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# The intersection of food insecure populations in the Midwest U.S. and rates of chronic health conditions

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## Abstract

**Background:** Food insecurity is the state of having insufficient access to adequate food in order to maintain a healthy lifestyle due to limited economic resources. This study expands upon the annual survey conducted by the USDA ERS, while providing evidence that additional factors, notably, medical or health-related issues play vital roles in the relationship between households and food security.

**Methods:** The data for this study were generated by surveying Midwestern residents. The sample of respondents was targeted to be representative of the Midwest in terms of sex, age, and income and was completed by 1265 respondents. The survey included the CPS Food Security Supplement to assess the food security of respondents. All respondents were asked the 10 household focused food security questions and respondents who indicated having children were asked the additional 8 child focused questions. Additionally, respondents were asked demographic, food security, and health status questions.

**Results:** Of the sample, 25% were considered food insecure. Being male, middle aged, having children, having household diabetes, having a household eating disorder, and having household depression/anxiety are significant determinants of decreased food security.

**Conclusions:** Establishing clear relationships between health and food can help to inform legislation. This analysis suggests the inclusion of chronic illness and health information to improve metrics and inform food security legislation.

**Keywords:** Food insecurity, Regional, Chronic health, Midwest

## Background

During election years, media and news sources overflow with information about candidates and platforms, covering a spectrum of political, social, and economic issues. Forbes featured an article presenting data from Pew Research about the 2016 presidential campaign, which found that 84% of voters deemed the “economy” the leading ballot issue which was followed by “terrorism,” “foreign policy,” and “health care” [1]. One component of the legislature that impacts the economy and addresses various aspects of food-related issues is ratified between elections—the Farm Bill. In 2014, President Barack Obama

signed the latest Farm Bill into effect and commented to an audience at Michigan State University, “the Farm Bill is not just about helping farmers,” and explained that it covers economic initiatives such as jobs, innovation, and infrastructure [2]. Importantly, the largest portion of the Farm Bill is dedicated to nutrition assistance programs. According to the United States Department of Agriculture’s (USDA) “Budget Summary and Annual Performance Plan: FY 2016,” expenditures to meet mandatory and discretionary Farm Bill programs for 2016 were estimated to be \$148 billion and 73% of budget outlays were for nutrition assistance [3]. President Obama explained “this country has helped Americans put food on the table when they hit a rough patch, or when they’re working hard but aren’t making enough money to feed their kids” [2].

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### Food security and chronic health

One example of a “rough patch” President Obama included was household illness [2]. It is understood that food assistance programs, such as the Supplemental Nutrition Assistance Program (SNAP), are designed to be temporary solutions, covering short-term crisis by providing aid for a few months, of which illness is considered a temporary economic strain on households [2].

A number of studies have analyzed and discussed a relationship between food security and illness. Using the USDA Economic Research Service (ERS) 30-day measure (a derivative survey of the Current Populations Survey (CPS) Food Security Supplement), Knight et al. [4] found 17.0% of respondents with diabetes were food insecure, and food insecure individuals were more likely to be medically uninsured. Furthering health considerations, Knight et al. [4] found that 18.9% of respondents with diabetes scrimped on medication (delaying filling prescriptions, inability to afford medication, taking less medication) and scrimping was positively and strongly correlated with food insecurity.

A similar study, also using the USDA ERS 30-day food security measure, found that 22% of adults with chronic diseases were food insecure or had cost-related medication under use and 11% reported both [5]. Berkowitz et al. [5] also found that participants of Women Infant Children (WIC) programs had decreased instances of food insecurity/cost-related medication underuse and suggest investigating the program dynamics. Muldoon et al. [6] found that there were higher odds of mental illness (specifically depression and anxiety) among those who experience insufficient food and hunger compared to those without hunger. A study done by Dharamasen et al. [7] found correlations linking food insecurity to health, including positive correlations between food insecurity and adult obesity, adult obesity and poverty, and adult obesity and unemployment [7].

### Food security and regional impact

While President Obama referred to the USA as a whole in 2014, most food assistance is distributed at regional levels, so it is important to understand the impacts regional characteristics may have on food security. One study by Moore and Diez Roux [8] compared *local food environments* across regions in three states and found a number of impactful differences. Comparatively, North Carolina had the largest population and highest median income of the study, while New York was the most urban [8]. In terms of food, New York had the highest number of food stores per square mile, compared to Maryland and North Carolina, and grocery stores were the most common stores in New York and Maryland, but convenience stores were most common in North Carolina [8]. Lower-income areas were found to have more grocery stores, meat and

fish markets, and liquor stores than higher-income areas but fewer supermarkets, vegetable markets, bakeries, natural food stores, and specialty stores [8]. Dharamasen et al. [7] found that food insecurity was positively correlated with race, poverty, and the number of grocery stores, but negatively correlated with expenditures at full service and fast food restaurants.

Other studies suggest that neighborhood relationships have little to no impact on food security. A study of Canadian neighborhoods was unable to link food security to neighborhood characteristics such as grocery stores, but concluded that household resource constraints and social capital contributed more to food insecurity risk [9]. Similarly, in a study done in Philadelphia, PA, researchers concluded that food access (nearness to quality food) did not impact food security, but access to aid programs and household financial constraints did [10].

Given that the economy (including food security) and health care (including non-temporary chronic illness) are leading issues in the USA, it is important to understand the overlap of household food security and health status. This study sought to quantify food security and chronic healthfulness of an extended Midwestern sample. This study focused on obtaining a sample of respondents, which was targeted to be representative in terms of sex, age, income, and state of residence. No screening of any kind related to food security was employed, which makes this data collection effort distinct from many others which focus on households with income limits or utilize screening questions (related to food security) for at least some portion of potential respondents. This study also pursued an exploration of the intersection of food security and chronic healthfulness in order to understand possible relationships between the two. This study also included a county-level poverty indicator in order to explore the relationship between community and household food security.

## Methods

### Measuring food security

The USDA ERS measures food security for the USA. In the “Household Food Security in the United States in 2014” report, it was reported that 14.0% of US households were food insecure or did not have “access at all times to enough food for an active, healthy life for all household members” due to limited economic resources [11].

The USDA ERS uses a survey generally referred to as the Current Populations Survey (CPS) Food Security Supplement which contains eighteen total questions: ten adult/household-specific questions and eight additional questions if children are present in the household. The questions ask whether certain behaviors involving food acquisition and diet quantity and quality occurred in the household over the last 12 months [11]. The complete

eighteen questions and possible response options as presented by the CPS Food Security Supplement are included in “Appendix.” Using the ten adult/household-specific questions, food security was calculated at four levels: high food security (HFS), marginal food security (MFS), low food security (LFS), and very low food security (VLFS). Responses of “yes,” “often,” “sometimes,” “almost every month,” and “sometimes but not every month” were tallied, and each respondent was given a raw score ranging from one to ten [12]. Scores of zero were ranked as HFS, one or two as MFS, three to five as LFS, and six or higher as VLFS. When using all eighteen questions, scores of zero were ranked as HFS, one or two as MFS, three to seven as LFS, and eight or higher as VLFS [12].

An important deliberation in food security assesses the way it is measured. Burchi and De Muro [13] wrote “The way food security is theorised, measured and finally analyzed affects the typology of policies that will be adopted.” The CPS Food Security Supplement was designed to measure three food security domains: uncertainty, quality, and quantity [14, 15]. Coates et al. [14] compared 22 food security measures across 15 countries, including the CPS Food Security Supplement and several variations, and found a number of comparisons: 18 of the 22 measures include uncertainty measures, 16 of the 22 addressed the ability to eat healthy or proper diets, 21 of the 22 contained questions about running out of food and perceptions that there was not enough food for each member to eat as much as they should or want. Despite comparability, Coates et al. [14] ultimately concluded that the CPS Food Security Supplement may not adequately cover all domains important to food insecurity but offers a good foundation.

Other criteria for measuring food security have been assessed. Burchi and De Muro [13] reviewed a number of food security measures and concluded a capability approach can improve measurements by accounting for more direct and indirect drivers. However, they concede including all factors requires an ability to access large amounts of information and can be improbable [13]. A capability approach assesses food entitlements (employment status, assets, skill sets, etc.), basic capabilities (food access/ quality, health status, decision making, etc.), and the capability to be food secure (nutrition knowledge, cultural and religious beliefs, etc.) [13]. Relatedly, Dian-sari and Naseki [16] found that household-head education and household-head nutritional knowledge were significant variables when predicting subjective household food security; increasing either factor increased the likelihood the household would be subjectively more food secure. Headey and Ecker [17] evaluated food measures, including leading US tools, and concluded that dietary diversity is a leading food security indicator and can be used to measure trends, shocks, seasonality, and

individuals, in a way that poverty and calorie availability subjective indicators (i.e., affordability and satisfaction) cannot. The CPS Food Security Supplement has a number of accepted measurement criteria [14, 17], but could be improved with more information.

### Survey instrument and data collection

A survey instrument was designed to collect data for this analysis and was hosted at Purdue University using Qualtrics. Lightspeed GMI facilitated obtaining a sample of Midwest residents through a large proprietary opt-in database in February 2016. The respondent’s sex, age, annual pretax household income, and state of residence were targeted to be representative of the population of the Midwest region based on the U.S. Census Bureau [18]. The survey attracted 7277 total link clicks, 7 people did not start the survey, 29 were under the age of 18, 578 were pushed out because of the state of residence quota, 5377 were pushed out because of the income quota, and 21 gave questionable or extreme response upon evaluation of the data. The final sample of completed surveys used in this analysis was 1265.

This study defines the Midwest according to the U.S. Census Bureau region definition and represents the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin [19], but also includes Midwestern neighbors Kentucky and Tennessee. Looking at the 2012–2014 state averages presented by Coleman-Jensen et al. [11], the Midwest contained a wide range of food insecurity proportions, with North Dakota having the lowest Midwestern and national rate of 8.4%, and Ohio with the highest of the Midwest at 16.9%. Kentucky and Tennessee had rates of 17.5 and 16.3% food insecurity, respectively [11]. A comparison of food insecurity rates for this study’s sample and those reported by Coleman-Jensen et al. [11] are provided in the results.

Demographic questions included in the survey asked about sex, age, annual pretax household income, state of residence, and household composition. For annual pretax household income, seven income categories were included and were condensed into three categories: low income: less than \$35,000, mid-income: \$35,000–\$75,000, and high income: \$75,000 or more. County of residence was collected in addition to respondents’ state of residence. Each county was paired with a U.S. Census Bureau Poverty estimate [20] in order to evaluate community conditions, in relationship with household specifics. The estimate represents the percent of the county population of all ages living at or below the national poverty line. For this study, the proportions were grouped into three categories 0–10, 11–20, and 21% or greater. Like the food insecurity proportions presented in Coleman-Jensen et al.

[11], the Midwest has a wide range of county-level poverty. For this sample, North Dakota had the lowest county average poverty of 10.8% and Ohio with the highest of 16%, and Kentucky had the highest rates of the sample with a county average of 20.6% living in poverty.

The food security questions explored were based on the CPS Food Security Supplement [11]. All respondents were asked the ten adult/household-specific questions. The results were calculated using the methods outlined in the “U.S. Household Food Security Survey Module: Three-stage Design, with Screeners” report [21]. The report suggests a screening question and income-based screening options. These options were left out of this study in order to obtain a broader understanding of the food security status of the complete sample of respondents.

For comparative purposes, two subsamples, households with and without children, were generated. All respondents were asked the ten household focused food security questions, and the sample of respondents who indicated that there were no children living in the household ( $n=749$ ) were asked no further questions. Respondents who indicated having children (persons younger than 18 years old) ( $n=360$ ) formed a second subsample and were asked the full eighteen-question survey, and the four levels were calculated with the score adjusted to accommodate the added questions. No supplementary calculations were done for the remaining respondents who did not indicate clearly if children were present in the household ( $n=150$ ).

Respondents were asked questions about the prevalence of health conditions in their households. To assess health conditions, respondents were asked “Please indicate if you or someone in your household have any of the following conditions” which included a list of responses: diabetes, Crohn’s disease, celiac disease, eating disorder, depression/ anxiety, high blood pressure, and high cholesterol.

#### Data analysis

Summary statistics were generated for each question, and cross-tabulations were performed in SPSS statistical software [22]. An ordered logit model was estimated using Stata/SE 14.1 [23] in order to identify determinates that contribute to the likelihood that a respondent will fall into increasing levels of food insecurity severity.

Ordered logits have been used to assess the probability of ranked outcomes. Migliore et al. [24] used an ordered logit to evaluate the likelihood of increased organic food purchases using quality conventions and income as independent variables. Diansari and Nanseki [1] used an ordered logit to predict household subjective food security status in Indonesia using insecure, somewhat insecure, somewhat secure, secure, and highly secure as the ranked dependent variable. Peterson et al. [25] employed

an ordered logit to understand consumer factors (credence attributions, time, conveniences) influencing the likelihood a consumer will choose a specific local food retailer, among US and French consumers.

For each respondent, the food security level was converted into a numeric value in order to generate a discrete dependent variable: HFS equaled zero, MFS one, LFS two, and VLFS three. The independent variables were primarily discrete binary variables where one equaled the variable descriptor. The variables were: male, age 18–24, age 25–44, age 45–64, low income less than \$35,000, mid-income: \$35,000–\$74,999, diabetes, Crohn’s disease, celiac disease, eating disorder, depression/anxiety, high blood pressure, and high cholesterol. Percent of county population in poverty was the only continuous variable with the potential to range from 0 to 100%.

Ordered logits estimate the likelihood that an outcome will fall between or beyond estimated thresholds and the thresholds were calculated using the ranked dependent variable [26]. For this study,  $y$  represents the dependent variable and can take on the values:  $y=0, 1, 2$ , or 3.

Rank would be established using  $k$  to represent thresholds of  $j$ ,

$$\begin{aligned} \text{If } k_{j-1} < y^* < k_j & \text{ then } y = j, \quad \text{for } j = 1, \dots, 2, \text{ and} \\ \text{If } k_2 < y^* & \text{ then } y = 3, \end{aligned}$$

where  $y^*$  is a latent variable [26] and will be estimated by the model. The food security rank for each respondent is represented by  $y^*$ . For each survey respondent  $i$ , food security can be explained by variables  $X_i$ ,

$$y^* = \beta X_i + u_i.$$

The probability of each rank,  $j$ , can then be estimated and depends on the regression outcome falling between  $k_j$  and  $k_{j-1}$  [26]

$$Pr(y_i = j) = Pr(k_{j-1} < \beta X_i + u_i < k_j).$$

#### Results

A sample targeted to be representative of the Midwest population was collected in February of 2016 and consisted of 1265 completed surveys. Summary statistics on demographics reported are provided in Table 1. Forty-nine percent of the sample was male, and 28% of households reported having children. Income was collected by providing seven principal categories, but for conciseness the income categories were condensed into three groups: low income: less than \$35,000 (32%), mid-income: \$35,000–\$75,000 (34%), and high income: more than \$75,000 (34%).

U.S. Census Bureau Poverty estimates for each county [20] were evaluated and condensed into three categories.

**Table 1 Sample demographics (n = 1265). Source: Population percentages obtained from: U.S. Census Bureau; American Community Survey, 2014 American Community Survey 1-Year Estimates, Table S1901; generated by S. R. Dominick; using American FactFinder; <http://factfinder2.census.gov>; 21 Sept 2015**

| Variable description   | Survey (% of respondents) | U.S. Census Bureau, 2014 American Community Survey 1-year estimates (%) |
|--|---------------------------|---|
| Male   | 48                        | 49  |
| <i>Age</i>   |                           |   |
| 18–24  | 08                        | 13  |
| 25–44  | 33                        | 31  |
| 45–64  | 38                        | 36  |
| 65 and older   | 21                        | 20  |
| <i>Income</i>  |                           |   |
| Less than \$25,000   | 21                        | 24  |
| \$25,000–\$34,999  | 11                        | 11  |
| \$35,000–\$49,999  | 14                        | 14  |
| \$50,000–\$74,999  | 20                        | 19  |
| \$75,000–\$99,999  | 13                        | 12  |
| \$100,000–\$149,999  | 13                        | 12  |
| \$150,000 or more  | 09                        | 08  |
| <i>Household composition</i>   |                           |   |
| No children in household   | 59                        |   |
| Children in household  | 28                        |   |
| Unstated or ambiguous  | 12                        |   |
| <i>Poverty level % of county population</i>                                  |                           |   |
| Low: less than 10%   | 22                        |   |
| Mid: 11–20%  | 64                        |   |
| High: more than 21%  | 13                        |   |
| <i>You or someone in your household have any of the following conditions</i> |                           |   |
| Diabetes   | 24                        |   |
| Crohn's disease  | 08                        |   |
| Celiac disease   | 07                        |   |
| Eating disorder  | 08                        |   |
| Depression/anxiety   | 25                        |   |
| High blood pressure  | 44                        |   |
| High cholesterol   | 41                        |   |

Twenty-two percent of respondents lived in a county where less than 10% of the population lived at or below the poverty line (low poverty), 64% lived where 11–20% of the population lived at or below the poverty line (mid-poverty), and 13% lived where those living at or below poverty make up 21% or more of the population (high poverty). Survey participants were asked about a number of chronic health conditions. Forty-four percent of respondents indicated that they or someone in their household had high blood pressure. Personal or household member high cholesterol was selected by 41%, depression/anxiety by 25%, diabetes by 24%, Crohn's disease and eating disorders were each selected by 8% of the sample, and celiac disease was selected by 7%.

Table 2 summarizes the percent of respondents from each state who were calculated to be in food insecure households and compares that proportion with the estimations reported by the USDA [11]. For most states, the percent of respondents who were found to be in food insecure households were higher than those estimated by the USDA. Comparatively, the highest state food insecurity rate estimated by both this study and the USDA was for Kentucky and the lowest for North Dakota. The results for this sample could be higher because the respondents were not screened by income or using the optional screening question [12]. Table 2 also summarizes the percent of the population of each state living at or below the poverty line, for which the highest rate

**Table 2 State-by-state food insecurity comparison with 2012–2014 USDA estimated averages**

|              | % of sample respondents per state<br>( <i>n</i> = 11,265) | USDA ERS 2012–2014 state<br>averages (%) | % of county population living<br>at or below poverty (sample<br>averages) |
|--------------|---|--|---|
| Illinois     | 35  | 11.7                                     | 14  |
| Indiana      | 24  | 14.6                                     | 15  |
| North Dakota | 00  | 8.4                                      | 11  |
| South Dakota | 21  | 11.9                                     | 15  |
| Ohio         | 24  | 16.9                                     | 16  |
| Kansas       | 28  | 15.9                                     | 13  |
| Nebraska     | 16  | 13.9                                     | 12  |
| Iowa         | 06  | 11.4                                     | 12  |
| Missouri     | 31  | 16.8                                     | 14  |
| Michigan     | 27  | 14.7                                     | 16  |
| Minnesota    | 14  | 10.4                                     | 11  |
| Wisconsin    | 14  | 16.3                                     | 13  |
| Kentucky     | 39  | 17.5                                     | 21  |
| Tennessee    | 27  | 11.4                                     | 18  |
| Mean         | 22  | 14                                       |   |

Source of Comparison USDA ERS 2012–2014 Average: Coleman-Jensen et al. [11]. Household Food Security in the United States in 2014, ERR-194, U.S. Department of Agriculture, Economic Research Service

is also in Kentucky and the lowest are North Dakota and Minnesota.

#### Analyzing food security status across household characteristics

A food security status was calculated for the survey sample ( $n = 1265$ ) as well as for two subsamples (households with reported children  $n = 360$  and households without children  $n = 749$ ). A summary of the proportions can be found in Fig. 1. Sixty-five percent of the total sample of HFS, 25% were food insecure, with 10% of LFS and 15% of VLFS. For households with children, 44% were food insecure compared to 18% of households without children. Households with children had the highest proportion of respondents in each food insecure group, 15% were of LFS, and 28% were of VLFS. Households without children had 8% of LFS and 10% of VLFS.

The total sample and the two household composition subsamples food security statuses, not including MFS for concision, were cross-tabulated with four demographic categories: sex, age, income level, and percent population living at or below the poverty line for the respondent's county of residence. A full summary can be found in Table 3.<sup>1</sup> Z tests were performed to test the statistical difference in proportions across demographic categories. For additional understanding, each of the ten questions

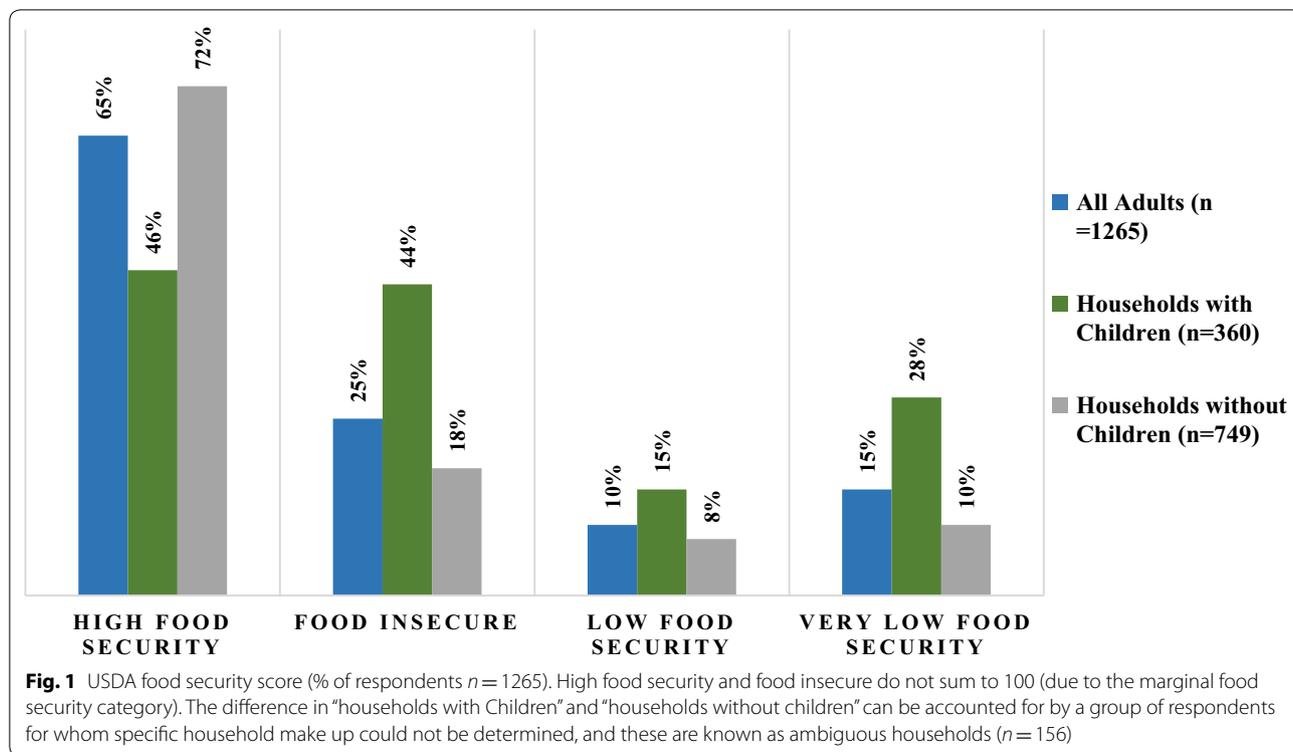
and subsequent responses were cross-tabulated with the same demographics and can be found in Table 4.

Females received HFS scores of zero more frequently than males. When looking at the ten adult/household-specific questions, males answered “often true,” “almost every month,” and “yes” more frequently when compared to females.<sup>2</sup> Sixty-seven percent of females had a calculated score of zero compared with 61.8% of males. Of the total sample, 18.8% of males and 12.3% of females reported being of VLFS. In terms of specific severity, males more frequently selected “yes” in response to the questions “You were hungry but didn’t eat because there wasn’t enough money for food,” “Did you lose weight because there wasn’t enough money for food,” and “Did you or other adults in your household ever not eat for a whole day because there wasn’t enough money for food?” The trends were similar for households with children. While there is less security overall for each sex, a greater portion of females (53.5%) were considered to be of high food security compared with males (38.4%).

For the total sample, younger respondents had higher rates of food insecurity than older respondents. Thirty-five percent of 18–24-year-olds and 40.2% of 25–44 had a calculated score of three or higher and were considered food insecure, compared with 18.1% of 45–64-year-olds and 10.4% of those 65 years old or

<sup>1</sup> For reference: for both the USDA ten-question and eighteen-question surveys, respondents in the High Food Security group had a total score of zero and those considered food insecure had a score of three or higher.

<sup>2</sup> For reference: a selection of “yes,” “often,” “sometimes,” “almost every month,” and “sometimes but not every month” contribute to increased food insecurity score.



older. For the statement “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more,” 18.3% of 25–44-year-olds selected “Often true,” and was over double the frequency of 18–24-year-olds (7.3%), 45–64-year-olds (3.5%), and those 65 years old or older (2.6%). The youngest age groups also had the highest proportions of VLFS, 18.8% of 18–24-year-olds and 27.2% of 25–44-year-olds, compared with 4.5% of those 65 years old or older. Distinctively, for the questions “Did you (or other adults in your household) ever cut the size of your meals or skip meals because there wasn’t enough money for food,” “Did you eat less than you felt you should because there wasn’t enough money for food?” “You were hungry but didn’t eat because there wasn’t enough money for food,” the younger two categories selected “yes” at higher rates compared to the older two categories.

The subsample of households with children showed similar trends with the youngest age groups more frequently in food insecure categories. Respondents considered of HFS made up 32.1% of 18–24-year-olds and 42.8% of 25–44-year-olds compared with 56.0% of 45–64-year-olds and 85.7% of those 65 years old or older. Respondents 25–44 had the largest portion of VLFS individuals with 33.2%, and this was not different from the 25% of 18–24-year-olds but was different and higher than those 45–64 years old.

Less of a gap between high food security and food insecure respondents was found across ages for the subsample of households without children. Fifty-six percent of 18–24-year-olds and 58.6% of 25–44-year-olds were considered of HFS, compared with 71.8% of 45–64-year-olds and 85.1% of those 65 years old or older. Of those who reported being 18–24 and being 25–44 years old, 30.4 and 30.7% were considered food insecure, compared with 16.7% of respondents 45–64 years old and 9.9% of 65-year-olds or older. The youngest age groups also had the highest proportions for LFS and VLFS.

Respondents in the low- and middle-income levels, largely, selected “often true,” “almost every month,” and “yes” with higher frequency than the remaining income groups. The low-income group more frequently selected “often true” and “sometimes true” for the statement “We worried whether our food would run out before we got money to buy more,” but, the high-income group was the next most frequent selector of “often true” and the lowest selector of “sometimes true.” For the statement “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more.” Both the low-income group (8.8%) and the high-income group (11.3%) selected “often true” more frequently compared to the mid-income (5.2%) and were not statistically different from each other. The results for the question “Did you (or other adults in your household) ever cut the size of your meals or skip meals

**Table 3 USDA food security status and demographics cross-tabulation**

| Food security level                | Sex               |                   | Age                |                    |                    |                     |                    |                    |                    | Income levels      |                    |                    |  | Poverty level % of county pop. |  |  |
|------------------------------------|-------------------|-------------------|--------------------|--------------------|--------------------|---------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--|--------------------------------|--|--|
|                                    | Male (A)          | Female (B)        | 18–24 (C)          | 25–44 (D)          | 45–64 (E)          | 65+ (F)             | Low (G)            | Middle (H)         | High (I)           | Low (J)            | Mid (K)            | High (L)           |  |                                |  |  |
|                                    |                   |                   |                    |                    |                    |                     |                    |                    |                    |                    |                    |                    |  |                                |  |  |
| <i>All Adults</i>                  |                   |                   |                    |                    |                    |                     |                    |                    |                    |                    |                    |                    |  |                                |  |  |
| Count                              | 607               | 658               | 96                 | 415                | 485                | 269                 | 407                | 425                | 433                | 280                | 815                | 170                |  |                                |  |  |
| High food security                 | 61.8 <sup>B</sup> | 67.9 <sup>A</sup> | 51.0 <sup>EF</sup> | 48.7 <sup>EF</sup> | 70.9 <sup>CD</sup> | 84.4 <sup>CDE</sup> | 47.2 <sup>HI</sup> | 68.7 <sup>GI</sup> | 78.1 <sup>GH</sup> | 72.9 <sup>KL</sup> | 63.3 <sup>J</sup>  | 60.0 <sup>J</sup>  |  |                                |  |  |
| Food insecure                      | 28.5 <sup>B</sup> | 21.9 <sup>A</sup> | 35.4 <sup>EF</sup> | 40.2 <sup>EF</sup> | 18.1 <sup>CD</sup> | 10.4 <sup>CDE</sup> | 34.4 <sup>HI</sup> | 22.1 <sup>G</sup>  | 19.2 <sup>G</sup>  | 17.5 <sup>KL</sup> | 26.0 <sup>J</sup>  | 31.7 <sup>J</sup>  |  |                                |  |  |
| Low food security                  | 9.7               | 9.6               | 16.7 <sup>EF</sup> | 13.0 <sup>EF</sup> | 7.4 <sup>CD</sup>  | 5.9 <sup>CD</sup>   | 14.5 <sup>I</sup>  | 10.4 <sup>I</sup>  | 4.4 <sup>GH</sup>  | 6.8                | 10.4               | 10.6               |  |                                |  |  |
| Very low food security             | 18.8 <sup>B</sup> | 12.3 <sup>A</sup> | 18.8 <sup>EF</sup> | 27.2 <sup>EF</sup> | 10.7 <sup>CD</sup> | 4.5 <sup>CDE</sup>  | 19.9 <sup>HI</sup> | 11.8 <sup>G</sup>  | 14.8 <sup>G</sup>  | 10.7 <sup>KL</sup> | 15.6 <sup>KL</sup> | 22.4 <sup>KL</sup> |  |                                |  |  |
| <i>Households with children</i>    |                   |                   |                    |                    |                    |                     |                    |                    |                    |                    |                    |                    |  |                                |  |  |
| Count                              | 190               | 170               | 28                 | 250                | 75                 | 7                   | 52                 | 132                | 176                | 77                 | 239                | 54                 |  |                                |  |  |
| High food security                 | 38.4 <sup>B</sup> | 53.5 <sup>A</sup> | 32.1 <sup>EF</sup> | 42.8 <sup>EF</sup> | 56.0 <sup>CD</sup> | 85.7 <sup>CD</sup>  | 17.3 <sup>HI</sup> | 44.7 <sup>G</sup>  | 54.5 <sup>G</sup>  | 53.2               | 43.7               | 42.6               |  |                                |  |  |
| Food insecure                      | 48.9 <sup>B</sup> | 37.6 <sup>A</sup> | 57.1 <sup>EF</sup> | 46.4 <sup>E</sup>  | 32.0 <sup>CD</sup> | 14.3 <sup>C</sup>   | 59.6 <sup>HI</sup> | 40.2 <sup>G</sup>  | 41.5 <sup>G</sup>  | 35.1               | 45.4               | 48.1               |  |                                |  |  |
| Low food security                  | 12.6              | 18.2              | 32.1 <sup>D</sup>  | 13.2 <sup>C</sup>  | 16.0               | 14.3                | 34.6 <sup>HI</sup> | 18.2 <sup>GI</sup> | 7.4 <sup>GH</sup>  | 19.5               | 14.0               | 14.8               |  |                                |  |  |
| Very low food security             | 36.3 <sup>B</sup> | 19.4 <sup>A</sup> | 25.0               | 33.2 <sup>E</sup>  | 16.0 <sup>D</sup>  | 0.0                 | 25.0               | 22.0 <sup>I</sup>  | 34.1 <sup>H</sup>  | 15.6 <sup>KL</sup> | 31.4 <sup>J</sup>  | 33.3 <sup>J</sup>  |  |                                |  |  |
| <i>Households without children</i> |                   |                   |                    |                    |                    |                     |                    |                    |                    |                    |                    |                    |  |                                |  |  |
| Count                              | 343               | 406               | 46                 | 140                | 341                | 222                 | 297                | 243                | 209                | 166                | 486                | 97                 |  |                                |  |  |
| High food security                 | 72.3              | 72.4              | 56.5 <sup>EF</sup> | 58.6 <sup>EF</sup> | 71.8 <sup>CD</sup> | 85.1 <sup>CDE</sup> | 51.2 <sup>HI</sup> | 80.2 <sup>GI</sup> | 93.3 <sup>GH</sup> | 79.5 <sup>KL</sup> | 70.8 <sup>J</sup>  | 68.0 <sup>J</sup>  |  |                                |  |  |
| Food insecure                      | 19.0              | 17.5              | 30.4 <sup>EF</sup> | 30.7 <sup>EF</sup> | 16.7 <sup>CD</sup> | 9.9 <sup>CDE</sup>  | 31.0 <sup>HI</sup> | 14.4 <sup>GI</sup> | 4.3 <sup>GH</sup>  | 10.2 <sup>KL</sup> | 18.9 <sup>KL</sup> | 27.8 <sup>KL</sup> |  |                                |  |  |
| Low food security                  | 7.6               | 8.4               | 15.2 <sup>EF</sup> | 15.0 <sup>EF</sup> | 5.9 <sup>CD</sup>  | 5.4 <sup>CD</sup>   | 13.5 <sup>HI</sup> | 7.0 <sup>GI</sup>  | 1.4 <sup>GH</sup>  | 2.4 <sup>KL</sup>  | 9.3 <sup>J</sup>   | 11.3 <sup>J</sup>  |  |                                |  |  |
| Very low food security             | 11.4              | 9.1               | 15.2 <sup>F</sup>  | 15.7 <sup>F</sup>  | 10.9 <sup>F</sup>  | 4.5 <sup>CDE</sup>  | 17.5 <sup>HI</sup> | 7.4 <sup>GI</sup>  | 2.9 <sup>GH</sup>  | 7.8 <sup>L</sup>   | 9.7 <sup>L</sup>   | 16.5 <sup>KL</sup> |  |                                |  |  |

For each demographic category (i.e., sex, age), each value of one column marked with a superscript of another column denotes significant difference at the .05 level. No superscript denotes no difference. No calculations were done across demographic categories. High food security and food insecure do not sum to 100. The difference is for a category called marginal food security. The difference in "households with children" and "households without children" can be accounted for by a group of respondents for whom specific household make up could not be determined; these are known as ambiguous households (n = 156)

**Table 4 USDA 10 demographic, income, and poverty comparisons**

|  | % of resp. | Sex               |                   | Age                 |                     |                     |                     |                    | Income levels      |                    |                    |                   | Poverty level % of county pop |          |  |
|--|------------|-------------------|-------------------|---------------------|---------------------|---------------------|---------------------|--------------------|--------------------|--------------------|--------------------|-------------------|-------------------------------|----------|--|
|  |            | Male (A)          | Female (B)        | Age                 |                     |                     |                     |                    | Low (G)            | Middle (H)         | High (I)           | Low (J)           | Mid (K)                       | High (L) |  |
|  |            |                   |                   | 18-24 (C)           | 25-44 (D)           | 45-64 (E)           | 65+ (F)             |                    |                    |                    |                    |                   |                               |          |  |
| Count  |            | 607               | 658               | 96                  | 415                 | 485                 | 269                 | 407                | 425                | 433                | 280                | 815               | 170                           |          |  |
| <i>We worried whether our food would run out before we got money to buy more</i>   |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Often true   | 08         | 9.6               | 7.3               | 9.4 <sup>F</sup>    | 16.1 <sup>EF</sup>  | 4.7 <sup>D</sup>    | 2.6 <sup>CD</sup>   | 13.0 <sup>HI</sup> | 4.5 <sup>GI</sup>  | 7.9 <sup>GH</sup>  | 3.9 <sup>KL</sup>  | 8.7 <sup>JL</sup> | 14.1 <sup>JK</sup>            |          |  |
| Sometimes true   | 17         | 20.8 <sup>B</sup> | 14.4 <sup>A</sup> | 22.9 <sup>DF</sup>  | 24.8 <sup>EF</sup>  | 15.7 <sup>DF</sup>  | 7.4 <sup>CDE</sup>  | 24.8 <sup>HI</sup> | 16.9 <sup>GI</sup> | 11.1 <sup>GH</sup> | 14.3               | 18.3              | 18.8                          |          |  |
| Never true   | 72         | 66.9 <sup>B</sup> | 76.3 <sup>A</sup> | 62.5 <sup>EF</sup>  | 55.9 <sup>EF</sup>  | 77.9 <sup>DEF</sup> | 88.5 <sup>CDE</sup> | 57.5 <sup>HI</sup> | 76.9 <sup>G</sup>  | 80.1 <sup>G</sup>  | 80.0 <sup>KL</sup> | 70.4 <sup>J</sup> | 64.7 <sup>J</sup>             |          |  |
| <i>The food that ((we) bought just didn't last, and ((we) didn't have money to get more.</i>   |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Often true   | 08         | 10.9 <sup>B</sup> | 6.2 <sup>A</sup>  | 7.3 <sup>DF</sup>   | 18.3 <sup>CEF</sup> | 3.5 <sup>D</sup>    | 2.6 <sup>CD</sup>   | 8.8 <sup>H</sup>   | 5.2 <sup>GI</sup>  | 11.3 <sup>H</sup>  | 4.3 <sup>KL</sup>  | 8.5 <sup>JL</sup> | 15.3 <sup>JK</sup>            |          |  |
| Sometimes true   | 17         | 18.5              | 15.5              | 31.3 <sup>EF</sup>  | 22.2 <sup>EF</sup>  | 15.1 <sup>CDF</sup> | 7.1 <sup>CDE</sup>  | 27.3 <sup>HI</sup> | 15.8 <sup>GI</sup> | 8.3 <sup>GH</sup>  | 12.9               | 17.8              | 19.4                          |          |  |
| Never true   | 72         | 67.5 <sup>B</sup> | 76.9 <sup>A</sup> | 58.3 <sup>EF</sup>  | 55.7 <sup>EF</sup>  | 80.2 <sup>DEF</sup> | 89.2 <sup>CDE</sup> | 60.4 <sup>HI</sup> | 76.9 <sup>G</sup>  | 79.2 <sup>G</sup>  | 81.4 <sup>KL</sup> | 71.0 <sup>J</sup> | 64.1 <sup>J</sup>             |          |  |
| <i>(((we) couldn't afford to eat balanced meals.</i>   |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Often true   | 08         | 8.6               | 7.9               | 9.4 <sup>F</sup>    | 13.5 <sup>EF</sup>  | 7.0 <sup>FD</sup>   | 1.9 <sup>CDE</sup>  | 13.5 <sup>HI</sup> | 4.9 <sup>G</sup>   | 6.5 <sup>G</sup>   | 4.6 <sup>K</sup>   | 9.4 <sup>J</sup>  | 8.2                           |          |  |
| Sometimes true   | 19         | 21.1              | 17.8              | 26.0 <sup>EF</sup>  | 28.9 <sup>EF</sup>  | 15.3 <sup>CDF</sup> | 9.7 <sup>CDE</sup>  | 28.3 <sup>HI</sup> | 18.8 <sup>GI</sup> | 11.5 <sup>GH</sup> | 15.4 <sup>L</sup>  | 19.4              | 25.9 <sup>J</sup>             |          |  |
| Never true   | 70         | 67.5 <sup>B</sup> | 72.8 <sup>A</sup> | 59.4 <sup>EF</sup>  | 54.2 <sup>EF</sup>  | 76.5 <sup>DEF</sup> | 87.7 <sup>CDE</sup> | 55.0 <sup>HI</sup> | 74.1 <sup>GI</sup> | 80.8 <sup>GH</sup> | 78.2 <sup>KL</sup> | 68.7 <sup>J</sup> | 64.7 <sup>J</sup>             |          |  |
| <i>Did you (or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?</i> |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Yes  | 18         | 20.3              | 16.1              | 20.8 <sup>F</sup>   | 29.9 <sup>EF</sup>  | 13.4 <sup>DF</sup>  | 7.4 <sup>CDE</sup>  | 26.0 <sup>HI</sup> | 14.1 <sup>G</sup>  | 14.5 <sup>G</sup>  | 12.9 <sup>KL</sup> | 18.7 <sup>J</sup> | 24.1 <sup>J</sup>             |          |  |
| No   | 79         | 76.4 <sup>B</sup> | 81.3 <sup>A</sup> | 71.9 <sup>EF</sup>  | 65.8 <sup>EF</sup>  | 84.9 <sup>DEF</sup> | 91.1 <sup>CDE</sup> | 68.6 <sup>HI</sup> | 83.5 <sup>G</sup>  | 84.3 <sup>G</sup>  | 85.0 <sup>KL</sup> | 77.8 <sup>J</sup> | 74.7 <sup>J</sup>             |          |  |
| <i>Of those who said yes: How often did this happen?</i>   |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Almost every month   | 47         | 60.2 <sup>B</sup> | 32.1 <sup>A</sup> | 40.0                | 58.9 <sup>F</sup>   | 27.7 <sup>D</sup>   | 45.0                | 34.0 <sup>I</sup>  | 40.0 <sup>I</sup>  | 76.2 <sup>GH</sup> | 47.2               | 44.7              | 56.1                          |          |  |
| Some months  | 38         | 30.1 <sup>B</sup> | 48.1 <sup>A</sup> | 45.0                | 29.8 <sup>E</sup>   | 52.3 <sup>D</sup>   | 40.0                | 45.3 <sup>I</sup>  | 45.0 <sup>I</sup>  | 20.6 <sup>GH</sup> | 33.3               | 40.8              | 34.1                          |          |  |
| Only 1 or 2 months   | 13         | 7.3 <sup>B</sup>  | 18.9 <sup>A</sup> | 5.0                 | 11.3                | 16.9                | 15.0                | 17.9 <sup>I</sup>  | 13.3 <sup>I</sup>  | 3.2 <sup>GH</sup>  | 11.1               | 13.8              | 9.8                           |          |  |
| <i>Did you eat less than you felt you should because there wasn't enough money for food?</i>   |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Yes  | 18         | 19.6              | 17.2              | 26.0 <sup>EF</sup>  | 25.8 <sup>EF</sup>  | 15.1 <sup>CD</sup>  | 10.0 <sup>CD</sup>  | 27.8 <sup>HI</sup> | 15.8 <sup>G</sup>  | 12.0 <sup>G</sup>  | 14.3 <sup>L</sup>  | 18.9              | 22.4 <sup>J</sup>             |          |  |
| No   | 79         | 77.3              | 80.1              | 67.7 <sup>EF</sup>  | 69.4 <sup>EF</sup>  | 82.9 <sup>DEF</sup> | 89.6 <sup>CDE</sup> | 67.3 <sup>HI</sup> | 81.4 <sup>GI</sup> | 86.8 <sup>GH</sup> | 83.2 <sup>L</sup>  | 77.9              | 75.3 <sup>J</sup>             |          |  |
| <i>You were hungry but didn't eat because there wasn't enough money for food?</i>  |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Yes  | 14         | 16.3 <sup>B</sup> | 11.2 <sup>A</sup> | 18.8 <sup>EF</sup>  | 22.7 <sup>EF</sup>  | 10.3 <sup>DEF</sup> | 4.1 <sup>CDE</sup>  | 18.9 <sup>HI</sup> | 12.0 <sup>G</sup>  | 10.4 <sup>G</sup>  | 9.6 <sup>KL</sup>  | 14.2 <sup>J</sup> | 17.6 <sup>J</sup>             |          |  |
| No   | 83         | 79.2 <sup>B</sup> | 85.7 <sup>A</sup> | 75.0 <sup>EF</sup>  | 71.3 <sup>EF</sup>  | 87.4 <sup>DEF</sup> | 94.1 <sup>CDE</sup> | 74.9 <sup>HI</sup> | 84.5 <sup>G</sup>  | 88.0 <sup>G</sup>  | 87.1 <sup>KL</sup> | 81.3 <sup>J</sup> | 81.2 <sup>J</sup>             |          |  |
| <i>Did you lose weight because there wasn't enough money for food?</i>   |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Yes  | 10         | 14.0 <sup>B</sup> | 6.8 <sup>A</sup>  | 10.4 <sup>F</sup>   | 16.9 <sup>EF</sup>  | 8.0 <sup>DF</sup>   | 4.1 <sup>CDE</sup>  | 12.0               | 8.5                | 10.4               | 7.9 <sup>J</sup>   | 10.2              | 14.7 <sup>J</sup>             |          |  |
| No   | 86         | 81.4 <sup>B</sup> | 89.8 <sup>A</sup> | 79.2 <sup>EF</sup>  | 77.1 <sup>EF</sup>  | 89.5 <sup>DEF</sup> | 94.8 <sup>CDE</sup> | 80.8 <sup>HI</sup> | 88.0 <sup>G</sup>  | 88.2 <sup>G</sup>  | 88.6 <sup>L</sup>  | 85.8              | 81.2 <sup>J</sup>             |          |  |
| <i>Did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food?</i>                    |            |                   |                   |                     |                     |                     |                     |                    |                    |                    |                    |                   |                               |          |  |
| Yes  | 09         | 11.9 <sup>B</sup> | 5.8 <sup>A</sup>  | 8.3 <sup>DF</sup>   | 17.8 <sup>CEF</sup> | 4.7 <sup>DF</sup>   | 1.9 <sup>CDE</sup>  | 8.4                | 7.8                | 9.9                | 4.6 <sup>KL</sup>  | 9.2 <sup>J</sup>  | 12.9 <sup>J</sup>             |          |  |
| No   | 89         | 84.8 <sup>B</sup> | 92.1 <sup>A</sup> | 87.5 <sup>DEF</sup> | 77.6 <sup>CEF</sup> | 93.6 <sup>DEF</sup> | 97.0 <sup>CDE</sup> | 87.2               | 89.9               | 88.7               | 93.2 <sup>KL</sup> | 88.0 <sup>J</sup> | 84.1 <sup>J</sup>             |          |  |

**Table 4 (continued)**

|  | % of resp. | Sex      |            | Age               |                    |                   |          | Income levels |            |          |         | Poverty level % of county pop |          |  |  |
|--|------------|----------|------------|-------------------|--------------------|-------------------|----------|---------------|------------|----------|---------|-------------------------------|----------|--|--|
|  |            | Male (A) | Female (B) | 18-24 (C)         | 25-44 (D)          | 45-64 (E)         | 65 + (F) | Low (G)       | Middle (H) | High (I) | Low (J) | Mid (K)                       | High (L) |  |  |
|  |            |          |            |                   |                    |                   |          |               |            |          |         |                               |          |  |  |
| <i>Of those who said yes: How often did this happen?</i> |            |          |            |                   |                    |                   |          |               |            |          |         |                               |          |  |  |
| Almost every month                                       | 43         | 43.1     | 42.1       | 12.5 <sup>D</sup> | 50.0 <sup>CE</sup> | 26.1 <sup>D</sup> | 60.0     | 38.2          | 39.4       | 48.8     | 38.5    | 42.7                          | 45.5     |  |  |
| Some months  | 47         | 44.4     | 52.6       | 87.5 <sup>D</sup> | 43.2 <sup>C</sup>  | 47.8              | 40.0     | 47.1          | 48.5       | 46.5     | 46.2    | 48.0                          | 45.5     |  |  |
| Only 1 or 2 months                                       | 05         | 8.3      | 0.0        | 0.0               | 2.7 <sup>E</sup>   | 17.4 <sup>D</sup> | 0.0      | 8.8           | 6.1        | 2.3      | 0.0     | 6.7                           | 4.5      |  |  |

For each demographic category (i.e., sex, age), each value of one column marked with a superscript of another column denotes significant difference at the .05 level. Responses for the category "don't know/ prefer not to answer" can be found by subtracting the sum of responses shows per question from 100%

because there wasn't enough money for food?" and the sub question of "how often did this happen?" are particularly interesting. While the low-income group more frequently selected "yes," the high-income group more frequently selected "almost every month."

Looking at the total sample, the low-income group had the lowest proportion of HFS respondents and the highest portions of LFS and VLFS respondents. Thirty-four percent of the respondents in the low-income group were considered food insecure; specifically, 14.5% were of LFS and 19.9% of VLFS. For the mid-income group, 22.1% were food insecure, which was not different from the 19.2% of high-income respondents who were food insecure. Also 10.4% of mid-income respondents were of LFS and 11.8% were of VLFS. The high-income group had the largest proportion of respondents in the HFS group with 78.1%.

The lowest-income group still reported the largest proportions of food insecurity, but the proportions for mid- and high incomes were also larger when looking specifically at the subsample of households with children. Fifty-nine percent of the low-income group, 40.2% of the mid-income group, and 41.5% of the high-income group were considered food insecure. Interestingly, one of the higher proportions of VLFS for households with children was reported in the high-income group. Thirty-four percent of the high-income group had a calculated VLFS status, and was not different from the 25.0% reported in the low-income group, but is different from the proportion of mid-income respondents with 22.0%. When looking at households without children, the low-income group reported the highest food insecure proportion. HFS respondents made up 51.2% of the low-income group and 31.0% were food insecure, compared with 93.3 and 4.3% of the high-income group, respectively. The low-income group also reported the highest LFS and VLFS proportions with 13.5 and 17.5%.

Respondents living in a county with a higher percent of people living at or below poverty have higher rates of food insecurity. Seventy-two percent of the total sample living in areas of low poverty were considered of HFS, compared to 63.3% of respondents living at mid-poverty and 60.0% of respondents living at high poverty. Respondents living in a high-poverty county were more frequently of VLFS (22.4%) compared with those living in a low-poverty county (10.7%) and a mid-poverty county (15.6%). Those living in a high-poverty county also selected "yes" more frequently to the questions "Did you eat less than you felt you should because there wasn't enough money for food?" "You were hungry but didn't eat because there wasn't enough money for food?" "Did you lose weight because there wasn't enough money for food?"

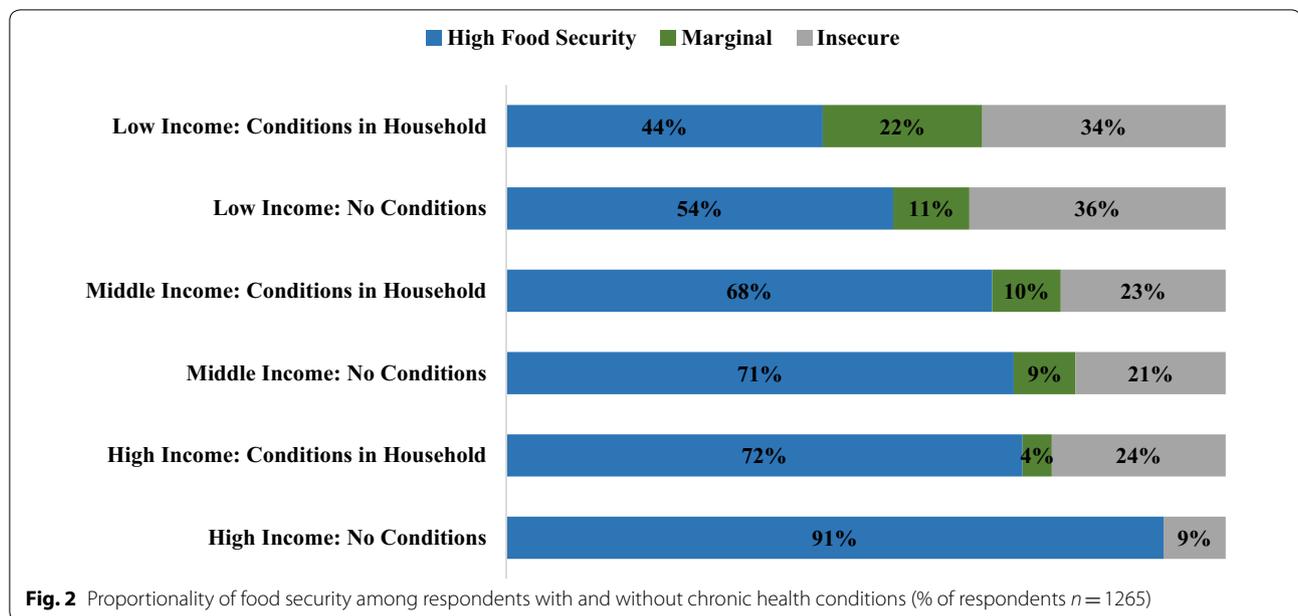
For the subsample of households with children, 31.4% of respondents living in a mid-poverty county and 33.3% of respondents living in a high-poverty county were of VLFS, almost double the rate of respondents living in a low-poverty county (15.6%). Households without children living in a low-poverty county were more frequently of HFS, 79.5% compared with 70.8% of respondents living in a mid-poverty county, and 68.0% living in a high-poverty county. Respondents living in a high-poverty county were also more frequently food insecure with 27.8% of the sample and were more frequently of VLFS (16.5%).

#### **Food security and chronic health indicators**

If food aid programs are intended to support temporary conditions, it is important to consider the impact of chronic health conditions on food security status. Respondents were asked to indicate whether they or someone in their household had any of seven common conditions, which may impact an afflicted person's relationship with food. The conditions were: diabetes, Crohn's disease, celiac disease, eating disorder, depression/ anxiety, high blood pressure, and high cholesterol.

Figure 2 displays a preliminary analysis of the hypothesis that a relationship exists between chronic health and food security, even among the high-income groups. Each income level was proportioned into two groups: those for whom someone in the household had at least one of the health conditions and those for whom no one is afflicted. Each of those six groups was then proportioned into three levels of food security: HFS, MFS, and food insecure.

For the low-income group, 132 respondents did not report any instances of the seven chronic health conditions and 275 reported at least one. Of those who did not report any instances, 54% were of HFS, 11% were of MFS, and 36% were food insecure. Of the 275 respondents that reported a chronic health condition, 44% were of HFS, 22% were of MFS, and 34% were food insecure. In the mid-income group, 163 respondents reported no chronic health conditions and 262 reported at least one. Of those who did report a health condition, 68% were considered of HFS, 10% were of MFS, and 23% were considered food insecure. Of those who did not report a condition, 71% were of HFS, 9% were of MFS, and 21% were considered food insecure. Among the high-income group, 139 respondents did not report a health condition and 294 indicated at least one. Of those who did not report a condition, 91% were considered of HFS, 0% were of MFS, and 9% were considered food insecure. Of those who did report a condition, 72% were of HFS, 4% were of MFS, and 24% were considered food insecure. Since this population was of particular interest, a comparative Fishers exact test was performed and revealed that the



proportions of respondents who were high income, had a household health condition, and were food insecure were statistically different and higher compared to those who were of high income, had no household health conditions, and were food insecure. In short, the intersection between food insecurity and health conditions consistently emerges as important and necessary to consider if aiming to improve household’s well-being, and this consideration exists even among high-income groups.

To understand the relationship between food security and health, cross-tabulations and Z test were performed to determine statistical difference between the proportions of respondents (Table 5). Generally, higher rates of food insecurity existed for respondents who indicated that at least one health condition was present in the household.

Respondents who indicated having diabetes or that someone in the household had diabetes had larger proportions of food insecurity overall and larger proportions of VLFS. These relationships were stronger for the subsample of households with children. Of households with children, 66.7% of respondents who reported household diabetes were food insecure, compared with 33.3% of respondents without household diabetes. Over half the respondents with household diabetes were of VLFS, 52.3% compared with only 17.7% of respondents with no instance of diabetes. The subsample of households without children has a similar relationship. Twenty-three percent of respondents with household diabetes were food insecure, compared with 16.7% of respondents without an instance of diabetes. Also 14.6% of respondents with

household diabetes were of VLFS, compared with 9.0% without household diabetes.

Respondents with household Crohn’s disease were more frequently food insecure (62.2%) than those without household Crohn’s disease (21.9%). Over half the respondents with Crohn’s disease were of VLFS (51.0% compared with 12.4%). This relationship is also true for the subsample of respondents with children. Eighty percent of respondents with children and with household Crohn’s disease were also food insecure, and 68.7% were of VLFS. Households with children but without instances of Crohn’s disease were HFS, at 52.2%. For households with celiac disease, 65.5% were food insecure and 54.8% were of VLFS. Comparatively, 67.8% of respondents without instances of celiac disease were HFS. For the subsample of households with children, 82.5% were food insecure and 73% were of VLFS when celiac disease was also present in the household.

Of respondents who indicated they or someone in their household experienced an eating disorder, 26.0% were HFS and 64.0% were food insecure, in contrast to respondents who did not report household eating disorders (68.3% were HFS). Over half the respondents who indicated household eating disorders were also of VLFS (51.0%). Similarly, of households with children, 52.0% of respondents who did not report an eating disorder were HFS and 83.3% of households which reported an eating disorder were food insecure, with 73.3% of VLFS. In households without children, the trend is similar, though less extreme. Only 38.7% of households without children who reported household

**Table 5 USDA food security status and chronic condition cross-tabulation**

| Food security level                | Diabetes          |                   | Crohn's disease   |                   | Celiac disease    |                   | Eating disorder   |                   | Depression/ anxiety |                   | High blood pressure |                   | High cholesterol  |                   |
|------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|---------------------|-------------------|---------------------|-------------------|-------------------|-------------------|
|                                    | No (A)            | Yes (B)           | No (A)              | Yes (B)           | No (A)              | Yes (B)           | No (A)            | Yes (B)           |
| <i>All adults</i>                  |                   |                   |                   |                   |                   |                   |                   |                   |                     |                   |                     |                   |                   |                   |
| Count                              | 958               | 307               | 1167              | 98                | 1181              | 84                | 1165              | 100               | 949                 | 316               | 709                 | 556               | 752               | 513               |
| High food security                 | 69.8 <sup>B</sup> | 49.8 <sup>A</sup> | 68.1 <sup>B</sup> | 27.6 <sup>A</sup> | 67.8 <sup>B</sup> | 25.0 <sup>A</sup> | 68.3 <sup>B</sup> | 26.0 <sup>A</sup> | 72.4 <sup>B</sup>   | 42.7 <sup>A</sup> | 65.6                | 64.2              | 65.6              | 64.1              |
| Food insecure                      | 20.9 <sup>B</sup> | 38.1 <sup>A</sup> | 21.9 <sup>B</sup> | 62.2 <sup>A</sup> | 22.2 <sup>B</sup> | 65.5 <sup>A</sup> | 21.7 <sup>B</sup> | 64.0 <sup>A</sup> | 19.6 <sup>B</sup>   | 41.5 <sup>A</sup> | 25.2                | 24.8              | 25.5              | 24.4              |
| Low food security                  | 9.4               | 10.4              | 9.5               | 11.2              | 9.6               | 10.7              | 9.4               | 13.0              | 8.6 <sup>B</sup>    | 12.7 <sup>A</sup> | 11.4 <sup>B</sup>   | 7.4 <sup>A</sup>  | 11.8 <sup>B</sup> | 6.4 <sup>A</sup>  |
| Very low food security             | 11.5 <sup>B</sup> | 27.7 <sup>A</sup> | 12.4 <sup>B</sup> | 51.0 <sup>A</sup> | 12.6 <sup>B</sup> | 54.8 <sup>A</sup> | 12.4 <sup>B</sup> | 51.0 <sup>A</sup> | 11.0 <sup>B</sup>   | 28.8 <sup>A</sup> | 13.8                | 17.4              | 13.7 <sup>B</sup> | 17.9 <sup>A</sup> |
| <i>Households with Children</i>    |                   |                   |                   |                   |                   |                   |                   |                   |                     |                   |                     |                   |                   |                   |
| Count                              | 249               | 111               | 293               | 67                | 297               | 63                | 300               | 60                | 244                 | 116               | 236                 | 124               | 246               | 114               |
| High food security                 | 55.8 <sup>B</sup> | 22.5 <sup>A</sup> | 52.2 <sup>B</sup> | 16.4 <sup>A</sup> | 52.2 <sup>B</sup> | 14.3 <sup>A</sup> | 52.0 <sup>B</sup> | 13.3 <sup>A</sup> | 54.1 <sup>B</sup>   | 27.6 <sup>A</sup> | 53.0 <sup>B</sup>   | 31.5 <sup>A</sup> | 52.0 <sup>B</sup> | 31.6 <sup>A</sup> |
| Food insecure                      | 33.3 <sup>B</sup> | 66.7 <sup>A</sup> | 35.2 <sup>B</sup> | 80.6 <sup>A</sup> | 35.4 <sup>B</sup> | 82.5 <sup>A</sup> | 35.7 <sup>B</sup> | 83.3 <sup>A</sup> | 35.2 <sup>B</sup>   | 61.2 <sup>A</sup> | 36.0 <sup>B</sup>   | 58.1 <sup>A</sup> | 38.2 <sup>B</sup> | 55.3 <sup>A</sup> |
| Low food security                  | 15.7              | 14.4              | 16.0              | 11.9              | 16.5              | 9.5               | 16.3              | 10.0              | 14.8                | 16.4              | 16.5                | 12.9              | 17.1              | 11.4              |
| Very low food security             | 17.7 <sup>B</sup> | 52.3 <sup>A</sup> | 19.1 <sup>B</sup> | 68.7 <sup>A</sup> | 18.9 <sup>B</sup> | 73.0 <sup>A</sup> | 19.3 <sup>B</sup> | 73.3 <sup>A</sup> | 20.5 <sup>B</sup>   | 44.8 <sup>A</sup> | 19.5 <sup>B</sup>   | 45.2 <sup>A</sup> | 21.1 <sup>B</sup> | 43.9 <sup>A</sup> |
| <i>Households without children</i> |                   |                   |                   |                   |                   |                   |                   |                   |                     |                   |                     |                   |                   |                   |
| Count                              | 592               | 157               | 726               | 23                | 735               | 14                | 594               | 19                | 593                 | 156               | 396                 | 353               | 426               | 323               |
| High food security                 | 73.8              | 66.9              | 72.9              | 56.5              | 72.4              | 71.4              | 73.4 <sup>B</sup> | 48.4 <sup>A</sup> | 77.6 <sup>B</sup>   | 52.6 <sup>A</sup> | 70.2                | 74.8              | 71.8              | 73.1              |
| Food insecure                      | 16.7 <sup>B</sup> | 23.6 <sup>A</sup> | 17.8              | 30.4              | 18.2              | 14.3              | 17.3 <sup>B</sup> | 38.7 <sup>A</sup> | 14.3 <sup>B</sup>   | 32.7 <sup>A</sup> | 20.5                | 15.6              | 19.7              | 16.1              |
| Low food security                  | 7.8               | 8.9               | 8.0               | 8.7               | 8.0               | 7.1               | 7.7               | 16.1              | 6.6 <sup>B</sup>    | 13.5 <sup>A</sup> | 9.3                 | 6.5               | 10.6 <sup>B</sup> | 4.6 <sup>A</sup>  |
| Very low food security             | 9.0 <sup>B</sup>  | 14.6 <sup>A</sup> | 9.8               | 21.7              | 10.2              | 7.1               | 9.6 <sup>B</sup>  | 22.6 <sup>A</sup> | 7.8 <sup>B</sup>    | 19.2 <sup>A</sup> | 11.1                | 9.1               | 9.2               | 11.5              |

For each demographic category (i.e., sex, age), each value of one column marked with a superscript of another column denotes significant difference at the .05 level. No superscript denotes no difference. No calculations were done across demographic categories. High food security and food insecure do not sum to 100. The difference is for a category called marginal food security. The difference in "households with Children" and "households without children" can be accounted for by a group of respondents for whom specific household make up could not be determined, and these are known as ambiguous households (n = 156)

eating disorders were food insecure, and 22.6% were of VLFS. Comparatively, 17.3% of respondents who did not report an eating disorder were food insecure and 9.6% were of VLFS.

Of respondents who reported household depression/anxiety, 42.7% were considered HFS, while 72.4% of respondents who did not report household depression/anxiety were considered HFS. Respondents who reported household depression/anxiety were also more frequently of LFS (12.7%) and of VLFS (28.8%) compared with respondents who did not report household depression/anxiety (8.6 and 11.0%, separately). Similarly, of the subsample of households with children, 44.8% of those who reported household depression/anxiety were of VLFS and 61.2% were food insecure in total. More frequently, households without reported depression/anxiety were food secure (54.1% compared with 27.6%). Households without children who reported household depression/anxiety were more frequently food insecure. Thirty-two percent of households without children who reported household depression/anxiety were food insecure compared with 14.3% of households without children and without depression/anxiety. Also, more respondents without children were frequently of VLFS, 19.2% compared with 7.8%.

For the total sample, food security for respondents with household high blood pressure was not statistically different from respondents without household instance of high blood pressure except in the category LFS. Eleven percent of respondents without household high blood pressure were more frequently of LFS, compared with 7.4% of respondents with household high blood pressure. This result is counterintuitive to the results presented for the previous conditions. Households with children showed results similar to all other reported conditions. Of households with children, 53.0% of respondents who did not indicate instance of high blood pressure were HFS, compared with 31.5% of respondents who did indicate. Fifty-eight percent of respondents with household high blood pressure were food insecure and 45.2% were of VLFS.

Respondents without instances of high cholesterol were more frequently considered of LFS (11.8%) compared with respondents who reported household high cholesterol (6.4%). Conversely, respondents with household high cholesterol were more frequently considered of VLFS. Households with children were more frequently food insecure and of VLFS if they also reported that they or someone in their household had high cholesterol. Respondents without instance of household high

**Table 6 Estimated level of food insecurity ordered logit (n = 1265)**

| Variables                            | Coefficient (SE)  | Marginal effects   |                        |                   |                        |
|--------------------------------------|-------------------|--------------------|------------------------|-------------------|------------------------|
|                                      |                   | High food security | Marginal food security | Low food security | Very low food security |
|                                      |                   | dy/dx (SE)         | dy/dx (SE)             | dy/dx (SE)        | dy/dx (SE)             |
| Male                                 | .2498* (.1315)    | -.0522 (.0275)     | .0149 (.0079)          | .0159 (.0084)     | .0214 (.0113)          |
| Age 18–24                            | 1.1435*** (.2971) | -.2393 (.0616)     | .0684 (.0190)          | .0728 (.0196)     | .0980 (.0256)          |
| Age 25–44                            | 1.7554*** (.2419) | -.3673 (.0494)     | .1050 (.0177)          | .1117 (.0175)     | .1504 (.0213)          |
| Age 45–64                            | .9182*** (.2150)  | -.1921 (.0444)     | .0549 (.0139)          | .0584 (.0143)     | .0787 (.0184)          |
| Low income less than \$35K           | 2.1023*** (.1903) | -.4399 (.0377)     | .1258 (.0168)          | .1338 (.0156)     | .1802 (.0175)          |
| Middle income: \$35K–\$74,999        | .6972*** (.1809)  | -.1459 (.0373)     | .0417 (.0116)          | .0444 (.0118)     | .0597 (.0155)          |
| Household with children              | .9298*** (.1614)  | -.1945 (.0335)     | .0556 (.0110)          | .0592 (.0112)     | .0797 (.0142)          |
| Poverty level % of county population | .0225* (.0124)    | -.0047 (.0026)     | .0013 (.0007)          | .0014 (.0008)     | .0019 (.0010)          |
| Diabetes                             | .5086*** (.1736)  | -.1064 (.0362)     | .0304 (.0108)          | .0323 (.0113)     | .0436 (.0150)          |
| Crohn's disease                      | .3183 (.3896)     | -.0666 (.0815)     | .0190 (.0233)          | .0202 (.0248)     | .0272 (.0334)          |
| Celiac disease                       | .1444 (.4642)     | -.0302 (.0971)     | .0086 (.0277)          | .0091 (.0295)     | .0123 (.0398)          |
| Eating disorder                      | .9906*** (.3497)  | -.2072 (.0732)     | .0592 (.0217)          | .0630 (.0229)     | .0849 (.0302)          |
| Depression/anxiety                   | .5097*** (.1543)  | -.1066 (.0323)     | .0305 (.0097)          | .0324 (.0101)     | .0436 (.0134)          |
| High blood pressure                  | -.0188 (.1654)    | .0039 (.0346)      | -.0011 (.0099)         | -.0012 (.0105)    | -.0016 (.0141)         |
| High cholesterol                     | .1336 (.1715)     | -.0279 (.0358)     | .0079 (.0102)          | .0085 (.0109)     | .0114 (.0147)          |
| Cut one                              | 3.9113 (.3257)    |                    |                        |                   |                        |
| Cut two                              | 4.5523 (.3329)    |                    |                        |                   |                        |
| Cut three                            | 5.3128 (.3413)    |                    |                        |                   |                        |
| Pseudo-R <sup>2</sup>                | .1588             |                    |                        |                   |                        |
| Prob >χ <sup>2</sup>                 | .0000             |                    |                        |                   |                        |
| Log likelihood                       | -1089.1399        |                    |                        |                   |                        |

For STATA, the ordered logit thresholds are reported as “cuts.” Margins predicted at sample means  
 p values: \* p < .10, \*\* p < .05; \*\*\* p < .01

cholesterol were more frequently HFS. Respondents in households without children and with high cholesterol in the household were statistically different from, and less frequently of LFS, than households without children and without household instance of high cholesterol.

**Identifying determinants of food insecurity status with ordered logit model**

An ordered logit was run in order to understand the significance of household chronic health status as a contributing factor to short-term (12-month) food security status, and the results can be found in Table 6. The model run was found to be significant overall, and the likelihood ratio χ<sup>2</sup> results are presented.

All demographics included were significant determinates. Being male increased the likelihood the household would have increased food insecurity. At the margin, being male decreased the likelihood of a household receiving a score of zero (or being high food security) and increased the likelihood of receiving a score greater than zero. Being in either of the included age categories increased the likelihood that a respondent would be food insecure, and being 25–44 had the greatest

marginal contributions. The lower-income categories were also significant variables for predicting food insecurity and being in the low-income group had the higher marginal contributions. The presence of a child in the household increased the likelihood that a respondent would be food insecure.

The poverty-level score was the only continuous variable, and the logit suggests that as the poverty level of the county increases, a household living in that county was more likely to be food insecure. Of all seven chronic illnesses, diabetes, eating disorders, and depression/anxiety were statistically significant. Having either of these conditions present in the household increases the likelihood that a respondent will be food insecure. At the margin, having an eating disorder had the highest contribution. All of the logit results supported the findings of the cross-tabulations.

**Discussion**

The results of the cross-tabulations for income were consistent with findings from the USDA in that lower incomes generally experience reduced food security. However, there were areas where closer examination of

each question suggested reduced security could be experienced across broader income ranges. Recall, there were comparable results and statistical sameness between the high- and low-income groups for the statements “We worried whether our food would run out before we got money to buy more,” “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more” and for the question “Did you (or other adults in your household) ever cut the size of your meals or skip meals because there wasn’t enough money for food?” and the sub question of “how often did this happen?”

In order to consider the relationship between high income and food security further, the household composition of high-income respondents was investigated. For high-income respondents whose household compositions were known ( $n=385$ ), respondents were divided into two groups, those in a household with four or more people ( $n=140$ ) and those with a household composition of less than four ( $n=245$ ). A Fisher’s exact test was performed, and high-income respondents with a household composition of four or more had statistically different proportions of respondents in each food security category, compared to high-income respondents with a household composition of less than four people. Of the 140 respondents who were high income and had four or more people in their household, 39% were considered food insecure, compared to only 11% of the 245 respondents who were high income but had less than four household members. The relationship between food insecurity and household composition is important to consider for households at all income levels, even high-income groups. According to the USDA Food and Nutrition Service (FNS), household size and income are taken into consideration when dispensing benefits. According to the FNS, households of four people must earn at most \$2633 gross income a month to qualify, which is roughly \$31,596 annually [27]. As shown in this analysis, even households of \$75,000 or more can experience food insecurity, especially with four or more household members, but they may not qualify for benefits.

The impact of children on food security was reflective of the household composition findings. In all demographic comparisons and chronic health comparisons, households with children had higher instances of food insecurity and higher rates of more severe food insecurity than households without children. Children were also a significant variable in the logit estimations. This finding was supported by Coleman-Jensen et al. [11] who found that households with children had higher rates of food insecurity.

Comparable to the literature, chronic illness has an impactful relationship with food security. The unique finding in this study was that the results suggest that the

nature of the illness may be important; however, it may be unrelated to food inherently. Diabetes was a significant indicator of food insecurity and was similar to the results found by Knight et al. [4]. The results of the cross-tabulations and logit estimations were reflective of Muldoon et al. [6]; generally, respondents with household depression/anxiety had higher rates of food insecurity. Diabetes, eating disorders, Crohn’s disease, celiac disease, high blood pressure, and high cholesterol all have food management considerations, but only diabetes and eating disorders were significant in the logit predictions. Depression/anxiety may be perceived to be the furthest removed from food and eating of the chronic illnesses investigated, but was identified as a significant variable. This suggests that the nature of food security and chronic illness may go beyond the intuitive relationship with food and that the specific nature of the illness may be important. As mentioned, aid programs were intended to support temporary conditions, but the results here suggest it is important to consider the impact of chronic conditions.

Another interesting result was the higher instance of food insecurity among males in the sample. This may seem counterintuitive to Coleman-Jensen et al. [11] who reported higher rates of food insecurity and very low food insecurity among households headed by single females. Marital status of the sample was not studied, although further analysis could shed light on this comparison. The results of this study were also similar to those found in Knight et al. [4] with higher rates of food insecurity among 18–44-year-olds.

This study also found that an individual was more likely to be food insecure as the poverty level of their county of residence increased. These results suggest that communities play a significant role in food security. These findings were not contradictory of the findings of Mayer et al. [10] and Kirkpatrick and Tarasuk [9], who suggest neighborhood-level impacts might not play a role in food security because both focused on grocery access. However, this was reflective of Dharamasen et al. [7] and Moore and Diez Roux [8] who considered regional income and poverty impacts. Overall food insecurity maybe related to limited food access due to resource constraints, both in the region and in the household, and not the specific availability of food markets.

## Conclusion

It was found that 25% of the total sample were considered food insecure. Food insecurity was higher among males, middle-aged individuals, households with children, and low incomes. In the analysis of regional impacts, it was found that respondents living in counties with greater portions of the population living at or below the poverty

line were more likely to be food insecure. When looking at chronic health, diabetes, eating disorders, and depression/anxiety were found to be significant variables predicting health score.

The researchers of this study acknowledge a number of health issues can be alleviated by improved food quality and access, so addressing chronic illness as a contributor of food security can improve the metrics of food security measurement and can improve policy designed to ease food access constraints on households. This study focused on the Midwest, but similar studies could be applied to measures around the world and inform global programs. As pointed out by Coates et al. [14], the CPS Food Security Supplement used by the USDA is comparable to a majority of measures used around the world. The Midwest represented a wide range of US food security, as measured by the CPS Food Security Supplement. The results reported here suggest that the CPS Food Security Supplement may underestimate the nature of food security by missing key factors such as income constraints (even in higher incomes), local community factors, and the impact of chronic illness. If the CPS Food Security Supplement underestimates US food security, measures similar to it around the world may also be underestimating.

While voter's ballots and election polls suggest food security and health care are separate issues, it is clear from this study and a number of the studies reviewed, the two issues are related in significant ways. The current Farm Bill, the leading food and nutrition legislation in the USA, will be in effect until at least 2018 [28]. Establishing clear relationships between health and food can inform large pieces of legislation like the Farm Bill. The results presented here suggest the inclusion of chronic illness and health to improve metrics and inform food security legislation because of the impactful relationship between chronic illness and food security, specifically with respect to diabetes, eating disorders, and depression/anxiety.

Special consideration should also be given to high-income populations who may be ineligible under current policy for benefits but who could still be hungry due to household composition and household health conditions. Uncovering the impacts, especially impacts that were previously unknown or seem counter to convention (i.e., food insecurity challenges in high-income households), that current food policies have on Midwestern households is imperative in informing impactful future policies.

Policies evaluating food security should also include evaluations of the community. While this study focused on poverty indicators, reviewed studies have found other community variables that relate to food security.

For effectiveness and efficiency, policy should consider all factors, case in point, policy addressing local food access by increasing food supply may not alleviate the issue if the target region is most impacted by income constraints related to limited health care. This study included children and household size, but other household dynamics such as marital status, the specific ages of the children, and number of generations in the household should be studied in future research.

Future studies of both health and food security could and should include an indicator for the other factor. Future research should also directly ask whether respondents actively chose between medication and food, and under what circumstances. It is also important to note that other illnesses require treatment that is not limited to medication and can lead to financial hardship, such as therapy. Future research should broaden the scope of illness and treatment and explore the impact on food security status. Additionally, future studies of health and food security should also include regional components in order to understand the impact of location on each. Policy makers should consider how food and health overlap when measuring food security and when generating programs to alleviate it.

#### Authors' contributions

SD participated in data collection, data analysis, and manuscript preparation. NJOW participated in data collection, data analysis, and manuscript preparation. AR participated in manuscript preparation. JZGW aided in data analysis. LA participated in data collection and manuscript preparation. All authors read and approved the final manuscript.

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None.

#### Competing interests

The authors declare that they have no competing interests.

#### Availability of data and materials

The data sets used and/or analyzed during the current study available from the corresponding author on reasonable request.

#### Consent for publication

Information on the research objective was provided to the survey respondents in advance of them opting into completing the survey instrument. Respondents were instructed of their ability to opt out of the survey at any point. The privacy and confidentiality of participants were also maintained.

#### Ethics approval and consent to participate

Approval for the data collection process employed for this analysis was obtained from the Purdue University Human Research Protection Program Institutional Review Board (IRB) under Protocol No. 1511016805.

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## Appendix: USDA ERS Food Security Questions

### Questions Used To Assess the Food Security of Households in the CPS Food Security Survey

1. “We worried whether our food would run out before we got money to buy more.” Was that often, sometimes, or never true for you in the last 12 months?
2. “The food that we bought just didn’t last and we didn’t have money to get more.” Was that often, sometimes, or never true for you in the last 12 months?
3. “We couldn’t afford to eat balanced meals.” Was that often, sometimes, or never true for you in the last 12 months?
4. In the last 12 months, did you or other adults in the household ever cut the size of your meals or skip meals because there wasn’t enough money for food? (Yes/No)
5. (If yes to question 4) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
6. In the last 12 months, did you ever eat less than you felt you should because there wasn’t enough money for food? (Yes/No)
7. In the last 12 months, were you ever hungry, but didn’t eat, because there wasn’t enough money for food? (Yes/No)
8. In the last 12 months, did you lose weight because there wasn’t enough money for food? (Yes/No)
9. In the last 12 months did you or other adults in your household ever not eat for a whole day because there wasn’t enough money for food? (Yes/No)
10. (If yes to question 9) How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

*(Questions 11-18 were asked only if the household included children age 0-17)*

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

Questions obtained from; Coleman-Jensen et al. [15]. Household Food Security in the United States in 2014, ERR-194, U.S. Department of Agriculture, Economic Research Service.

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