

Measuring Food Security in the United States for More Than 25 years: History, Methods, Findings, and Opportunities

Irma Arteaga, PhD; Parke E. Wilde, PhD



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ABSTRACT

This article sets the stage for the “25 Years of Food Security Measurement: Answered Questions and Further Research” conference, with support from the Economic Research Service of the US Department of Agriculture, by providing some history of federal food security measurement, summarizing notable findings, and reviewing selected special topics in analysis methods. The federal government uses food security surveys to monitor national progress toward reducing food insecurity and to evaluate federal nutrition assistance programs. For the monitoring purpose, there is a tension between focus (on a single authoritative measurement approach) and breadth (encompassing multiple tools or instruments suitable for diverse populations, contexts, and applications). For the program evaluation purpose, challenges include coordination with study designs capable of real causal estimation in the face of strong self-selection effects and tailored reference periods in survey questions that match the timing of program participation. Some analysis methods treat the food security survey items as distinct experiences of hardship, whereas others treat the food security survey items as windows on an underlying latent variable, a food insecurity score. The severity of food-related hardship may be assessed quantitatively by the number of distinct hardships reported, by the estimated value of a latent food insecurity score, or by the frequency of occurrence for sentinel hardships. Ongoing work investigates statistical approaches that are sufficiently simple for policy application and yet sufficiently flexible to accurately match the empirical survey evidence. *J Acad Nutr Diet.* 2023;123(10S):S5-S19.

FOR SLIGHTLY MORE THAN 25 YEARS, THE US Department of Agriculture (USDA) has used Census Bureau data to scientifically estimate the annual prevalence of household food insecurity, a measure of food-related hardship.^{1,2} This anniversary provides an opportunity to reflect on the achievements of the US food security measurement, contemplate lessons learned, and consider potential changes going forward to better serve the purposes of federal investment in this policy area. As part of a conference and journal special issue supported by USDA Economic Research Service (ERS), this article sets the stage by providing some history of federal food security measurement, summarizing notable findings, and reviewing selected special topics in measurement methods that will be used in the issue's other articles. We aim to include some high-profile studies along with other less famous and more idiosyncratic examples of recent research suggesting potential directions for further development.

A food security measure should satisfy several criteria. It should be suitable for at least two major policy-relevant purposes: monitoring national progress toward food

security goals and evaluating federal nutrition assistance programs and other policies. It also should be appropriate for diverse populations, close in meaning to the intended conceptual definition of household food security, and simple enough to explain to policy makers. Emphasizing a single focused authoritative food security measure is useful for some of these criteria, whereas a broader array of multiple measures may be better for different contexts and diverse populations. This tension between focus and breadth reappears in subsequent sections on history, methods, monitoring progress, program evaluation, and conclusions.

HISTORY OF THE FOOD SECURITY MEASURE

The USDA food security measure was created after Congress passed the National Nutrition Monitoring and Related Research Act of 1990 (see the [Figure](#)). USDA's 10-year comprehensive plan developed under the Act recommended a standardized instrument to measure food insecurity in the United States and at the state and local levels. Good sources for the history of the USDA household food security measurement exist.³⁻⁵

Previously, before the mid-1990s, food-related measures of hardship were based on anthropometrics (wasting or

Statement of Potential Conflict of Interest

See page S19.

stunting), household income (poverty), or growth of emergency food services (food banks and food pantries), none of which met the need for a representative validated survey-based measure of food security. A simple USDA food sufficiency question predates the official household food security measure. It has remained as a screener question on federal surveys and has received increased attention in 2020 during the coronavirus disease 2019 (COVID-19) pandemic due to its adaptation for the Census Bureau's high-frequency Household Pulse Survey, discussed in the next section (see Methods).

In January 1994, the Food and Nutrition Service of USDA and the National Center for Health Statistics of the US Department of Health and Human Services sponsored the National Conference on Food Security Measurement and Research. Participants at that conference were academic experts who led nutrition and hunger projects, private researchers from Abt Associates, Mathematica Policy Research and similar organizations, as well as staff from federal agencies that studied and collected data related to food insecurity and insufficiency. The participants conceptually defined food security and recommended an approach to scientifically measure food insecurity using a national survey.

In April 1995, the first nationally representative food insecurity survey was administered by the US Census Bureau, via a supplemental module to the Current Population Survey (CPS).¹ Abt Associates analyzed the data from the 1995 survey; Mathematica Policy Research had a contract with the Food and Nutrition Service to determine the stability of the food security measure for the period 1995-1997. Thereafter, CPS annually collected food security data as part of a supplemental module. The 1995 technical report led by Abt Associates found that scaling techniques justified three thresholds and four food security categories: food secure, food insecure with hunger not evident, food insecure with moderate hunger, and food insecure with severe hunger.

One group of questions in the first CPS Food Security Supplement addressed coping or resource augmentation, including actions that households might take to deal with scarce food resources. Examples of these questions are sending children to eat at a friend's, putting off paying other bills to buy food, or obtaining meals from soup kitchens or food banks. The report concluded that these questions did not meet the statistical criteria for inclusion in the scale.⁶

The wording of food security questions has not changed much since 1995. From the beginning, the CPS had a battery of 18 questions to measure food insecurity for households with children and 10 questions to measure food insecurity for households without children (CPS Food Security Supplement). In 1998, ERS assumed responsibility for analyzing food insecurity measures, as well as sponsorship of the annual household food security survey module in the CPS. Since then, small changes have occurred, mainly related to the screening questions and ordering of items rather than the actual content of the questionnaire. USDA has conducted split ballot tests of variations in the wording of some questions, including child-referenced items and a "balanced" meals question. In addition, shorter six-item and two-item survey instruments were developed for particular uses, discussed in the Methods section.

In 2006, USDA consulted with the Committee on National Statistics of the National Academies on a high-profile review: "Food Insecurity and Hunger in the United States: An

RESEARCH SNAPSHOT

Research Question: Reviewing the 25-year history of US food security measurement, what lessons may guide future innovations using food security surveys to measure national progress and evaluate the effectiveness of federal nutrition assistance programs?

Key Findings: Sound measurement strategy involves a tension between focus and breadth. A focused authoritative 12-month measure may be used as a high-profile indicator of national progress toward food security goals. Alternatively, a broader set of measures may be best for distinct populations with diverse experiences of food-related hardship or for evaluating particular interventions and programs that may influence specific dimensions of food security.

Assessment of the Measure."⁵ Based on one recommendation from that report, the labels of the four food security status categories were changed to: high food security, marginal food security, low food security, and very low food security. The first two categories indicate food security, whereas the last two indicate food insecurity. The term *hunger* was removed from the category labels, although one of the survey items still does ask about going hungry. The Expert Committee explained that hunger might result from food insecurity, and measuring hunger required detailed and extensive information on physiological experiences of each household member.

Following another recommendation from the National Academies review, the order of items was changed for households with children, so that all adult-referenced items would precede all child-referenced items. Engelhard and colleagues⁷ estimated measures of statistical fit for food security items, with attention to the order in which questions were asked. The National Academies review made other recommendations about the statistical models used to assess household food security measures, as will be discussed further in the Methods section

The USDA questions are used on most US national surveys, including but not limited to CPS, Panel Study of Income Dynamics, National Longitudinal Survey of Youth, Early Childhood Longitudinal Survey Birth Cohort and Kindergarten Cohort, National Health Interview Survey, National Health and Nutrition Examination Survey, and the Medical Expenditure Panel Survey.⁸

The use of sound statistical methods to validate the USDA food security instrument and scale has motivated other countries and organizations to use the survey in its current form (eg, Young Lives), or to adapt it.⁹⁻¹¹ Moreover, the USDA food security instrument has influenced the way we measure food security around the world. For example, in 2014 the United Nations, Food and Agriculture Organization's Voices of the Hungry project developed a measure of food insecurity, the Food Insecurity Experience Scale (FIES). It was modeled after the USDA food security survey module and consists of eight questions. FIES is a standardized measure of individuals' direct experiences of food insecurity and is used to compare food insecurity around the globe.¹² It is currently used by 146 countries.

THE HISTORY OF FOOD SECURITY MEASUREMENT

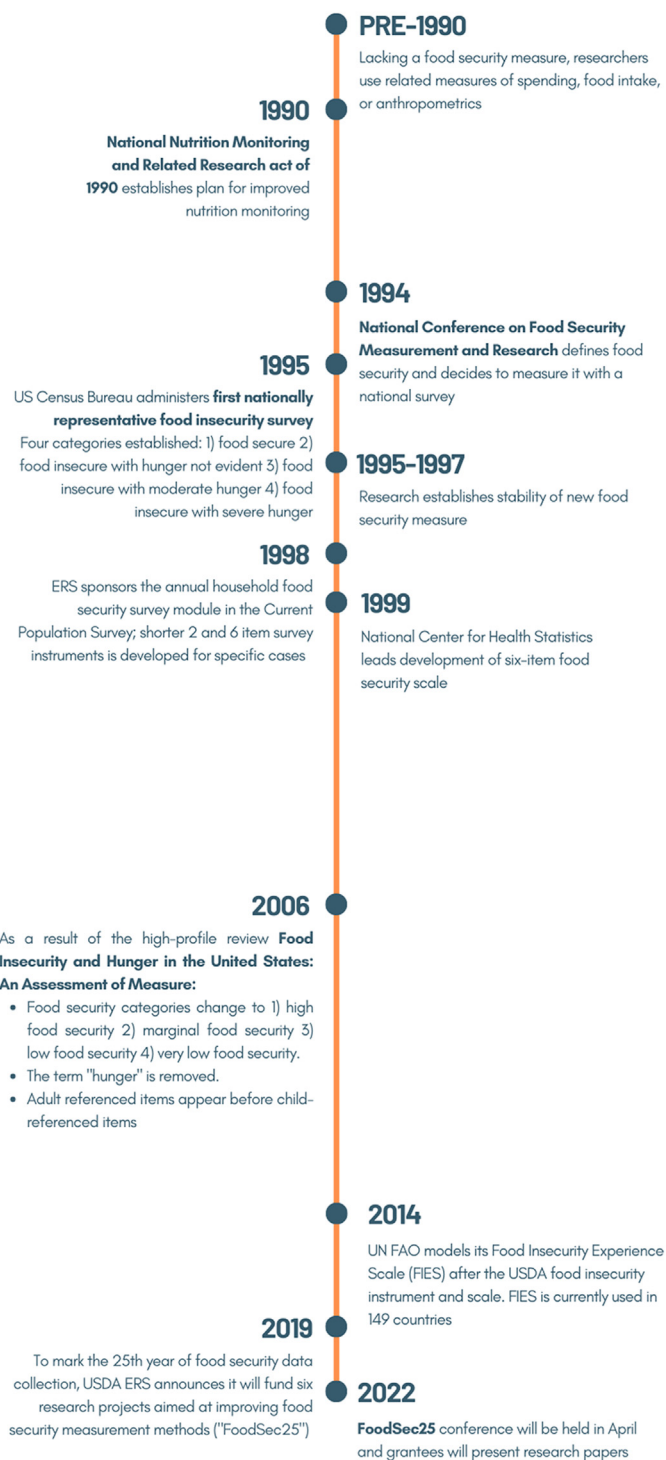


Figure. Selected events in the history of US food security measurement.

Table 1. Response frequencies for binary household food security items (household and adult referenced) from a nationally representative sample of US households with and without children in the 2020 Current Population Survey^a

Scale item ^b	All households	Households without children	Households with children
	←—————% ^c —————→		
Household item			
Worried food would run out before (I/we) got money to buy more	14.2	11.9	19.9
Food bought didn't last, and (I/we) didn't have money to get more	11.4	9.9	15.0
Couldn't afford to eat balanced meals	11.3	10.5	13.2
Adult item			
Adult(s) cut size of meals or skipped meals	6.2	5.8	7.2
Respondent ate less than felt he/she should	6.3	5.7	7.4
Adult(s) cut size or skipped meals in 3 or more months	4.7	4.5	5.1
Respondent hungry but didn't eat because couldn't afford food	3.2	3.1	3.7
Respondent lost weight	2.1	2.1	2.1
Adult(s) did not eat for whole day	1.2	1.2	1.2
Adult(s) did not eat for whole day in 3 or more months	0.9	0.9	0.8

^aData source: <https://www.ers.usda.gov/data-products/food-security-in-the-united-states>. [Accessed: February 11, 2023].

^bQuestions refer to resource limitation (eg, "... because [I was/we were] running out of money..."). See Coleman-Jensen et al. (2021)¹.

^cWeighted estimates, omitting nonresponders.

METHODS

This section discusses conceptual definitions, the food security survey items and category thresholds that determine federal food insecurity prevalence statistics during the past 12 months, an alternate measure with 30-days in place of a 12-month reference period, alternate measures for food insecurity in households with children, shorter survey-based approaches such as the Hunger Vital Signs and the older USDA food sufficiency question used on the Household Pulse Survey, and item response theory (IRT) models used for several statistical purposes. The methods for federal household food security measurement are described in multiple sources.^{1,13-16}

Conceptual Definitions

USDA defines household food security as having “access at all times to enough food for an active, healthy life for all household members.” Households that are not food secure may be called “food insecure.” These food-insecure households may be subclassified as having “low” or “very low” food security. USDA defines very low food security as “the more severe range of food insecurity where one or more household members experienced reduced food intake and disrupted eating patterns at times during the year because of limited money and other resources for obtaining food.”¹³

In operational practice, the classifications used for estimating food security prevalence using survey data are related

to, but not precisely the same as, the conceptual definitions.¹⁷ USDA notes, “This operational measure does not specifically address whether the household members’ food intake was sufficient for active, healthy lives—the conceptual definition of food security.”¹³ Instead, the survey items ask about specific symptoms of hardship, which we describe next.

Instruments

Food Security Items and Category Thresholds. The empirical categories are based on the number of affirmative responses to survey questions, so it is useful to become familiar with the specific survey items and their response frequencies. The food security classification system used in the high-profile statistics for monitoring national progress, cited previously in the introduction, is based on 18 survey items.¹³ These 18 items are referred to as the US Household Food Security Survey Module.

Ten of the items use survey questions asked of all households (Table 1). The first three most frequently affirmed of these 10 items are “household items.” The remaining seven of the 10 items asked of all households are “adult items,” describing the experience of the respondent or other adults in the household. The final eight of the 18 items are “child items,” based on questions asked only of households with children (Table 2).

The original survey questions provide much information about how frequently hardships occur. For most of the items, the survey asks whether the household experienced the

Table 2. Response frequencies for binary household food security items (child referenced) from a nationally representative sample of US households with children in the 2020 Current Population Survey^a

Scale item ^b	Households with children % ^c
Child item	
Relied on few kinds of low-cost food to feed child(ren)	12.9
Couldn't feed child(ren) balanced meals	7.7
Child(ren) were not eating enough	3.6
Cut size of child(ren)'s meals	1.9
Child(ren) were hungry	0.9
Child(ren) skipped meals	0.6
Child(ren) skipped meals in 3 or more months	0.5
Child(ren) did not eat for whole day	0.1

^aColeman-Jensen et al. (2021)².

^bQuestions refer to resource limitation (eg, "... because I was/we were) running out of money..."). See Coleman-Jensen et al. (2021)¹.

^cWeighted estimate.

hardship never, sometimes, or often (Table 3). For later statistical analysis, the survey questions may be condensed into binary survey items that are affirmed (the hardship is sometimes or always experienced) or not affirmed (never experienced). At times, as discussed later in this section, researchers have explored using statistical models that treat the survey questions as "polytomous," with three separate classifications for never, sometimes, or often.

Food security modules in federal surveys are administered with a skip pattern. Any household with income above 185% of the poverty level that does not affirm the initial screeners or one of the first three items is not administered the remaining (household) items, and these nonadministered items are counted as nonaffirmations. For any household administered the fourth through the eighth item, any household that does not affirm at least one of those is not administered the final two. According to the most recent USDA report,¹ rates of food insecurity among households with incomes at or above 185% of the federal poverty level was only 5% in 2021. USDA makes the reasonable assumption that higher-income households that report none of the initial symptoms of food insecurity are indeed food secure.

The raw score is the number of affirmative responses to the binary survey items. There are at least two commonly used ways of interpreting the survey items and raw score. As a summary interpretation, the survey items may be seen as multiple food-related hardships that households experience;

the raw score is merely a way of summarizing the collection of experiences. As a latent variable interpretation, the survey items may be seen as multiple windows on a single underlying latent food insecurity variable, using statistical tools from the field of item response theory, which are described further below. In one such IRT model commonly used in US food security research, the Rasch model, the raw score is a sufficient statistic that contains all of the information needed to estimate the latent food insecurity variable.

Based on the raw score, households are classified into food security categories. Official prevalence estimates for the categorical variables are widely cited. In some cases, the threshold for a particular category differs for households with and without children (Table 4). The intent of USDA's approach is to have the categories represent approximately equal levels of severity in households with and without children, so that a single food security status classification can be used for all households.

Food Security Status for Households with Children.

USDA researchers have explored separate classifications for households with and without children, as an alternative experimental approach.^{18,19} Adult food security status may be determined by responses to the 10 household- and adult-referenced items (Table 5), whereas child food security status may be determined by response to the eight child-referenced items (Table 6).

Under this alternative approach, a question arises about how to classify the overall food security status of the household. In households with children, the household could be considered food insecure in the case that either adults or children or both were classified as food insecure. Or, one could simply classify household food security status based on the 10 household- and adult-referenced items in all households. USDA research into experimental food-security classification methods discusses indications of internal and external validity, with some strengths and weaknesses for each option.¹⁸

Twelve-Month and 30-Day Measures. The food security measures described above reference the previous 12 months. Because participants enter and exit federal nutrition assistance programs from month to month, an alternative measure with a shorter reference time period is more useful for program evaluation purposes. The statistical supplement to USDA's annual report provides estimates of food security during the 30 days before the interview, in households with and without participation in federal nutrition assistance programs.² This 30-day measure has been validated. The hardship described in a survey item is more likely to have occurred in the past 12 months than in the past 30 days.

Shorter Instruments. Shorter instruments for food security measurement, including a two-item and a six-item survey, have been used to assess household food insecurity.²⁰ Both versions have been validated as screeners.²¹ The advantages of these short instruments are the decreased respondent burden and minimal bias compared with longer versions. The disadvantages are that they do not measure the most severe levels of food insecurity, they are less precise than the 18-item instrument, and they do not ask questions regarding

children in the household. Shorter two-item instruments may also be more feasible in clinical health care settings.

For the two-item survey, the Hunger Vital Signs, the following two questions have been used: “We worried whether our food would run out before we got money to buy more.” Was that often true, sometimes true, or never true for your household in the last 12 months? “The food we bought just didn’t last and we didn’t have money to get more.” Was that often true, sometimes true, or never true for your household in the last 12 months?” At least one alternative question would be needed for a two-item survey that aimed at assessing hunger.

The six-item short form of the food security survey module has had minor technical improvements to wording since the 1995 module. Blumberg and colleagues²¹ found that the six-item survey was useful not only in a clinical setting but had applications for national survey use as well.

The Household Pulse Survey administered during the COVID-2019 pandemic is a 19-item questionnaire assessing employment status, food sufficiency, housing security, education disruptions, and physical and mental well-being.²² Food-related hardship is assessed using several questions, including a version of the long-standing USDA food sufficiency question: “Which of these statements best describes the food eaten in your household? Enough of the kinds of food (I/we) wanted to eat; enough, but not always the kinds of food (I/we) wanted to eat; sometimes not enough to eat; often not enough to eat.”

The food sufficiency question differs in content scope and reference time period from household food security questions, although it is possible to estimate the most probable food security status corresponding to the four response options for the food sufficiency question.²³ The current Household Pulse Survey provides a unique example of a shorter household food sufficiency measurement instrument, with a short 7-day reference period, incorporated into a larger more general survey, with relatively specific questions in the context of the pandemic and the need for recent data to feel the “pulse” of the nation during a national emergency.²²

Survey Mode. In addition to the survey content, there also has long been interest in whether or not the mode of survey administration affects the estimated prevalence of food security. Two decades ago, Nord and Hopwood²⁴ compared in-person interviews with phone interviews; the effect of interview mode was small. Recent research after the start of the COVID-19 pandemic suggests that Internet surveys overstate prevalence of food insecurity by 9% to 14%, but prevalence of food security using Internet surveys were closer to the US government estimates when it was assumed that all households with incomes above 185% of the federal poverty level were food secure.²⁵ Further research is needed to understand the effect of interview mode with current technology.

Cognitive Testing

Cognitive interviews are widely used to pretest survey instruments by identifying comprehension and response problems.²⁶ This approach is used to create new survey questions and to understand and interpret existing survey

instruments. For the original USDA food security module, researchers pretested survey items.^{6,27} A decade later, researchers also used cognitive testing when improving their children’s food security measure,²⁴ and in 2019 ERS contracted with US Census Bureau to conduct cognitive testing of the entire CPS Food Security Supplement questionnaire.

Several items in the food security module have been a special focus for cognitive testing. “Running out of food” and “balanced meals” might not be clearly understood or might have different meaning for different populations.²⁸ Studies from Hawaii, India, and Indonesia show that the term *balanced meals* depends on cultural contexts. Suggested variations of that phrase based on cognitive testing are: *healthy and varied diet* or *nutritious meal*.^{29–31} Cognitive testing may suggest alternative answers when questions have multiple choices. Cognitive testing in the US with Latino immigrant mothers suggests that the option “hardly ever” should be used instead of “never.”³²

There has been limited cognitive testing of the US food security module in languages other than English. About 42 million people aged 5 years and older speak Spanish at home in the United States. Chinese languages (Mandarin, Cantonese, and others) are spoken by about 3 million people in the United States. Although formal cognitive testing has not been conducted for the Spanish version of the CPS-FSS food security items, researchers at USDA ERS have validated the Spanish version using Rasch analysis.³³ In the past, a lack of standardized Spanish translation led to the use of different Spanish variants of the CPS-FSS module. For example, the “balanced meals” item was translated variously as “*comida balanceada*” (balanced meals) and “*comida nutritiva*” (nutritious meals),³⁴ whereas the new USDA standardized Spanish module now uses “*comida variada y nutritiva*.”³³ However, for the Chinese version of the CPS-FSS module, no cognitive testing or Rasch analysis has been conducted to date. In Chinese no equivalent words are found for “balanced meals” or “eat less than you felt you should.”^{32,35}

Among areas for future research, formal cognitive testing of the Spanish and Chinese versions of the USDA food security instrument can use Hispanic and Chinese subjects from different parts of the country and who speak different dialects. There is limited research on whether a shorter version of items is more convenient for certain populations. Harrison and colleagues³⁴ found that low-income Spanish speakers prefer shorter versions of the items because they can easily understand them. Cognitive testing can also be used to examine the appropriate age when a child can start reporting his or her own food security.

Analysis Tools

Analysis tools include survey weights for descriptive statistics and statistical models for understanding household food security as a latent variable. Federal surveys that assess household food security are weighted for national representativeness. In principle, the weights are inversely proportional to a household’s probability of being selected for the survey sample. Based on observable characteristics, such as race, ethnicity, household headship, and geographic location, the weights indicate how many households in the population are represented by each household in the

Table 3. Response frequencies for never/sometimes/often items in the 2020 Current Population Survey^a

Scale item ^b	All households			Households without children			Households with children		
	Never	Sometimes	Often	Never	Sometimes	Often	Never	Sometimes	Often
	← % ^c →								
Household items									
Worried food would run out before (I/we) got money to buy more	85.5	11.2	3.1	87.9	9.1	2.8	79.8	16.1	3.7
Food bought didn't last, and (I/we) didn't have money to get more	88.3	9.2	2.2	89.8	7.7	2.2	84.7	12.7	2.3
Couldn't afford to eat balanced meals	88.4	8.6	2.6	89.2	7.7	2.8	86.4	10.8	2.3
Child items									
Relied on few kinds of low-cost food to feed child(ren)							86.2	10.4	2.4
Couldn't feed child(ren) balanced meals							91.4	6.5	1.1
Child(ren) weren't eating enough							95.4	3.0	0.5

^aData source: <https://www.ers.usda.gov/data-products/food-security-in-the-united-states>. [Accessed: February 11, 2023].

^bQuestions refer to resource limitation (eg, "... because (I was/we were) running out of money..."). See Coleman-Jensen et al. (2021)¹.

^cWeighted estimates, omitting nonresponders.

sample. Nonresponse bias may remain a concern to the extent that nonresponse is associated with unobservable factors rather than these observable characteristics. Declining response rates are a concern for several major federal surveys, including the CPS.³⁶

Some decisions in federal measurement methods, including decisions about the raw score thresholds for food security status classification, draw on scaling tools from IRT, a field of statistics with long-standing applications in educational testing and psychometrics. The National Academies report mentioned above describes several potential IRT methods, including the Rasch model, which was originally used to develop the federal food security measurement approach, and several alternatives.⁵

The Rasch model is akin to a logistic regression model showing the log-odds of affirmative response to the survey items as a function of the severity of the item and a food security scale score for the household. With the Rasch model, the raw score (the number of affirmative responses, an integer variable) is a sufficient statistic for the underlying food security scale score (a continuous variable). This means one can use the raw score to determine the food security scale score without needing other information about which questions were answered affirmatively. The Rasch model is unidimensional, which means that the survey items are taken to provide information about a single underlying latent variable. USDA chose to develop a unidimensional measure of food security that captures two central dimensions of food security, food certainty and food sufficiency. As a result,

respondents to the household food security survey model are assumed to formulate their responses to the food-security questions based on the food available to them relative to their subjective needs.¹⁵

Because the raw score is a sufficient statistic for the scaled Rasch score, the official food security status classifications are based on raw score thresholds—which are straightforward to interpret—rather than direct estimates from an IRT model. In this sense, the IRT models do not directly determine household food security prevalence estimates. The IRT models do help determine what thresholds should count as equivalent for households that are asked different questions, most notably households with and without children,¹⁷ and these models are heavily used in validation research.

Previous research has found that Rasch model estimates for the severity of survey items differ in households with and without children, which violates one of the model's technical assumptions and complicates efforts to use the Rasch model for setting equivalent raw score thresholds among these groups.^{5,19,37,38} Formally, the Rasch model rules out differential item functioning, which is differences across populations in the frequency of affirming items when the underlying food security score is held constant. Noting other evidence of this type of differential item functioning with respect to several household characteristics, the National Academies report investigated more general statistical models in the IRT family.⁵

However, these alternative IRT models each present additional difficulties in estimation and ease of explanation to

Table 6. Frequency of raw score for child-referenced items from a nationally representative sample of US households with children in the 2020 Current Population Survey^a

Raw score	Households with children
	%
0	85.9
1	6.6
2	4.0
3	2.0
4	0.7
5	0.5
6	0.1
7	0.2
8	0.1

^aColeman-Jensen et al. (2021).²

Beyond descriptive studies, food security research has addressed important policy questions. For example, studies on the effects of the American Recovery and Reinvestment Act on food security⁵² and specifically on the changes of SNAP benefit sizes on food security and other health outcomes^{53,54} have guided the federal response to the COVID-19 pandemic that included more than \$2 billion per month in emergency SNAP supplements to take all participating households up to the maximum amount. Moreover, with the majority of schools closed in 2020 due to the pandemic, Pandemic Electronic Benefits Transfer card have also been used to distribute money to families to replace meals that children would have received through the National School Lunch Program. Such studies build on decades of research into the effects of food assistance programs on food security and health outcomes by academic researchers, health experts, and physicians.⁵⁵

Since the creation of the food security measure in 1995, researchers have also examined food security for vulnerable populations such as elderly, immigrants, children, and more recently women. In the case of seniors, food security is associated with adverse health outcomes, including health status, self-reported health, depression, anxiety, and disabilities.^{56–61} Research on food insecurity and immigrants have focused on Hispanic/Latino subjects.⁶² Food insecurity is associated with weight increase with longer US residence for immigrant women.⁶³ Relative to Hispanic natives, Hispanic immigrant households and children are more likely to be food insecure.^{64–66} Whereas SNAP has been found to be a protective factor for food insecurity, with the passage of the Personal Responsibility, Work, and Reconciliation Act, non-citizens became ineligible for food assistance programs and mixed families reduced their allotment of SNAP, which contributed to an increase of food insecurity.⁶⁷ Recent high levels of food insecurity among immigrants can be explained by level of acculturation, and economic stress,⁶⁸ maternal education, and household size,⁶⁶ as well as the Great Recession, language barriers to get access or keep access to food

assistance programs, and increasing anti-immigrant sentiment.⁶⁹

Just recently, research in the United States has focused on examining the relationship between gender and sexuality, food insecurity and health outcomes and found that women of color; elderly women; and lesbian, gay, bisexual, transgender, queer, and others population experience disproportional rates of food insecurity.⁷⁰ Key variables that explain food insecurity for women are domestic violence,⁷¹ and the way they shop and make their meals.⁷² In addition, social capital and geographical location explain food security experiences for elderly women.^{73,74} Transgender and gender nonconforming people experience high rates of food insecurity largely due to lack of steady employment opportunities and layered discrimination.⁷⁵

EVALUATION OF FEDERAL NUTRITIONAL ASSISTANCE PROGRAMS

Prior literature has studied the effects of a wide variety of antipoverty policies and safety net programs on food insecurity,⁷⁶ including the effects on the SNAP, the Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the National School Lunch Program (NSLP), among others.

SNAP

SNAP is the nation's largest antihunger program and a key part of the social safety net, providing food spending support to 40 million people monthly in 2020. A large literature finds that SNAP improves household food security.^{52,77–82} Evaluation efforts are challenging, because people who participate in these programs may differ systematically from those who do not. Cross-sectional comparison shows that SNAP participants have high levels of food insecurity. Among households with income below 130% of the federal poverty level (a gross income threshold used in SNAP eligibility determination), 45.4% of SNAP participants in 2020 were food insecure and 24.8% of SNAP nonparticipants were food insecure.²

Results from studies that sought to control for this self-selection have varied depending on the methods used. Older studies using simultaneous equation models,⁸³ fixed effects models,⁸⁴ and propensity score matching⁸⁵ have found unclear evidence regarding the relationship between SNAP and food security, often reporting positive but not statistically significant estimates. These older studies shed light on the nature of confounding factors suggesting that unobserved factors are probably time-varying and affect from time to time. More recent studies have found that SNAP participation reduces the severity or incidence of household food security. These studies use instrumental variables approaches,^{78,81} fixed effects,⁸⁶ and partial identification bounding methods,⁸⁷ regression discontinuity design,⁸⁸ among others. A study by Gregory, Rabbitt, and Ribar⁸⁹ replicates the modeling strategies used in the literature and finds that SNAP reduces food insecurity, but effects might differ across subpopulations and are not always statistically significant.

WIC

There is a small number of studies examining the relationship between WIC participation and food insecurity. Although

earlier studies are not causal and find mixed results, more recent studies find WIC participation associated with lower risk of food insecurity. Using a small sample size of around 300 pregnant, first-time participants in WIC, Herman and colleagues⁹⁰ found that WIC makes a significant contribution to reducing food insecurity. A few studies used logistical regression analysis. Oberholser & Tuttle⁹¹ found a positive association between food security status and WIC participation but did not find a relationship between number of months receiving WIC and food security status. Metallinos-Katsaras and colleagues⁹² report a positive association between WIC participation and food security for most subgroups, except for the households that were categorized as food secure at WIC entry, where a negative association was found. Additionally Black and colleagues⁹³ observe a higher but not statistically significant rate of reports of food insecurity among WIC-eligible nonparticipants than WIC participants. More recently and using quasiexperimental designs, researchers have found that WIC increases food security or that aging out of WIC increases food insecurity. Using regression discontinuity design, Arteaga and colleagues⁹⁴ and Cho⁹⁵ found that ageing out of WIC increases food insecurity in households with children. Using partial identification methods to jointly account for unobserved counterfactual outcomes and underreporting of WIC participation, Kreider, Pepper, and Roy⁹⁶ found that WIC reduces the prevalence of child food insecurity.

NSLP

There is limited literature on the effects of NSLP on food security and its results are mixed. Arteaga and Heflin⁹⁷ used an instrumental variable approach and found that NSLP reduces food insecurity at school entry. Huang and Barnidge⁹⁸ use seasonal difference in NSLP participation to examine the effects of the program on food security and found that additional participation in the program increases food security. Using an experimental design, Burke and colleagues⁹⁹ examined the effect of having access to three meals on school days and a food backpack on weekends. They found that being in the treatment group reduced the most severe form of food insecurity in children, but increased less severe form in children, adults, and households.

School Breakfast Program

There is limited research that examines the association between participation in the School Breakfast Program and food security. Using a nationally representative dataset and a probit model, Bartfeld and Ahn¹⁰⁰ found that accessing school breakfast was associated with a reduction of marginal food insecurity among low-income third graders. A more recent study by Fletcher and Frisvold¹⁰¹ examined the influence of availability of SBP on food security among elementary school children using a difference-in-difference approach that compares differences in child food insecurity within states and across states in schools with different requirements to provide breakfast at school. This study found that access to the School Breakfast Program reduced the likelihood of low food security, although the estimated influence seemed large, and researchers suggested further research using a different dataset.

Prior research also examines the effects of food programs not only on food security, but also on health outcomes, as well study take-up and administrative burden during the certification process. SNAP participation is found to mitigate the negative association between food insecurity and health outcomes.⁵⁶ In addition, research suggests that states that require schools to offer school breakfast programs have reduced food security for young children.¹⁰¹ This body of research points to the importance of policy action such as increase take-up rates for WIC and SNAP, and to making changes to the recertification process in terms of administration and length.¹⁰²

DISCUSSION

This review provides just an introduction to the lively and energetic body of research on household food security measurement in the United States, while also communicating a sense of how much remains to do. At this 25th anniversary of this area of work, five interesting questions may be contemplated looking forward.

What Are the Comparative Merits of Focusing on a Primary Authoritative Food Security Measure vs Using More Varied Measures for Distinct Populations and Purposes?

A primary authoritative 12-month measure may be used for a high-profile indicator of national progress toward food security goals and for cross-national comparisons. Alternatively, more varied measures may be best for distinct populations with diverse experiences of food-related hardship^{103,104} or for situations of crises¹⁰⁵ or for evaluating particular interventions and programs that may influence some dimensions of food security more than others or to measure food security for a particular individual.¹⁰⁶ A substantial challenge with more varied measures is comparability of the level of hardship. The threshold for being classified as “food insecure” may be difficult to interpret when different measures for different populations are based on different underlying survey questions.

How Much Should the Definition of Food Security Be Broadened to Address Additional Dimensions?

Broadening the definition of food security in one direction, Mozaffarian and colleagues¹⁰⁷ proposed greater emphasis on “nutrition security,” focusing on experiences that are associated with risk of chronic disease, with implied policy responses offering more specific nutrition benefits. Broadening the definition in another direction, Chilton and Rose¹⁰⁸ suggest an approach to food security that engages a human right framework, with implied policy responses addressing deeper social challenges such as “lack of adequate education and living wages, lack of access to health care and health information, and exposure to unsafe living conditions such as unsafe water, poor housing, and dangerous neighborhood environments.” In the same broader spirit, Singleton and colleagues¹⁰⁶ explore research that connects food insecurity to racism and structural violence. It is comparatively more feasible to address these broader dimensions of food security in the case that the measurement program encompasses an array of different tools for different purposes (the second approach in the

previous paragraph). By contrast, if the official measurement approach focuses on one primary authoritative measure, then these additional dimensions, such as nutrition-related chronic disease risk or poverty-related structural violence, may be too much for a single measure to handle; they may best be seen merely as external correlates of food insecurity rather than dimensions that are part of the definition of food insecurity.

Are High-Profile Prevalence Statistics Best Interpreted as Summaries of Experiences of Food-Related Hardship or as Estimated Values for a Latent Variable Within an IRT Framework?

Some widely read and influential sources on US household food security, including the annual USDA food security reports, make little reference to IRT models. When prevalence statistics are interpreted as summaries of the food security survey items, the estimates do not depend on specific assumptions of statistical models used for analysis. Other sources consider estimated scores for a latent food security variable to be the fundamental objective of food security measurement. Such latent variable estimates may be derived from comparatively simple and easy to communicate statistical models such as the Rasch model (which depend on comparatively strict assumptions that may not be empirically corroborated) or from more complex models within the broader IRT family of models (which may be more correct statistically but more difficult to explain in policy applications).

What Are Options for Assessing the severity or Depth of Food Insecurity?

One approach emphasizes the raw score, the number of binary survey items that is affirmed by respondents. A larger raw score indicates more severe food insecurity. This approach works equally well whether analysts interpret the raw score as merely a summary of several survey items or within a Rasch model framework as a representation of the underlying food security latent variable. Another approach is to directly focus on the latent food insecurity variable, within the framework either of the Rasch model or a more complex IRT model, each of which has strengths and limitations. A third approach, which would involve more change from current practice, would give greater emphasis to the frequency and timing of experiences of hardship, for example making greater use of questions about whether the hardship was experienced never, sometimes, or often.

In What Ways can Survey Instruments Be Shortened for Effective Use in Time-Constrained Interview Settings?

The methods section earlier reviewed a variety of two-item and six-item food security survey instruments, and recent research has abbreviated the child and adult HFSM.¹⁰⁹ Furthermore, the much older USDA food sufficiency question received new attention in 2020-2022 due to high-profile adaptation with a short 7-day reference period to monitor short-term hardship in the Household Pulse Survey during the COVID-19 pandemic, although this food sufficiency

measure is not the same as household food security. Heavier use of a short food security or food sufficiency instrument would have implications for the three preceding questions in this section: it goes well with a narrow focus rather than broadening the concept of food security to encompass new issues, with thinking of prevalence statistics as a simple summary of experiences of hardship rather than accurate measures of a latent variable in an IRT framework, and with using frequency of experiences of hardship (rather than range of items affirmed) as the best way of assessing severity.

Strategic thinking about future advances in US food security measurement may require considering these five questions jointly. Reflecting on the literature reviewed in this article, and especially the six final presentations by grantees from the project 25 Years of Food Security Measurement, we see some opportunities for future research in two very different directions.

First, in settings where variation in survey instrumentation is feasible, future research may modify the survey module to address diverse issues overlooked in a single canonical measure. For example, new survey questions may illuminate distinct aspects of food security for indigenous people including American Indians and Alaskan Natives¹⁰¹ or unique circumstances of crisis settings such as pandemics or natural disasters.¹⁰² Other modifications may address nuances in interpretation of Spanish language translations,⁹⁹ intrahousehold differences in symptoms of hardship,¹⁰³ and broader contextual circumstances such as racism and structural violence.¹⁰⁶ However, such additions come with a sacrifice, because they cannot all be incorporated into a simple unitary measure for measuring national progress and evaluating nationwide federal nutrition assistance programs. These broader topics provide excellent material for a field of research, not for one federal government survey measure.

Second, for applications where a single authoritative survey measure is desirable, this review encourages exploration of simpler approaches than the current 18-item survey module. It is striking that, during the ordeal of the COVID-19 pandemic during 2020 to 2022, the most useful nationally representative government statistics on food-related hardship came from a variation on the decades-old USDA food sufficiency question as adapted for the Household Pulse Survey, asking about having enough food and the right kinds of food specifically in the past 7 days. The 12-month reference period in the federal government's 18-item household food security measure was too coarse to capture short-term changes in food supply chains or household exposure to repeated spikes in COVID-19 incidence; and the 30-day survey questions in the federal module currently are fielded only in the December CPS rather than every month. For more frequent use with a shorter reference period, a module with fewer than 18 items might be essential for reasons of expense and respondent burden. As just one example, one of our small grant projects described a short two-item instrument as a candidate for use in clinical settings.⁹⁹ With a longer 18-item survey modules, one measures the severity of food insecurity based on the number of items affirmed; with shorter instruments, instead, it is easier to understand severity based on how frequently the hardships are experienced over time. Short

instruments are less suitable for analysis with tools from the field of IRT, so we recognize that this approach would represent a substantial change in how we think about the theoretical underpinnings of food security measurement. Even so, in a spirit of thinking outside the box, it may be valuable to further explore an alternate comparatively inexpensive short survey instrument with just a couple sentinel hardships, using a short time reference period such as 30 days, and using frequency of occurrence as a straightforward measure of severity.

CONCLUSIONS

Modern survey-based household food security measurement in the past 25 years represents a great advance over the unsatisfactory tools that previously were available. Based on the enormous body of insightful work generated during this quarter century, there are great opportunities to continue and expand this research tradition while also considering with an open mind newer variations either to broaden the topic coverage of food security modules, develop simple easy-to-explain survey methods with short reference periods, or both. We look forward to seeing what happens next.

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AUTHOR INFORMATION

I. Arteaga is an associate professor, Truman School of Government and Public Affairs, University of Missouri, Columbia. P. Wilde is a professor, Friedman School of Nutrition Science and Policy, Tufts University, Boston, MA.

Address correspondence to: Irma Arteaga, PhD, Truman School of Government and Public Affairs, University of Missouri, E313 Locus Street Building, 615 Locus St, Columbia, MO 65211. E-mail: arteagai@missouri.edu

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