, unemployed women show a 1.5 times higher risk of low self-rated health than employed women (Kaleta et al., 2008).

3. Theoretical model

We explore the relationship between self-evaluated health status and food sufficiency while controlling for the demographic characteristics of respondents (Figure 1). Specifically, the study aims to answer the following research questions:

- How is food availability associated with the respondent's health status?
- How is food accessibility associated with the respondent's health status?
- How is food assistance participation associated with the respondent's health status?

Figure 1. The relationship between health status, food sufficiency, and demographic characteristics
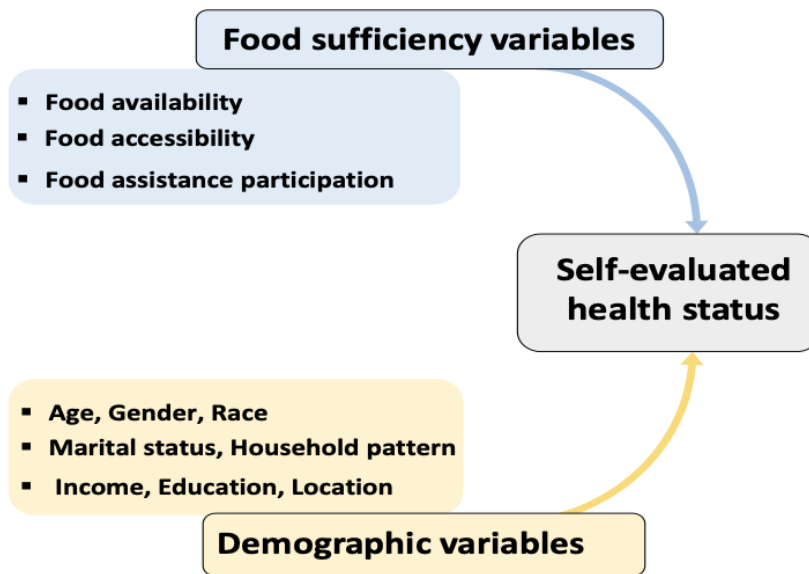
4. Materials and methods

4.1 Data

We used the NCR-Stat: Baseline Survey (Bednarikova et al., 2022) conducted by the North Central Regional Center for Rural Development (NCRCRD) in 2022. The NCR-Stat: Baseline Survey is a household survey including 4,669 respondents from all states in the NCR: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Participation in the survey was voluntary, and all information about respondents was de-identified. The dataset includes primary economic and social data collected at the state level and focused on households, businesses, and community well-being. However, the cross-sectional nature of the dataset represents a study limitation. The data contain one-time measurements, leading to difficulty in finding a cause-and-effect relationship. Despite this limitation, the dataset provides unique information about the socioeconomic characteristics of the respondents.

4.2 Methodology

We used an ordered probit regression analysis to evaluate the relationship between self-evaluated health status and food sufficiency. The equation for a probit model can be written as (Mehmetoglu & Jakobsen, 2022).

$$Y_i^* = \Phi\,(\alpha + \beta X + \gamma\,C + \varepsilon_i\,) \tag{1}$$

where the probit (the total probit) of Y is the dependent variable representing the probability that the event occurs given the independent variables X and C. In Eq. 1, the parameter α denotes the intercept, and the terms β and γ are slopes and regression coefficients, respectively, reflecting the effect of change of vectors X and C on Y. The parameter ε_i quantifies the random error, and Φ represents the cumulative standard normal distribution function. Considering the independent variables, the general form of the model becomes

$$\text{Health status}_i = \Phi\,(\alpha + \beta\,\text{Food security} + \gamma\,\text{Demographic characteristics} + \varepsilon_i) \tag{2}$$

Dependent Variable

The dependent variable *health status* is the self-evaluated health status of the respondent determined by the question, "How would you rate your health in general?" The survey participants rated their health status on a scale from 1 to 3, where 1 is poor, 2 is good, and 3 is excellent. The survey data show that 25.4% of the respondents indicated their health as poor, 37.1% as good, and 37.4% as excellent.

Independent Variables

We grouped independent variables into two categories: food sufficiency-related variables and household demographics. Table 1 shows the descriptive statistics of the variables.

The Food Sufficiency group includes three variables. The variable *food availability* is created from the question, "In the last 12 months, how often did food run out before you or other household members had money to buy more?". If the respondent or their family members ran out of food for at least 1 or 2 months, they are considered as not having food available. If they never ran out of food, they had food available. This dummy variable takes the value of 1 if the household has food available and 0 otherwise.

The variable *food accessibility* is created from the question, "Is it hard to get to the places where you purchase or receive food?". If the respondent ever found it hard to get to places to purchase or receive food, then they did not have food accessibility. On the other hand, if they never encountered hardship in finding a place to purchase or receive food, they had food accessible. If the household had food accessibility, then this dummy variable takes the value of 1, and 0 if otherwise. The variable *food assistance* results from the question, "Has anyone in your household participated in any of the Federal Food Assistance Programs?" The variable *food assistance* takes the value of 1 if the respondent was a food assistance recipient and 0 if otherwise.

The demographic variables include age, location, race, gender, educational attainment, income, type of household, and marital status. *Age* is a continuous variable that indicates the age of the respondent in 2022. The variable *gender* is a dummy variable with the value of 1 if the respondent was female, and 0 for otherwise. The variable *location* takes the value of 1 if the respondent was from a rural location and 0 if otherwise. The variable *race* is 1 if the respondent was white and 0 if otherwise. The *educational attainment* is a categorical variable that equals 1 if the respondent's educational attainment was grade 12 or GED and less, equals 2 if the educational attainment was 1 to 3 years of college or technical school, and 3 indicates 4-year graduate degree and higher. The variable *income* equals 1 if the household income was less than $25,000, 2 if the household income was between $25,000 to $49,999, and 3 if the household income was more than $50,000.

Family household variable indicates the household that consists of a householder and one or more other people living in the same household who are related to the householder by birth, marriage, or adoption. The nonfamily household consists of a householder living alone or with nonrelatives only, for example, with roommates or an unmarried partner. The responses take values of 1 for a family household and 0 if otherwise. The *marital status* variable is 1 if the respondent was married and 0 if otherwise.

Table 1. Descriptive statistics of all variables

Variable	Obs	Mean	Std. Dev.	Min	Max
i. Health	.	.	.	.	.
Poor	4,651	0.254	0.435	0	1
Good	4,651	0.372	0.483	0	1
Excellent	4,651	0.374	0.484	0	1
Food availability	4,608	0.676	0.468	0	1
Food accessibility	4,629	0.749	0.433	0	1
Food assistance	4,668	0.345	0.476	0	1
Family household	4,668	0.711	0.453	0	1
Age	4,668	51.155	17.866	18	93
Location	3,743	0.155	0.362	0	1
Race	4,596	0.842	0.365	0	1
Marital status	4,633	0.447	0.497	0	1
Gender	4,665	0.683	.466	0	1
i. Educational Attainment	.	.	.	.	.
Grade 12 or GED and less	4,658	0.291	0.454	0	1
College or technical school	4,658	0.371	0.483	0	1
Graduate degree	4,658	0.339	0.473	0	1
i. Income	.	.	.	.	.
Less than $25,000	4,502	0.224	0.417	0	1
$25,000-$49,999	4,502	0.317	0.465	0	1
More than $50,000	4,502	0.458	0.498	0	1

Data Source: Bednarikova et al. (2022). NCR-Stat: Baseline Survey

5. Results and discussion

Table 2 contains the results of the ordered probit regression model. The statistically significant variables are *food availability*, *food accessibility*, *age*, *race*, *marital status*, *educational attainment*, and *income*. The variables positively associated with better health outcomes are food availability, food accessibility, marital status, and higher income and educational attainment. Variables negatively associated with better health outcomes are age and race.

Table 2. Results of ordered probit regression analysis

	Coef.	St.Err.	Sig.
Food availability	.198	.051	***
Food accessibility	.217	.052	***
Food assistance	.009	.049	
Family household	-.024	.053	
Age	-.008	.001	***
Location	.016	.053	
Race	-.154	.053	***
Marital status	.133	.051	***
Gender	-.04	.042	
Educational Attainment			
Grade 12 or GED and less (Reference category)	-	-	-
College or technical school	.092	.05	*
Graduate degree	.357	.053	***
Income			
Less than $25,000 (Reference category)	-	-	-
$25,000-$49,999	.243	.057	***
More than $50,000	.467	.06	***

*Note: Significance of coefficients in the model *** p<0.01, ** p<0.05, * p<0.1*

Source: Author's own calculations

To interpret properly the variables that might be significantly associated with the self-evaluated health status, we analyzed the marginal effects of the ordered probit model shown in Table 3. The results reveal that the respondents who do not lack food are more likely to report excellent health than others. Additionally, the marginal effect shows that having food available is associated with being 6 percentage points less likely to be in poor health status, 1.3 percentage points less likely to be in fair health status, and 7 percentage points more likely to be in excellent health status. Similar studies also show a strong positive association between food availability and health (Stuff et al., 2004). Food availability positively affects the respondent's health status, which answers our first research question.

Table 3. Marginal effect of the statistically significant variables

Statistically significant variables	Health		
	Poor	Fair	Excellent
Food availability	-0.0613	-0.013	0.0744
Food accessibility	-0.067	-0.0144	0.082
Age	0.002	0.000	-0.003
Race	0.047	0.010	0.058
Marital status	-0.041	-0.008	0.05
Educational Attainment - College or technical school	-0.0309675	-0.002153	0.0331205
Educational Attainment - Graduate degree and higher	-0.1093039	-0.0248072	0.1341112
Income - $25,000-$49,999	-0.084088	-0.0003175	0.0844055
Income - More than $50,000	-0.1508025	-0.0192042	0.1700067

Note: Only significant marginal impacts are reported.

Source: Author's own calculations

The respondents who had food accessibility (do not find hardship to purchase or receive food) have a positive association with health. More precisely, those with food accessibility are more likely to report excellent health. The marginal effect indicates that having food accessibility is associated with being 8 percentage points more likely to be in excellent health. Ahern et al. (2011) also found in their work that more per capita full-service restaurants, grocery stores, and direct-to-consumer farm sales are positively associated with health outcomes. This positive association between health and food accessibility relation answers our second research question.

Participation in the Federal Food Assistance Programs showed a negative association with self-evaluated health status. However, the result was not statistically significant in this study. It answered the third research question, that participating in food assistance programs was not significantly associated with self-evaluated health.

Several demographic factors might affect self-evaluated health status. The results show that older respondents are more likely to have poor health status than younger respondents. Interestingly, White respondents are less likely to report excellent health, which contradicts several previous studies (e.g., Boen, 2016). The marginal effect shows White respondents are 5.8 percentage points less likely to be in excellent health compared to respondents that self-identified as racial or ethnic minorities.

Additionally, the results reveal that married respondents are more likely to report better health status. Married respondents are 5 percentage points more likely to have excellent health. Other studies also show that married individuals are generally healthier than unmarried individuals (Waldron et al., 1996).

The results show that an increase in income might be significantly positively associated with self-reported health status. The respondents with a graduate degree or more are 13 percentage points

more likely to report excellent health than respondents with a high school degree. Higher levels of education might be positively associated with better self-reported health status, as people with tertiary education tend to be better informed about healthy decisions and choices and have greater knowledge of preventive measures (Zajacova & Lawrence, 2018). Moreover, a higher income level increases the likelihood of reporting excellent health. The respondents with household income of $50,000 or more are 13 percentage points more likely to report excellent health compared to those with a household income of less than $25,000.

6. Conclusion

Availability and accessibility to food play a critical role in respondents' health status. In this study, food availability and accessibility, described as food sufficiency, showed that food-secured respondents are more likely to report better health. Moreover, married respondents and respondents with higher income and educational attainment are more likely to report better health. On the other hand, older respondents and white respondents are more likely to report poor health.

The association between food sufficiency and health found in this study may help address the importance of food availability and accessibility for self-reported health status. The results regarding the healthier status of non-white respondents compared to White respondents suggest additional research to understand better the relationship between race and health status.

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Suggested citation