**Food Insecurity/Food Insufficiency: An Empirical Examination of
Alternative Measures of Food Problems in Impoverished U.S. Households**

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Abstract

This report analyzes different approaches to measuring food problems among impoverished households. Researchers investigating what public policy analysts refer to as hunger have sketched out alternative conceptual spaces within which these food problems can be measured. The narrower conceptual space may be termed food insufficiency and is distinguished by restricted household food stores, too little food intake among adults or children in the household, and direct reports or perceptions of hunger among household members. The broader conceptual space may be termed food insecurity. This term subsumes food insufficiency and extends to include resource insufficiency, the inability to acquire enough nutritious food through culturally normalized means, and anxiety about this inability, along with various attempts to augment or stretch the food supply. Since the late 1980s these two definitions of food problems in impoverished households have been understood as hunger, insofar as hunger is a measurable phenomenon for policy purposes in an advanced industrial nation such as the United States. These definitions are now central in the development of survey research items used to estimate the population prevalence of hunger, along with its predisposing socioeconomic conditions and resultant health and developmental consequences. Drawing on a data set containing survey responses from more than 5200 low income households with children in 11 sites from around the nation, we conduct an empirical inquiry of questionnaire items tapping phenomena from each conception defined above. Specifically, the study examines 34 distinct questionnaire items, and it addresses four research questions: (1) To what aspect of food insecurity or food insufficiency does each indicator point? (2) Can particular combinations of items be scaled? (3) When scaled, do the items demonstrate content validity? (4) How do the alternative measures perform in an operationalized model of the antecedents and consequences of household food problems? We test models that include variables such as household income, household food and shelter expenditures, and bills in arrears, along with the health status of a randomly chosen child from each household.

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INTRODUCTION

Researchers have produced two differing conceptions of food problems that occur in
impoverished households, namely, food insecurity and food insufficiency. Food insecurity has been
defined as a condition of inadequate food, inadequate in quantity or in nutritional value, as well as a lack
of access to food through culturally normalized channels (where such channels would include shopping
at a food market or gardening, for example). Food insufficiency (owing to constrained resources) has
been defined in terms of limited supplies of household food, cutbacks in food intake among household
members, and self-reports of hunger. These conceptions have come to guide construction of
questionnaire items and development of multi-item scales used by researchers who study domestic
hunger to inform public policy debates about its extent, dimensions, and health consequences.

BACKGROUND

During the past decade and a half, numerous studies have attempted to provide reliable
documentation of the extent of hunger in the United States. These attempts include reporting increases in
demand for emergency food assistance (U.S. Conference of Mayors, 1983), using anthropometric and
survey-based measures (Massachusetts Nutrition Survey, 1983), and counting the portion of the poverty
population not receiving or running out of food stamps (Physicians' Task Force, 1985).

Other studies employing a variety of methodologies and measures were undertaken during this
period in Texas, Oklahoma, New York, Arkansas, Florida, and Utah to estimate the extent of hunger in a

particular area (local, multicounty, statewide).[1] The School of Public Health at the University of California at Berkeley brought together researchers from many of these projects at a conference in February 1987. The conferees concluded that hunger is a sociopolitical problem that embodies biological, psychological, and socioeconomic aspects (Margen and Neuhauser, 1987). In so doing, the conferees embraced the social definition of hunger proposed by the President's Task Force on Food Assistance (1984), which framed hunger as a situation in which someone cannot obtain an adequate amount of food, even if the shortage is not prolonged enough to cause health problems. (For a more complete discussion of the shift from a medical model to a social scientific model, see Wehler, Scott, and Anderson, 1994.)

Nestle and Guttmacher (1992) report on the next round of surveys, those undertaken during the middle to late 1980s. Most of these studies sought to estimate the population prevalence of hunger. While many of these investigations could be said to have methodological limitations, either in the measure of hunger or in the sampling design or both, a strengthening of the movement can be observed throughout these endeavors in conceptualizing hunger using social terms, defining it as food insufficiency or food insecurity. The leading examples of this tendency are the Community Childhood Hunger Identification Project, or CCHIP (Wehler, 1986, 1987), and the study at Cornell University by Radimer (1990).

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[1]*Hunger in Texas: A State of Need.* Anti-Hunger Coalition of Texas. Summer 1982.

O*klahoma Impact.* Legislation Information Network of the Oklahoma Conference of Churches. Winter, 1982–83.

Hunger Watch - New York State Progress Report, April–July 1983–August 1983. Montefiore Medical Center, Department of Social Medicine.

Profile of "At Risk" Populations and Service Agencies. Hunger Watch, February 1984. Montefiore Medical Center, Department of Social Medicine.

Arkansas Hunger Project. Winthrop Rockefeller Foundation. October 15, 1984.

Hunger in Dade County, Florida. Metro-Dade Community Action Agency. February 1985.

Study of Low Income Households, Utah, 1985. Utah Nutrition Monitoring Project. Utahns Against Hunger and Utah Department of Health, Division of Family Health Services. May 1986.

Researchers with CCHIP had designed the conceptual framework for hunger used previously in the Massachusetts Nutrition Survey (1983). This framework was modified for use in CCHIP, arriving at an operational definition of hunger as food insufficiency due to constrained resources. At the household level it was measured as food shortages due to lack of food money, and at the individual level it was measured as insufficient food intake. Beginning in 1985 CCHIP conducted a pilot study in New Haven, Connecticut (Wehler, 1986), during which the conceptual framework was operationalized and tested using survey research methods.

A hunger index was developed consisting of eight questionnaire items. Two items measured inadequate household food resources (one tapped food money insufficiency and one tapped dietary monotony), two measured insufficient food intake among adult members (one tapped perceived intake inadequacy and one tapped cutbacks in food consumption), and the remaining four items measured insufficient food intake among children in the household (two tapped perceived intake inadequacy and two tapped direct reports of insufficient food consumption). The CCHIP hunger index was assessed using principal components factor analysis and formed into an unweighted summated scale. Cut points were set using predictive validation procedures. Households were classified as "hungry" if they answered affirmatively five or more items, as "at risk of hunger" if they answered from one to four items positively, and "not hungry" if they answered none of the items positively. Prevalence estimates could then be made using these three categories from the summated scale.

Following the pilot study, revisions were made in the research techniques (Wehler, 1987). A demonstration project was then conducted in Washington State during 1987–88. Results from this project (see Wehler, Scott, and Anderson, 1992) allowed researchers to standardize procedures for sampling, interviewing, scaling, and data analysis for subsequent CCHIP surveys conducted from 1988 through 1994.

The study by Radimer (1990) of women in upstate New York also helped move the research and policy communities toward consensus on an appropriate meaning for the term hunger and on measures to assess hunger. Her interviews revealed separate dimensions of hunger at the individual level and at the household level. Furthermore, hunger was depicted as a managed process, as women used coping strategies to avoid or delay hunger. The dimensions of household/individual hunger and adult/children's hunger contributed to forming and evaluating hunger scales. Radimer concluded that hunger prevalence could be analyzed based on a summated scale, as well as by grouping the results dichotomously to indicate whether a household, for example, was characterized as hungry.

Radimer and her colleagues (Radimer, Olson, and Campbell, 1990; Radimer et al., 1992) sought to forgo reliance on indirect (socioeconomic) measures of hunger. Instead, they defined hunger in terms of food insecurity—"the inability to acquire or consume an adequate quality or sufficient quantity of food in socially acceptable ways, or the uncertainty that one will be able to do so" (Radimer et al., 1992, p. 39S).

In 1988 a series of questions related to food insufficiency and food insecurity were developed for the Third National Health and Nutrition Examination Survey (NHANES III). NHANES is one of the major survey programs in the series of health-related studies conducted by the National Center for Health Statistics (NCHS) over the past 30 years. The primary purpose of NHANES is to measure and monitor the health and nutritional status of the U.S. population.

Pilot studies tested revised questionnaire items derived from the CCHIP surveys and USDA food consumption surveys. The CCHIP items were adapted for use in a general population survey (CCHIP was a survey targeted to low-income households with children under 12 years old). Researchers used NCHS's Questionnaire Design Research Laboratory to help ensure technical quality in the design of the NHANES III overall survey and in the wording, temporal references, ordering, and readability of the food insecurity-related questions (Briefel and Wotecki, 1992).

Nearly all studies by this period began adopting hunger definitions invoking food insufficiency or food insecurity (Cohen, 1990; Cohen and Burt, 1989; Morris, Neuhauser, and Campbell, 1992; House Select Committee on Hunger, 1989, 1990). See Leidenfrost (1993) for an overview of studies with hunger definitions framed in these ways.

The culmination of the trend to cast hunger in social terms is seen in the recommendation made by the Life Sciences Research Office (LSRO) of the Federation of American Societies for Experimental Biology. The American Institute of Nutrition requested a report by the LSRO about core indicators of nutritional status for difficult-to-sample populations. The report concludes that the best approach for researching such populations uses the notion of food insecurity. "Food insecurity exists whenever the availability of nutritionally adequate foods in social acceptable ways is limited or uncertain. Hunger (in its meaning of the uneasy or painful sensation caused by a lack of food) and malnutrition are potential, although not necessary, consequences of food insecurity" (Anderson, 1990, p. 1560).

Habicht and Pelletier (1990) underscore the importance and relevance of this move. They argue that a context of utility must be used to decide the "best" indicator of nutritional status for a given research effort. Moreover, "the definition of 'best' depends ultimately on what is most appropriate for the decision that must be made" based on the study's results (p. 1519). When the decision is whether or not to intervene through public policy by making food or resource assistance available to those in need, the indicator deemed "best" must be predictive of harm. This is simply because programmatic intervention aims at preventing harm. Any indicator of hunger used in this context would "usually not be the nutritional status of the individual, which usually changes too late for preventive intervention," but instead should be "measures of predisposing socioeconomic and dietary factors, or reflections of such factors" (p. 1520).

The upshot of the move in thought about hunger measurement from the Berkeley conference (1987) to the LSRO report (1990) is that the physiological harm due to insufficient food intake was

shifted from being the direct definition of hunger (the medical definition) to being the consequent of hunger. Hunger now becomes defined directly in dietary terms set in the context of constrained household resources; specifically, hunger is defined as inadequate food—either in quantity (food insufficiency), in quality (dietary monotony), or both—along with its restricted access through socially acceptable channels (food insecurity).

Research conducted at the turn of this decade and in the early 1990s further sharpened the emerging consensus on the definition of hunger. Surveys conducted by CCHIP showed a strong association between a measure of food insufficiency (CCHIP hunger index) and strategies used by families attempting to cope with food shortages (Wehler, Scott, and Anderson, 1991). These strategies, which encompass a number of avenues of augmenting both the household food supply and the number of meals that family members can consume, include borrowing food or money for food from friends or relatives, sending children to eat at the homes of others, getting food at food banks or food pantries, or getting meals at soup kitchens. The findings demonstrated that the prevalence of households relying on (some of) these coping strategies was greater than the prevalence of households classified as food insufficient.

Scott, Wehler, and Anderson (1994), using CCHIP data from surveys conducted in 1992–93, argued that questionnaire items measuring coping strategies and those measuring food insufficiency are not synonymous, concluding that "indicators of coping behaviors should not be included among the core indicators of hunger." They maintained that food insecurity (which subsumes both food insufficiency and behaviors that cope with food shortages) is a broader concept than hunger; they defined hunger more narrowly as food insufficiency. They recommended that if items measuring coping behaviors were to be included together with items measuring food insufficiency, then the resulting combination could form a food insecurity index, while the food insufficiency items alone could form a hunger index.

The culmination of these efforts throughout the 1980s and 1990s, made up of the contributions and conversations of numerous participants, led to the development of the new Current Population Survey (CPS) Food Security Supplement. The Food Security Measurement and Research Conference held in Washington, DC, in January 1994, pulled together these many previous efforts. What emerged from this conference and its follow-up workshops and development efforts is an instrument that has a broader set of dimensions than previous scales and a sample that has a broader scope than previous research.

This food insecurity questionnaire module was the result of years of collaboration by the United States Department of Agriculture's (USDA) Food and Consumer Service (FCS) with the NCHS, other experts outside government, and the Demographic Surveys Division of the U.S. Bureau of the Census. It was administered for the first time in the April 1995 CPS. The findings have been analyzed and published in a report released in September 1997 (USDA Summary Report of the Food Security Measurement Project, 1997). The report introduces a food insecurity index derived from core items in the questionnaire module. The index is formed using Rasch modeling, a nonlinear scaling technique developed for the educational testing industry, that sorts items into a weighted scale. The report includes baseline information on the extent of food problems in American households (with and without children).

The research in this report continues one of the threads of this collaborative conversation. Previous work using CCHIP data that has contributed to the team efforts to measure household food problems should be considered preliminary, because it has been limited by two factors. First, the research published in the Papers and Proceedings, Conference on Food Security Measurement and Research (Anderson, Wehler, and Scott, 1994; Scott, Wehler, and Anderson, 1994) drew on the only survey sites available at the time—five sites encompassing 2,200 respondents. Six additional sites are now available in the composite data set, containing responses from more than 3,000 additional households. Second,

previous work used a limited number of questionnaire items. The current report adds a dozen new items to the exploration, including many in the USDA food insecurity index.

DATA SOURCES

Empirical analyses of items indicative of food insecurity and food insufficiency are made possible by access to a large data set compiled from 11 surveys conducted by the Community Childhood Hunger Identification Project (CCHIP) from May 1992 to May 1994. CCHIP researchers interviewed households with incomes at or below 185 percent of the poverty level that had at least one child under the age of 12.

Table 1 displays the study parameters of the survey sites. They consist of four states (Utah—May 1992–October 1992; South Carolina—July 1992–April 1993; Maine—September 1992–December 1992; and Kansas—October 1993–May 1994), four single counties (Rensselaer County, New York—January 1993–July 1993; Franklin County and Athens County, Ohio—February 1993–July 1993; and Allegheny County, Pennsylvania—June 1993–May 1994), an 11-county region of central Indiana (September 1992–January 1993), a 27-county region of eastern Texas (April 1993–April 1994), and a district-wide survey of Washington, DC (February 1993–September 1993).

Hour-long, face-to-face interviews were conducted with respondents in 5,282 households. The number of eligible low-income families interviewed at each site varies, from 323 in Athens County, OH, to 720 in Allegheny County, PA, with 337 interviewed in Rensselaer County, NY, 342 in the District of Columbia, 369 in Franklin County, OH, 385 interviewed in Maine, 400 in Indiana, 417 in South Carolina, 609 in Kansas, 665 in Utah, and 715 in Texas. (These correspond to completion rates among eligible sampled households ranging from 66 percent to 91 percent.)

TABLE 1
Parameters for Survey Sites (1992–1994)

Parameters	Maine	New York	Indiana	South Carolina	Utah	Ohio	Ohio	Washington, DC	Pennsylvania	Kansas	Texas
Site	State	Rensselaer County	11 counties in central IN	State	State	Franklin County	Athens County	Entire district	Allegheny County	State	27 counties in eastern TX
Region	New England	Mid-Atlantic	East north central	South Atlantic	Mountain	East north central	East north central	South Atlantic	Mid-Atlantic	West north central	West south central
Dates of survey	9/92–12/92	1/93–7/93	9/92–1/93	7/92–4/93	5/92–10/92	2/93–7/93	2/93–7/93	2/93–9/93	6/93–5/94	10/93–5/94	4/93–4/94
Target population (N)	38,255	2,259	28,309	105,859	64,469	24,716	2,525	14,562	34,505	51,288	209,137
Sampling fraction	1.3%	22.8%	2.6%	0.5%	1.3%	1.8%	15.0%	3.4%	3.0%	1.8%	0.5%
Sample design	2-stage probability	2-stage probability	2-stage probability	2-stage probability	2-stage probability	2-stage probability	2-stage probability	2-stage probability	2-stage probability	2-stage probability	2-stage probability
PSU	block groups	block groups	block groups	block groups	block groups	block groups	block groups	block groups	block groups	block groups	block groups
Number of households enumerated	21,069	12,205	19,990	23,478	17,280	10,305	6,706	15,694	25,671	20,852	21,237
Completion rate among eligibles	82%	75%	66%	69%	89%	87%	91%	74%	75%	70%	82%
Refusal rate among contacts	6%	11%	12%	6%	3%	5%	5%	7%	16%	16%	5%

CHARACTERISTICS OF THE SAMPLED POPULATION

As seen in Table 2, low-income households had an average of 4.2 members with 2.4 children. Nearly a third (32.0 percent) were headed by females, while two parents were present in over half (53.3 percent) of the families. Over half (55.0 percent) of the households were white, while 23.4 percent were black, 11.1 percent were of Hispanic descent, and the remainder (10.5 percent) were of other racial backgrounds. Over a third (36.0 percent) of the households had incomes below 75 percent of the federal poverty level, 27.3 percent had incomes between 75 percent and 124 percent of poverty, and 36.7 percent had incomes between 125 percent and 185 percent of the poverty line. Over three-fourths (77.3 percent) of the households had at least one adult with a high school diploma. Approximately two-thirds (68.1 percent) of these families had wage income, and 57.2 percent had at least one full-time employee.

QUESTIONNAIRE ITEMS RELATED TO FOOD INSECURITY/FOOD INSUFFICIENCY

The CCHIP survey instrument contains 165 questions. In addition to CCHIP items designed to measure food insufficiency, other items in the survey are designed to measure food insufficiency and food insecurity. Questions on socioeconomic information and household financial information, as well as on the health status of a randomly selected child in the household, are also available to assess construct validity. All told, the questionnaire contains items that tap into 34 aspects of food insecurity and food insufficiency. Appendix 1 lists the questions (and their variable names).

RESEARCH QUESTIONS

1. To what aspect of food insecurity and food insufficiency does each indicator point?

2. How do the items associate with one another?

3. Do the items in the alternative measures, if scaled, exhibit content validity?

TABLE 2
Characteristics of Sample

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Number of households = 5282

Sociodemographics

The average household had 4.2 members with 2.4 children.

53.3% of the families had two parents present.
32.0% of the households were headed by females.

55.0% of the households were white.
23.4% of the households were African American.
11.1% of the households were Hispanic.

Economics

68.1% of the households had wage income.
57.2% of the households had at least one full-time employee.

49.8% of the households had income equal to or below the poverty line.

4.   Do the alternative measures cohere in expected ways with a currently accepted theoretical model of antecedents and consequences of household food problems?

FINDINGS

Research Question 1

To set a context for answering our first research question, consider the following two ways of understanding the relationship between food insecurity and food insufficiency. If one thinks of the range of experience entailed by each concept in terms of space, then food insecurity is broader, more encompassing in its range of experiences than food insufficiency (Wehler, Scott, and Anderson, 1994). This is because insecurity subsumes the experience of insufficient food.

For adults and children in the household, food insufficiency means that not enough food is being consumed. For the household as a whole, not enough food is available to eat when money is too limited to get more food. Food insecurity covers all of these items too, in the LSRO definition. In addition food insecurity refers to anxiety about food shortages, actions designed to stretch the supply of food money, and strategies to increase the supply of food, food money, or meals. These strategies involve turning to food pantries, soup kitchens, friends, or relatives for help. Understood in this way, food insecurity is like any type of human insecurity. Need deprivation signals an awareness of vulnerability, anxiety is experienced, and defensive or protective moves are undertaken in an attempt to cope with the threat.

Thus, the food insufficient are necessarily food insecure because they are in the midst of a food shortage crisis, while the food insecure are not necessarily food insufficient. This is because the insecure who are food sufficient are not at the moment lacking food. They have fended off the food shortage crisis with coping mechanisms, even though they may yet fear an upcoming or recurring episode of food insufficiency. A simple visual depiction of the spatial metaphor can be seen in Figure 1.

FIGURE 1

**CONCEPTUAL METAPHOR FRAMING
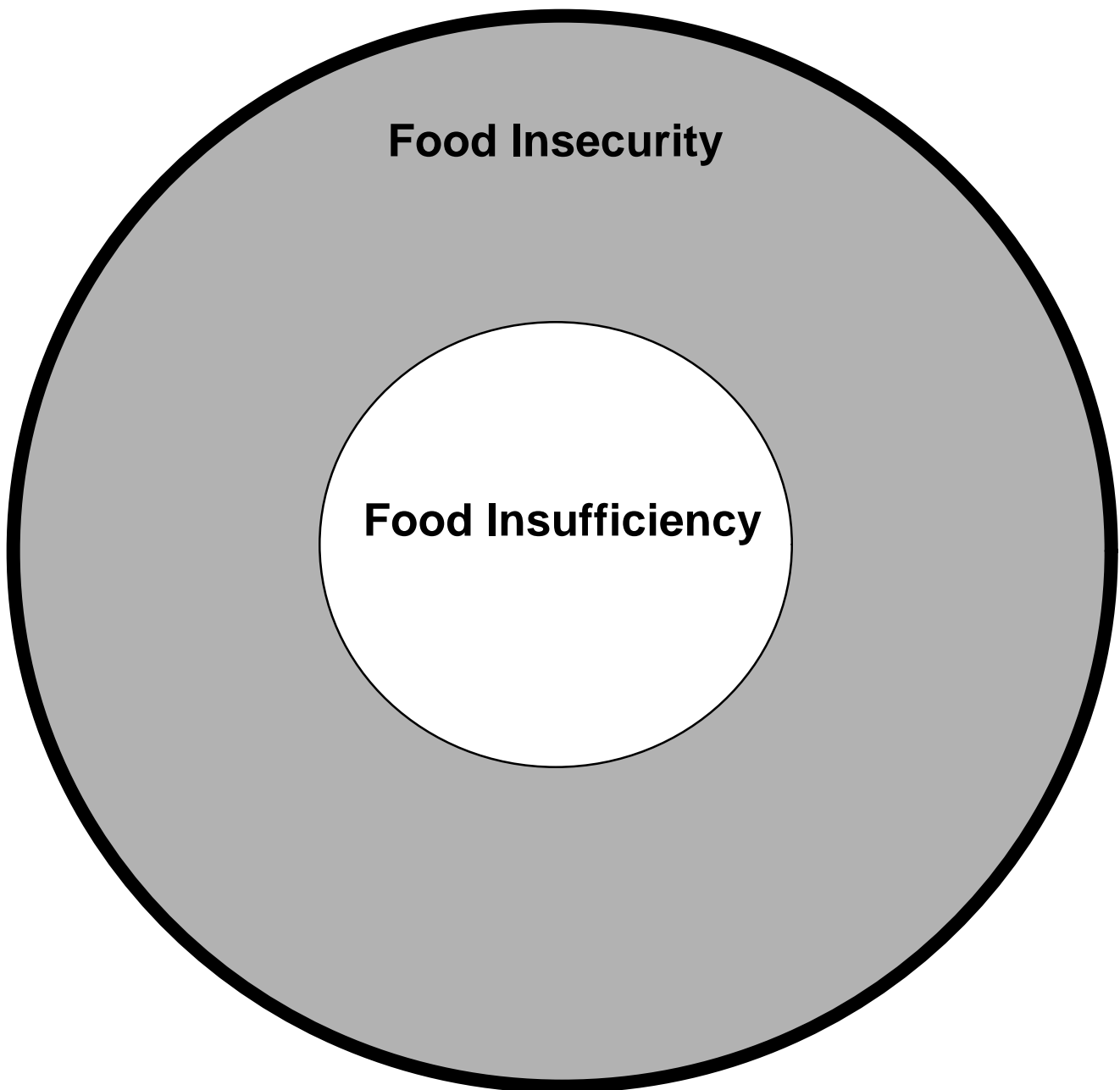FOOD INSECURITY AND
FOOD INSUFFICIENCY**

Figure 1 implies that food insecurity is the context that makes food insufficiency mean hunger. This is because food insecurity means food resource insufficiency. Public policy analysts are interested in hunger that arises from food resource insufficiency, no more and no less. Insufficiency of food occurs in other contexts as well. Sometimes it occurs by choice, as in dieting. Sometimes it occurs from constraints other than food resource constraints. For example, children or elders can experience food intake deficits due to abuse or neglect, or an adult can eat too little because of a psychological disorder, such as anorexia nervosa. Neither of these occasions of constrained food insufficiency is deemed hunger because the insufficient food intake is due to maltreatment or self-abuse rather than constrained resources.

To distinguish indicators of food insecurity from those of food insufficiency, the spatial frame can be applied to sites where behaviors of each construct take place. Food insufficiency takes place at the dinner table. The household manager serves portions that are too small for everyone, or she cuts back on her portion so that the children get enough to eat, or household members don't gather at the table often enough because of skipping meals, or adults or children report being hungry when there is too little food to sit at the table and eat. Even if the "dinner table" consists of a TV tray in the living room or a brown paper sack containing victuals eaten on the run or at work, the table can be understood as the site where food intake deficits occur and are reported.

Food insecurity takes place in a number of other sites. Anxiety about food shortages takes place in front of open doors—doors that reveal poorly stocked cabinets, pantries, and refrigerator shelves. Food stretching behaviors take place at the food preparation counter, sink, and stove, where the household manager substitutes and dilutes to make the food go further. Food resource stretching behaviors take place at the supermarket where the household manager buys cheaper foodstuffs, or at the coffee table with checkbook in hand, where bill payments are carefully juggled to free up a little extra food money. And resource augmentation behaviors occur at sites outside the household, at the dinner tables of friends

and relatives who provide meals, at the purses and wallets of friends and relatives who provide money, at food pantries that provide baskets of goods, or even at soup kitchens, alley doors of restaurants, or trash cans.

Understood spatially, indicators of food insufficiency and food insecurity tap behaviors that are differentially situated. Based on the LSRO definition, the two are related conceptually in the following way: Food insufficiency is a complex of behaviors and self-reports that gets its meaning as hunger in terms of the context of food insecurity (i.e., food resource insufficiency). When thinking about the constructs operationally, as questionnaire items asking about instances of each construct, the two sets of indicators are distinct. The import of this distinction pertains to whether and how items from both constructs can be scaled.

It may be easier to convey the distinction between the two constructs by assuming a temporal frame of reference. Household members can experience food insecurity before the onset of food insufficiency. They can also respond to or try to cope with an episode of food insufficiency once it is present (or even past) by seeking to stretch the food supply or augment food resources through means other than those considered "normal" in the culture (e.g., buying food at a grocery store with cash is considered normal). This frame implies a sequence of events in which some elements of food insecurity precede the experience of food insufficiency. Adult members of a household can anticipate imminent food shortages by noticing that money for food is dwindling and by trying to stretch the food budget, expressing anxiety about food shortages about to be experienced, and altering eating behavior to stretch the food supply. Food insufficiency may or may not occur at this point. It will *not* occur if the household successfully stretches its food supply or can receive a rapid and adequate influx of food, food money, or meals. Otherwise, food insufficiency will occur, and its presence is shown by a restricted amount of food in the household, by perceptions of adult respondents that they and perhaps their children are eating too little and therefore are hungry when there is no food to eat, and by distinct alterations in the eating

behavior of adults and perhaps children in the household, resulting in too little food being consumed due to constrained resources. During an episode of food insufficiency or just after such an occurrence, household members may try to cope with it. Coping mechanisms include augmenting their supply of food, money for food, or meals by borrowing from friends or relatives or asking for charity or getting discarded foodstuffs. And, of course, they may succeed temporarily in raising food intake to sufficient levels, even though they continue to remain food insecure. Figure 2 shows a simple illustration of the temporal metaphor.

It is important to note that the temporal relationship between food insecurity and food insufficiency is not analogous to that of risk factors for a disease and the disease itself. For the latter, as risk factors accrue (e.g., smoking, obesity, high cholesterol count, family history, previous episodes) so does the likelihood of the illness (e.g., cardiovascular disease). Rather, food insecurity refers in part to behaviors that seek to augment food and food resources. Food insecurity can lead to ways of coping with a food shortage crisis, and thereby possibly avoiding or preventing it. The import of this point pertains to whether and how researchers can measure severity of hunger, including the method used to set a cutting point for a hunger threshold.

Staying with the temporal metaphor makes it possible to construct a typology that demonstrates which construct is indicated by each of the questionnaire items. Table 3 displays the typology. It cross-classifies four categories of responses to questions about food problems by three groups of household members. The categories are (1) precursors of food insufficiency; (2) perceptions of insufficient food intake, including self-reported hunger; (3) eating behaviors involving food intake deficits; and (4) responses to food insufficiency that attempt to augment the supply of food, money for food, or meals using extrahousehold means of acquisition that are not normal in the culture. The three groupings of household members are the household or family as a whole, the adult or adults residing in the dwelling

FIGURE 2

TEMPORAL METAPHOR FRAMING
FOOD INSECURITY AND FOOD INSUFFICIENCY

FOOD INSECURITY

FOOD INSUFFIENCY

TABLE 3
Typology of Food Insecurity and Food Insufficiency Items

	Entire Household	Adults	Children
***Precursors to an episode of food shortages* (Food Insecurity Items)**	Q2 run out $ Q20 buy & serve less expensive food Q21 buy & serve less nutritious food Q23&24 not eat balanced meals	Q22 A eats differently than C	Q11 R worry - food quantity - C Q12 R worry - food quality - C
***Hunger Perceptions* (Food Insufficiency Items)**	Q17 perception of food sufficiency Q18&19 reported insufficiency	Q4 eat less than feels should	Q5 eat less than feels should Q7 self-reported hunger
***Hunger Behaviors* (Food Insufficiency Items)**	Q1 rely on limited # foods	Q3 cut/skip meals Q15 R skipped meals yesterday Q16 R not eat for whole day	Q6 cut or skip meals Q8 go to bed hungry Q9 eat breakfast Q10 not eat for whole day Q13 cut meals Q14 skip meals Q25 dilute formula
***Responses to an episode of food shortages* (Food Insecurity Items)**	Q26 borrow $ from F&R Q27 get food from F&R Q29 food from food pantry Q30 meals from soup kit. Q31 buy food on credit Q32 juggle bills Q33 get discarded food Q34 other ways of obtaining food		Q28 send C - meals from F&R

unit, and a randomly selected child—in this case, the child with the most recent birthday (CWMRB)—or the children residing in the dwelling unit.

The precursors of food insufficiency are items indicating food insecurity. The items point to awareness of and fear that an episode of food insufficiency is near, and to protective moves made to forestall the episode. Three items are indexed to the household as a whole—Q2, running out of money to make a meal (HNGR1);[2] Q20, buying and serving less expensive food in order to stretch the food money (DVCOPE4); and Q21, buying and serving less nutritious food in order to stretch the food money (DVCOPE5). Two items refer the adults in the household—Q22, feeding a meal to the children while the respondent eats something else to make sure the children get the food they need when trying to stretch the food supply (DVCOPE6); and Q24, not eating balanced meals because they cannot afford to when trying to stretch the food supply (DVCOPE7&8).[3] Three items ask about the household's children—Q11, the respondent worrying that the amount of food she can buy for the children will not be enough (WORRY1); Q12, the respondent worrying that the food she can afford for the children will not be healthy and nutritious (WORRY2); and Q23, not being able to give the children a balanced meal because the respondent cannot afford to do so when trying to stretch the food supply (DVCOPE7&8).

Hunger perceptions refer to items that point to the awareness of an episode of food insufficiency. Three questions ask about the household as a whole—Q17, whether there is enough to eat (HGR9); Q18, the number of days in the past month with no food or money to buy food; and Q19, reasons why there was no food or money for food in the past month (these last two were collapsed into a single variable,

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[2]CCHIP researchers had previously referred to this item as an indicator of food insufficiency. However, the logic inherent in this typology makes it apparent that the item by itself does not directly measure food insufficiency. While constrained resources is a necessary condition for food insufficiency as it is defined here, it is not sufficient as a specific indicator of food deprivation.

[3]For the sake of comparability to past research with the CCHIP scale, in the current analysis Q2 (HNGR1—running out of money to make a meal) is treated as a food insufficiency variable. In any future analyses that undertake food insufficiency/insecurity scale construction, the authors of this report maintain that the item is better understood as an indicator of food insecurity. See footnote 2.

HGR10&11C). One question asks about adults—Q4, whether the adults ever eat less than the respondent feels they should due to a lack of food money (HNGR5). Two other questions ask about the children—Q5, whether the children ever eat less than the respondent feels they should because of a lack of food money (HNGR13); and Q7, whether the children ever report hunger because of a lack of food in the house (HNGR21).

Hunger behaviors refer to items indicating the behavioral expression of an episode of food insufficiency. One bears directly on the household—Q1, relying on a limited number of foods because of running out of money to buy food for a meal (HNGR25). Three more seek information about adults—Q3, cutting meal sizes or skipping meals due to a shortage of food or food money (HNGR9); Q15, skipping meals yesterday due a lack of food or food money (HGR12); and Q16, not eating for a whole day within the past 12 months due to a lack of food or food money (HGR13). Seven items relate to the children—Q6, cutting the size of children's meals or having them skip meals due to a shortage of food money (HNGR17); Q8, children going to bed hungry due to a lack of food money (HNGR30); Q9, number of days in the past 7 that the CWMRB did not eat breakfast (BRKFST); Q10, whether the CWMRB did not eat for a whole day due to a lack of food or money for food within the past 12 months (CHGR1); Q13, cutting the size of children's meals because of a shortage of food money during the past 12 months (HGR1); Q14, children skipping meals due to insufficient food money during the past 12 months (HGR5); and Q25, children's formula being diluted or substituting Kool-Aid or sugar water to stretch the food supply when running out of money (DVCOPE9).

Responses to shortages of food and food money involve behaviors that endeavor to cope with an episode of food insufficiency. These items are indicators of food insecurity but are not direct indicators of food insufficiency. All but one of the items in this category are asked of respondents about their household as a whole, since the coping mechanisms invoked seek to increase the household-based supply of food, food money, or meals. There are eight of these items—Q26, borrowing food money from friends

or relatives when running short of money (DVCOPE10); Q27, getting food from friends or relatives when running short of money (DVCOPE11); Q29, getting food from a food pantry when running short of money (DVCOPE13); Q30, getting meals from a soup kitchen or church when running short of money (DVCOPE14); Q31, buying food on credit when running short of money (DVCOPE15); Q32, juggling bills to generate more money for food when running short of money (DVCOPE16), Q33, getting leftover food or food discarded by stores, restaurants, schools, or other people when running short of money (DVCOPE17); and Q34, getting food some other way when running short of money (DVCOPE18). One additional item is asked about the children in the household—Q28, sending the children to homes of friends or relatives for meals (DVCOPE12).

Table 4 groups the 15 items designated in the typological analysis as food insecurity indicators. The first column in Table 4 gives the question number of the item as it is listed in Appendix 1. The second column provides a brief label for the indicator. The third column shows the percentage of households in the CCHIP data set responding affirmatively to the item. The fourth column displays its variable name as it is listed in subsequent tables for the current analysis. As can be seen in column 3, the most commonly reported item is DVCOPE4, using less expensive foods to stretch food money (87.6 percent), while the least are DVCOPE14, getting meals from soup kitchens, and DVCOPE15, buying food on credit (each at 6.6 percent).

Table 5 groups the 17 items designated in the typology as food insufficiency indicators.[4] The format of Table 5 is identical to Table 4. Looking at the percentage of households answering affirmatively, shown in column 3, it is evident that the most frequently occurring item is HNGR25, relying on "emergency" foods (59.9 percent), while the least is CHGR1, CWMRB not eating for a whole day (1.1 percent).

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[4]Deleting HNGR30 would make the CCHIP scale marginally more reliable. The negligible gain in reliability would not have offset the loss of comparability to previous work. Consequently the CCHIP scale was left intact for this analysis.

TABLE 4

Food Insecurity Items

Question #	Variable Label	Percent	Variable Name
Q11	R WORRIES FOOD WON'T BE ENOUGH	47.0%	WORRY1
Q12	R WORRIES FOOD NOT NUTRITIOUS	37.3%	WORRY2
Q20	EVER USE LESS EXPENSIVE FOODS	87.6%	DVCOPE4
Q21	EVER USE LESS NUTRITIOUS FOODS	61.4%	DVCOPE5
Q22	EVER CHANGE A EATING PATTERNS	56.1%	DVCOPE6
Q23&24	NOT SERVING BALANCED MEALS	55.7%	DVCOPE7&8
Q26	EVER BORROW MONEY FOR FOOD	49.8%	DVCOPE10
Q27	EVER GET FOOD FROM FRNDS & RELS	46.3%	DVCOPE11
Q28	EVER SEND CHILDREN TO EAT WITH F&R	17.0%	DVCOPE12
Q29	EVER GET FOOD FROM PANTRY	28.7%	DVCOPE13
Q30	EVER GET MEALS FROM SOUP KITCHEN	6.6%	DVCOPE14
Q31	EVER BUY FOOD ON CREDIT	6.6%	DVCOPE15
Q32	EVER NOT PAY BILLS ON TIME	62.3%	DVCOPE16
Q33	EVER EAT DISCARDED FOOD	9.4%	DVCOPE17
Q34	EVER GET FOOD OTHER WAY	27.8%	DVCOPE18

TABLE 5

Food Insufficiency Items

Question #	Variable Label	Percent	Variable Name
Q1	HH EVER RELY ON EMERGENCY FOODS	59.9%	HNGR25
Q2	EVER RUN OUT OF MONEY FOR FOOD	46.9%	HNGR1
Q3	HH ADULTS EVER CUT SIZE OF/SKIP MEALS	42.3%	HNGR9
Q4	HH ADULTS EVER EAT < THEY SHOULD	39.9%	HNGR5
Q5	CHILDREN EVER EAT < THEY SHOULD	17.3%	HNGR13
Q6	CHILDREN EVER CUT SIZE OF/SKIP MEALS	17.0%	HNGR17
Q7	CHILDREN EVER REPORT HUNGER	16.0%	HNGR21
Q8	CHILDREN EVER GO TO BED HUNGRY	5.4%	HNGR30
Q9	# DAYS CWMRB EATS BREAKFAST	6.66	BRKFST
Q10	CWMRB NOT EAT FOR WHOLE DAY	1.1%	CHGR1
Q13	CHILDREN EVER CUT SIZE OF MEALS	19.0%	HGR1
Q14	CHILDREN EVER SKIP MEALS	6.7%	HGR5
Q15	R SKIPPED MEALS YESTERDAY	9.9%	HGR12
Q16	R NOT EAT FOR WHOLE DAY	14.4%	HGR13
Q17	PERCEIVED ADEQUACY OF FOOD EATEN		HGR9
Q18&19	REPORTED FOOD INSUFFICIENCY B/C NO $	16.4%	HGR10&11C
Q25	EVER DILUTE FORMULA	4.7%	DVCOPE9

Research Questions 2 and 3

Efforts to form scales are discussed next. The concepts of food insufficiency and food insecurity are more complex than can be expressed by a single item. Therefore, a set of items covering the various dimensions of the construct are scaled. Two analytic approaches, often used to determine whether various items form a coherent scale, are principal components factor analysis and reliability analysis. Factor analysis detects the number of dimensions represented in a set of items, while the Cronbach's alpha coefficient of reliability analysis detects whether any particular candidate item belongs in the scale. (For further discussion, see Anderson, Wehler, and Scott, 1994.)

Table 6 displays a principal components factor analysis of CCHIP food insufficiency items. The eight items that make up the CCHIP scale are Q1 through Q8 (see Table 5 and Appendix 1). The factor loadings are from the unrotated factor pattern. Two factors are retained using as a criterion eigenvalues of 1.0 or greater. Third and subsequent eigenvalues are 0.64 and lower. The factor loads in Factor1 range from 0.55 to 0.79, showing good coherence among the eight items. These results demonstrate content validity. The eigenvalue is approximately 4 and the percentage of variance explained is approximately 50 percent.

Table 7 shows the Varimax rotation pattern for these eight items. It illustrates two definable factors. The first factor taps an adult/household dimension of the experience of food insufficiency, pertaining to items about adults (HNGR9 and HNGR5) or about the household as an entire unit (HNGR25 and HNGR1). The other is a "child hunger" factor that subsumes the four items (HNGR13, HNGR17, HNGR21, and HNGR30) pertaining to the experience of food insufficiency among children in the household.

The Cronbach alpha coefficient shown in Table 8 is high (>0.80) for the eight items considered together, suggesting that the scale exhibits internal consistency. The first seven items listed at the bottom of Table 8 have strong correlation with the total (0.50 or greater). None of them, if deleted, raises the

TABLE 6

Factor Analysis of CCHIP Food Insufficiency Items
(N = 5282)

Variable	Factor1	Factor2
HNGR25	0.64040	-0.42995
HNGR1	0.67597	-0.38039
HNGR9	0.78249	-0.38473
HNGR5	0.76788	-0.38476
HNGR13	0.79310	0.37105
HNGR17	0.77526	0.36656
HNGR21	0.74015	0.36805
HNGR30	0.54945	0.50614
Total variance explained	4.148734	1.289290

TABLE 7

Factor Analysis of CCHIP Food Insufficiency Items
(N = 5282)
Varimax Rotation Pattern

Variable	Factor1	Factor2
HNGR25	0.75937	0.13538
HNGR1	0.75055	0.19573
HNGR9	0.83021	0.26658
HNGR5	0.81871	0.25642
HNGR13	0.31298	0.81776
HNGR17	0.30326	0.80214
HNGR21	0.27696	0.77883
HNGR30	0.04385	0.74575
Total variance explained	2.769693	2.668331

TABLE 8

Reliability Analysis of CCHIP Food Insufficiency Items

<u>Cronbach Coefficient Alpha</u>
for raw variables: 0.860
for standardized variables   0.864

Deleted Variable	Correlation with Total	Alpha	Label
HNGR25	0.531060	0.857103	Emergency food
HNGR1	0.569416	0.852886	Run out food $
HNGR9	0.686708	0.839649	A cut size/skip meals
HNGR5	0.668207	0.841771	A eat < should
HNGR13	0.700596	0.838047	C eat < should
HNGR17	0.676366	0.840837	C cut size/skip meals
HNGR21	0.643321	0.844606	C report hunger
HNGR30	0.441513	0.866739	C go to bed hungry

alpha coefficient. The eighth item, HNGR30 (children going to bed hungry), is the least coherent. Its correlation with the total is slightly below 0.50 (it is 0.44) and if deleted, raises the alpha coefficient by 0.002.[5]

Table 9 displays a principal components factor analysis of the USDA core module items. Twelve items from the questionnaire used in this data set are combined to form a scale that approximates the scale of USDA core items. There are ten food insufficiency items (Q1, Q3, Q4, Q5, Q7, Q10, Q13, Q14, Q16, Q17—see Table 5 and Appendix 1). There are also two food insecurity items (Q11, and Q23 & Q24 recoded into a single variable, DVCOPE7&8—see Table 4 and Appendix 1). Note that the scale developed by USDA in its Summary Report of the Food Security Measurement Project (1997) contains two additional items: respondent was hungry but didn't eat because he/she couldn't afford enough food, and sometimes people lose weight because they don't have enough to eat—in the last 12 months the respondent lost weight because there wasn't enough food. Neither question was contained in the CCHIP questionnaire. The factor loadings are from the unrotated factor pattern. Two factors are retained using as a criterion eigenvalues of 1.0 or greater. Third and subsequent eigenvalues are 0.95 and lower. The factor loads in Factor1 range from 0.26 to 0.79. Eleven of the 12 items show good coherence. The eigenvalue is over 5 and the percentage of variance explained is approximately 45 percent.

Table 10 shows the Varimax rotation pattern for these 12 items. Two factors are evident, an adult/household dimension (HNGR25, HNGR9, HNGR5, WORRY1, HGR9, DVCOPE7&8) and a child dimension (HNGR13, HNGR21, CHGR1, HGR1, HGR5). HGR13 (respondent reports not eating for a whole day) loads nearly evenly on both factors.

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[5]Q 24 (adults not eating balanced meals because they cannot afford to when trying to stretch the food supply) and Q23 (not being able to give the children a balanced meal because the respondent cannot afford to do so when trying to stretch the food supply) have been collapsed into a single indicator (DVCOPE7&8). In this form it represents a household level indicator because it points to an experience affecting all of the household members. In the typology in Table 3, the collapsed indicator is therefore placed in the household column.

TABLE 9

Factor Analysis of USDA Core Module Items
(N = 5282)

Variable	Factor1	Factor2
HNGR25	0.65830	-0.36469
HNGR9	0.79380	-0.29212
HNGR5	0.77768	-0.28630
HNGR13	0.72287	0.33918
HNGR21	0.69670	0.36128
CHGR1	0.25661	0.50909
WORRY1	0.66860	-0.22704
HGR1	0.72656	0.34086
HGR5	0.54106	0.56948
HGR13	0.56431	0.07432
HGR9	0.78224	-0.15246
DVCOPE 7&8	0.71576	-0.36264
Total variance explained	5.452374	1.457363

TABLE 10
Factor Analysis of USDA Core Module Items
(N = 5282)
Varimax Rotation Pattern

Variable	Factor1	Factor2
HNGR25	0.74900	0.07321
HNGR9	0.81940	0.20985
HNGR5	0.80283	0.20550
HNGR13	0.40280	0.68945
HNGR21	0.36871	0.69279
CHGR1	0.07755	0.56481
WORRY1	0.67937	0.19241
HGR1	0.40488	0.69293
HGR5	0.12241	0.77593
HGR13	0.42251	0.38139
HGR9	0.73064	0.31829
DVCOPE7&8	0.79515	0.10750
Total variance explained	4.166227	2.743510

The Cronbach alpha coefficient shown in Table 11 is high (>0.80) for the 12 items considered together, suggesting that the scale exhibits internal consistency. All the items at the bottom of Table 11 have good correlations with the total except for CHGR1 (CWMRB did not eat for whole day). Its correlation with the total is only 0.22, and its deletion would raise the alpha coefficient by 0.01, making the scale more reliable.

For this analysis, we created an unweighted additive scale of all food insufficiency items contained in the CCHIP data set (see Table 5). Table 12 displays a principal components factor analysis of the 17 food insufficiency items. The factor loadings are from the unrotated factor pattern. Three factors are retained using as a criterion eigenvalues of 1.0 or greater. Fourth and subsequent eigenvalues are 0.98 and lower. The factor loads in Factor1 range from -0.20 to 0.77. The eigenvalue is greater than 6 and the percentage of variance explained is approximately 37 percent.

Table 13 shows the Varimax rotation pattern for the 17 items. Three factors are evident. Factor1 taps an adult/household dimension (HNGR25, HNGR1, HNGR9, HNGR5, HNGR13, HGR9, HGR10&11C). Factor2 reveals a child dimension (HNGR13, HNGR17, HNGR21, HGR1, HGR5). Factor3 points to low-prevalence experiences of childhood hunger (HNGR30, child goes to bed hungry; CHGR1, CWMRB does not eat for a whole day). HGR12 (respondent skipped meals yesterday) nearly loads on the adult/household factor (factor load is 0.48).

The Cronbach alpha coefficient shown in Table 14 is high (>0.80) for the 17 items considered together, suggesting that the scale exhibits internal consistency. Three items (BRKFST, CHGR1, DVCOPE9) have weak correlation with the total and their deletion would increase the reliability of the scale.

For this project, we created an unweighted additive scale of all 15 food insecurity items contained in the CCHIP data set (see Table 4). Table 15 displays a principal components factor analysis of these items. The factor loadings are from the unrotated factor pattern. Four factors are retained using

TABLE 11
Reliability Analysis of USDA Core Module Items

Cronbach Coefficient Alpha
for raw variables: 0.887
for standardized variables   0.883

Deleted Variable	Correlation with Total	Alpha	Label
HNGR25	0.563930	0.875254	Use "emergency" food
HNGR9	0.709469	0.866826	A cut size/skip meals
HNGR5	0.691755	0.867868	A eat < should
HNGR13	0.649225	0.870351	C eat < should
HNGR21	0.626956	0.871641	C report hunger
CHGR1	0.223589	0.893826	CWMRB not eat - whole day
WORRY1	0.579189	0.874384	R worries food not enough
HGR1	0.656687	0.869917	C cut size of meals
HGR5	0.484767	0.879714	C skip meals
HGR13	0.492325	0.879292	R not eat whole day
HGR9	0.707063	0.866968	Perceived adequacy of food
DVCOPE7&8	0.624184	0.871801	C go to bed hungry

TABLE 12
Factor Analysis of Food Insufficiency Items
(N = 5282)

Variable	Factor1	Factor2	Factor3
HNGR25	0.58540	0.40425	-0.09064
HNGR1	0.63694	0.38813	0.02067
HNGR9	0.73829	0.40602	-0.05741
HNGR5	0.72365	0.41152	-0.02888
HNGR13	0.77078	-0.27175	-0.33458
HNGR17	0.77155	-0.31249	-0.36762
HNGR21	0.73282	-0.25309	-0.14162
HNGR30	0.57097	-0.43705	0.19843
BRKFST	-0.19856	0.20520	-0.31794
CHGR1	0.28914	0.39479	0.47222
HGR1	0.76133	-0.26689	-0.33203
HGR5	0.60291	-0.44462	0.17551
HGR12	0.47104	0.14816	0.35785
HGR13	0.56956	0.11613	0.42515
HGR9	0.74768	0.27565	0.06841
HGR10&11C	0.56422	0.13521	0.21648
DVCOPE9	0.18245	0.06574	-0.00827
Total variance explained	6.392638	1.675742	1.144840

TABLE 13
Factor Analysis of Food Insufficiency Items
(N = 5282)
Varimax Rotation Pattern

Variable	Factor1	Factor2	Factor3
HNGR25	0.68352	0.20662	-0.06660
HNGR1	0.72175	0.18295	0.04865
HNGR9	0.79593	0.28209	0.01183
HNGR5	0.79299	0.25356	0.02718
HNGR13	0.30874	0.81786	0.12517
HNGR17	0.27665	0.85880	0.11837
HNGR21	0.31856	0.67279	0.25888
HNGR30	0.11689	0.47136	0.56617
BRKFST	-0.03332	-0.04787	-0.42334
CHGR1	-0.01785	0.11467	0.67006
HGR1	0.30585	0.80794	0.12166
HGR5	0.13118	0.50855	0.56228
HGR12	0.47751	0.01000	0.37916
HGR13	0.53217	0.04948	0.48268
HGR9	0.72606	0.28353	0.17925
HGR10&11C	0.51664	0.15680	0.30330
DVCOPE9	0.17309	0.08442	0.02433
Total variance explained	3.984903	3.342776	1.885540

TABLE 14
Reliability Analysis of Food Insufficiency Items

<u>Cronbach Coefficient Alpha</u>
for raw variables: 0.798883
for standardized variables 0.869752

Deleted Variable	Correlation with Total	Alpha	Label
HNGR25	0.510822	0.861984	Use "emergency" food
HNGR1	0.567985	0.859543	Run out of food $
HNGR9	0.667880	0.855210	A cut size/skip meals
HNGR5	0.654307	0.855804	A eat < should
HNGR13	0.687570	0.854345	C eat< should
HNGR17	0.688426	0.854308	C cut size/skip meals
HNGR21	0.656957	0.855688	C report hunger
HNGR30	0.502263	0.862347	C go to bed hungry
BRKFST	-0.172821	0.889071	# days CWMRB eats breakfast
CHGR1	0.241883	0.873096	CWMRB not eat whole day
HGR1	0.680915	0.854638	C cut size of meals
HGR5	0.533817	0.861006	C skip meals
HGR12	0.405993	0.866388	R skipped meals yesterday
HGR13	0.510529	0.861997	R not eat whole day
HGR9	0.687649	0.854342	Perceived adequacy of food
HGR10&11C	0.498458	0.862509	Report food insufficiency -no $
DVCOPE9	0.156971	0.876480	Dilute formula

TABLE 15

Factor Analysis of Food Insecurity Items
(N = 5282)

Variable	Factor1	Factor2	Factor3	Factor4
WORRY1	0.67094	-0.12135	-0.16463	0.15948
WORRY2	0.58064	-0.27340	-0.11856	0.20324
DVCOPE4	0.50751	-0.23203	0.05390	0.07894
DVCOPE5	0.66293	-0.28425	-0.06065	0.12212
DVCOPE6	0.73231	-0.10304	-0.12731	0.01106
DVCOPE7&8	0.79806	-0.13001	-0.12436	0.04742
DVCOPE10	0.58946	0.28692	-0.13742	-0.37618
DVCOPE11	0.58841	0.29400	0.15750	-0.37864
DVCOPE12	0.43103	0.30981	0.21833	-0.42388
DVCOPE13	0.34723	0.53043	-0.03889	0.38796
DVCOPE14	0.21940	0.56688	0.02356	0.54727
DVCOPE15	0.15202	-0.08405	0.53851	0.03681
DVCOPE16	0.59564	-0.09016	-0.00316	-0.10411
DVCOPE17	0.27957	0.12755	0.50384	0.06973
DVCOPE18	0.10331	-0.26933	0.64212	0.16851
Total variance explained	4.172427	1.223089	1.129026	1.050291

as a criterion eigenvalues of 1.0 or greater. Fifth and subsequent eigenvalues are 0.97 and lower. The factor loads in Factor1 range from 0.10 to 0.80. The eigenvalue is greater than 4 and the percentage of variance explained is approximately 28 percent.

Table 16 shows the Varimax rotation pattern for the 15 items. It reveals four factors. The first factor taps an intrahousehold dimension of anxiety about food inadequacy and actions that stretch the food supply and resources for food (WORRY1, WORRY2, DVCOPE4, DVCOPE5, DVCOPE6, DVCOPE7&8, DVCOPE16). The second factor points to a dimension of reliance upon a social support network to cope with food shortages (DVCOPE10, DVCOPE11, DVCOPE12). The third factor taps a dimension of reliance upon private charity to expand the intake of food (DVCOPE13, DVCOPE14). The fourth factor seems to encompass a category of "other coping mechanisms."

The Cronbach alpha coefficient shown in Table 17 is relatively high (0.78) for the 15 items considered together. Four items (DVCOPE14, DVCOPE15, DVCOPE17, DVCOPE18) have weak correlation with the total and their deletion would increase the reliability of the scale.

In the section above, three different scaled measures of food insufficiency and one scaled measure of food insecurity are presented. Table 18 illustrates how these unweighted additive scales are related to each other. The three measures of food insufficiency—the CCHIP index (CCHIP), the truncated USDA index (USDA), and the general food insufficiency measure (INSUFF)—have intercorrelations ranging from 0.95 to 0.97, suggesting that they measure virtually the same phenomenon. This is not surprising since many of the items overlap in the three scales. The CCHIP scale makes up half of the items in the insufficiency scale, and five of the eight CCHIP items are in the USDA scale. Ten of the 17 items in the insufficiency scale are in the USDA scale. The correlation of these three indexes with the food insecurity scale is lower, ranging from 0.73 to 0.81, suggesting that they are not measuring the same thing. This is also not surprising, for two reasons. First, the typological analysis presented earlier concludes that insecurity and insufficiency, though related, are analytically distinct constructs. If true, an

TABLE 16
Factor Analysis of Food Insecurity Items
(N = 5282)
Varimax Rotation Pattern

Variable	Factor1	Factor2	Factor3	Factor4
WORRY1	0.68820	0.13083	0.16239	-0.01768
WORRY2	0.67926	-0.01323	-0.06000	0.04557
DVCOPE4	0.53219	0.08249	-0.00974	0.17440
DVCOPE5	0.72167	0.08643	0.01582	0.10163
DVCOPE6	0.69035	0.27976	0.09149	-0.00006
DVCOPE7&8	0.76454	0.27293	0.10958	0.02238
DVCOPE10	0.31527	0.67664	0.09271	-0.15604
DVCOPE11	0.24141	0.72002	0.09048	0.12625
DVCOPE12	0.07871	0.69153	0.03767	0.15257
DVCOPE13	0.14682	0.15084	0.71381	-0.01113
DVCOPE14	0.04360	0.00212	0.81552	0.05078
DVCOPE15	0.04604	0.07663	-0.01478	0.55975
DVCOPE16	0.51622	0.31774	-0.00575	0.07931
DVCOPE17	0.07350	0.21534	0.18864	0.51554
DVCOPE18	0.09226	-0.11849	-0.07624	0.70397
Total variance explained	3.270005	1.828818	1.285145	1.190866

TABLE 17
Reliability Analysis of Food Insufficiency Items

Cronbach Coefficient Alpha
for raw variables: 0.797796
for standardized variables 0.780951

Deleted Variable	Correlation with Total	Alpha	Label
WORRY1	0.538602	0.755775	R worries - food not enough
WORRY2	0.446608	0.763674	R worries - food not nutritious
DVCOPE4	0.395223	0.768005	Use less expensive foods
DVCOPE5	0.525801	0.756885	Use less nutritious foods
DVCOPE6	0.590696	0.751216	Change A eating patterns
DVCOPE7&8	0.665583	0.744554	Not serve balanced meals
DVCOPE10	0.455399	0.762928	Borrow $ for food
DVCOPE11	0.490284	0.759947	Get food from friends & relatives.
DVCOPE12	0.342299	0.772404	Send C to eat w/ friends&relatives
DVCOPE13	0.279236	0.777566	Get food from pantry
DVCOPE14	0.177202	0.785736	Get meals from soup kitchen
DVCOPE15	0.127492	0.789637	Buy food on credit
DVCOPE16	0.470675	0.761626	Not pay bills on time
DVCOPE17	0.234046	0.781212	Eat discarded food
DVCOPE18	0.084449	0.792972	Get food another way

TABLE 18

Correlation Analysis of Additive Scales

Scale	USDA	INSUFF	INSEC
CCHIP	0.95083	0.97197	0.72645
USDA	1.00000	0.96756	0.80559
INSUFF	0.96756	1.00000	0.73092

empirical assessment should be able to show that they are distinct. Second, the insecurity scale shares no items with the CCHIP scale or the insufficiency scale, and the insecurity scale has only two items in common with the USDA scale. We would not expect the insecurity scale to be measuring the same thing as the other three insufficiency scales.

All Items Scaled Together. Even if the items in Table 4 measure an analytically distinct construct compared with items in Table 5, Table 18 confirms that they are empirically related. This raises an important question. Can insecurity and insufficiency items be combined to form a single scale of food insecurity and hunger? This has been a central concern of the USDA Food Security Measurement Project—to identify and scale together core items measuring food insecurity and hunger (USDA Summary Report of the Food Security Measurement Project, 1997).

The educational testing industry has developed scaling techniques during the past three decades that can be used on items that have dichotomous response categories. Item Response Theory, and especially a version called Rasch modeling, provides two advantages over factor analysis (USDA Technical Report of the Food Security Measurement Project, 1997; Wainer et al., 1990; Wright, 1967, 1977). First, it does not require an assumption of linearity as does factor analysis. Thus it is well suited for use with dichotomous variables. Second, by way of a mathematical transformation it can fit a distribution of responses from two subsamples into a single curve.

The second advantage is particularly useful for the scale being developed by the USDA Food Security Measurement Project because in a general population, different items are asked of different types of households (USDA Technical Report of the Food Security Measurement Project, 1997). In particular, households with children are asked eight items in addition to the ten items asked of all households. Moreover, the items asked of households with children represent some of the least prevalent indicators of food insufficiency (e.g., child not eating for a whole day). The ability to fit two distribution curves together, taking into account the differences in prevalence of responses to items, allows for a

single, weighted summated scale of food insecurity/hunger instead of one each for households with and without children. Rasch models accomplish this by using an item-analysis procedure that assigns weights to each item based on how difficult it is to answer the item affirmatively. These two advantages have prompted the USDA Food Security Measurement Project to undertake Rasch analysis.

These advantages make Rasch modeling appropriate for scaling dichotomous items to be used with different types of households in a general population, with one key proviso—that all items relate to the same underlying unit of measurement. Let us rephrase the question asked above. Can Rasch modeling be used to make a meaningful, continuous scale with a mixture of food insecurity items and food insufficiency items? It cannot, for two reasons.

First, like all scaling techniques, Rasch scaling requires researchers to define a single underlying unit of measurement on theoretical or normative grounds (Wright, 1967). Once the construct (unit of measurement) has been defined, items are selected to represent this construct because they indicate a minimal or optimal amount of the unit. Alternatively, once the construct is defined, persons with qualities or behaviors typical of the unit are chosen as the standard, and items are tested by seeing whether households can be differentiated by how they answer the questions.

Previous research on the constructs of food insecurity and insufficiency (Scott, Wehler, and Anderson, 1994) and the typological and factor analyses presented earlier in this paper have concluded that food insufficiency and food insecurity are, as a matter of definition, different units of measurement.

Second, for the sake of argument, even if researchers could agree on the definition of a single unit of food insecurity/hunger measurement, the meaning of weights attached to particular scale items is different in educational assessment than in hunger assessment.

Next we illustrate more fully how these two reasons prevent having a useful and meaningful Rasch scale of food insecurity/hunger. Examine the results of a Rasch model that includes all 34 items in the CCHIP questionnaire that measure food insecurity and food insufficiency.

The Rasch model says that each item response should be logistically related to the underlying

scale through a logistic model

$$Pr(X_{ik} = 1) = 1 \,/\, 1 + \exp(-a_k - \beta_k S_i)$$

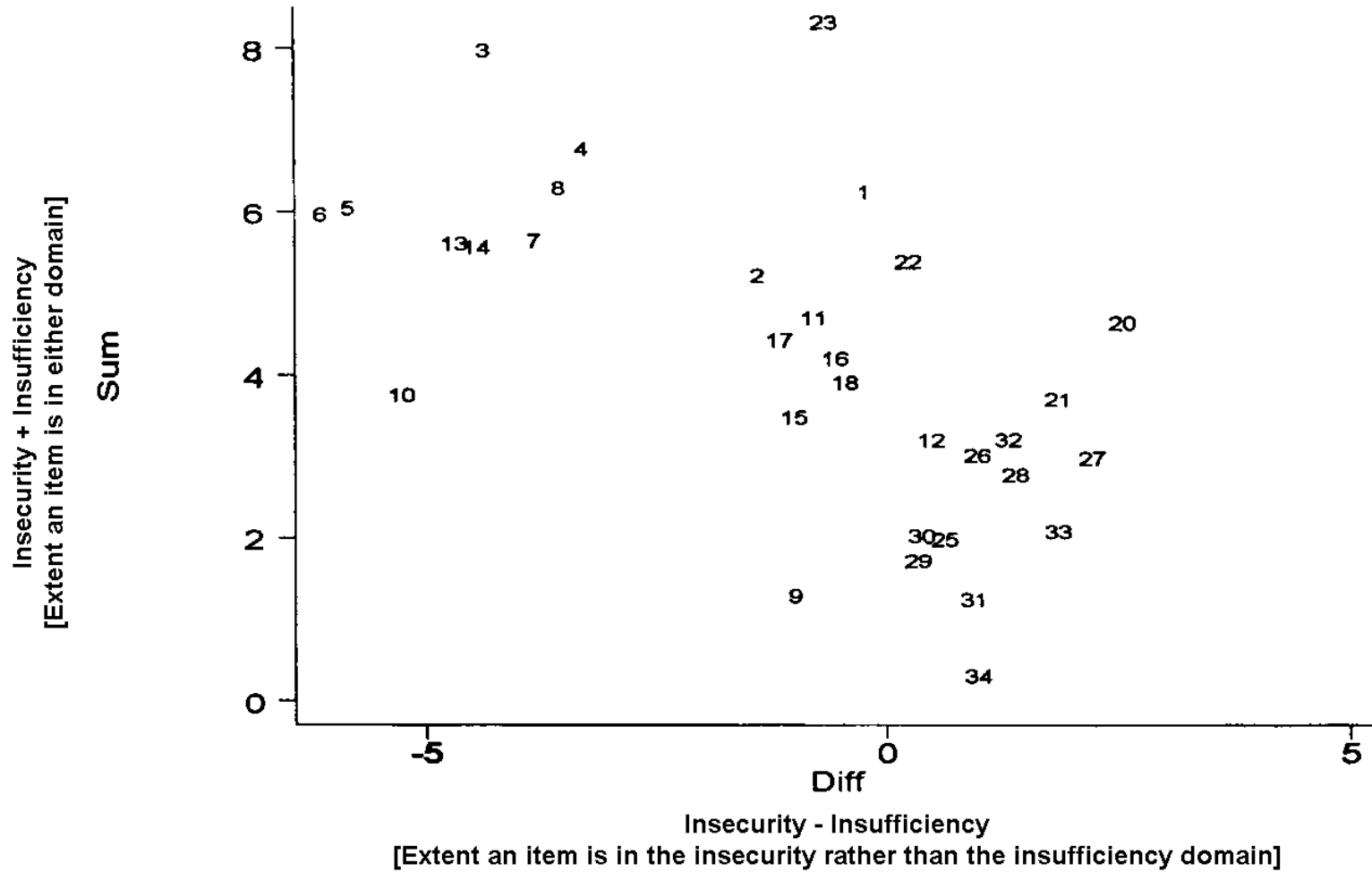where S_i is the underlying scale score for the *i*th household in the sample and k indexes the variables.[6]

With two domains in mind (insecurity and insufficiency) each item is fit as a function of these

two domains. Each is designated as an insecurity item or an insufficiency item, exactly as they are listed

in Tables 4 and 5, and an arithmetic average of the responses is calculated. In evaluating each item, that

item is eliminated from the averages to prevent tautological overlap. Then a logistic regression model is

fit in which that item is estimated from the two domain estimates. The logistic (log odds ratio)

coefficients of the two scales are graphed against each other.

Figure 3 shows the two domains expressed as the sum (insecurity + insufficiency along the y-

axis) and difference (insecurity – insufficiency along the x-axis). The sum (y-axis) shows the extent an

item is on either domain and the difference (x-axis) shows the extent an item is in the insecurity rather

than the insufficiency domain. Insecurity items should fall at the right and insufficiency items should fall

at the left. Items that fit well will sort to the top, whereas items that do not fit well will tend to be at the

bottom.

Judging from Figure 3, the items have a distinct and highly significant spread (the standard errors

are always less than 1.0 and often less than 0.5). They sort roughly into the two conceptual groups. The

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[6]It is also important to estimate a "two-parameter" model in which β_k parameters are estimated separately for each item k or a "one-parameter" model in which all of the β_k parameters are constrained to be equal. Here the decision is not quite so obvious. The β_k parameters account for different strengths of relationship between the items and the scale, and allowing them to vary is a little more efficient if some items are less relevant than others. The one-parameter model is very good for estimating item difficulties. The intercepts in the two-parameter model are, technically speaking, a byproduct of both the difficulties and the β_k parameters. In this particular study, the hypothesis of equal slopes can be rejected, $p<0.0001$. However the sample is quite large. Is this a meaningful difference? It appears to be a borderline case and that if non-belonging items are eliminated, the one-parameter model is adequate.

FIGURE 3
Log Odds Ratios of the Insecurity and Insufficiency Scales
(Numbers in the graph refer to questionnaire item numbers listed in Appendix 1)

two constructs together seem to describe the items well, and the items appear to be empirically grouped in a reasonable way, with some exceptions.

Q1 (limited foods) and Q2 (running out of money for food) appear to belong with the insecurity group rather than the insufficiency group. The typological analysis presented earlier concluded that Q2 ought to be deemed conceptually as an insecurity item. The Rasch analysis supports this conclusion and suggests that Q1 be reconsidered as well. Perhaps relying on limited foods (Q1) may be better understood as a response to food resource insufficiency than a direct measure of food insufficiency.

Q34 (other ways of getting food) and Q9 (a dichotomized recoding of the number of days child did not eat breakfast) and perhaps Q31 (buying food on credit) are very weak members of their respective classes, and appear to be good candidates for items to drop.

Table 19 displays these 34 items, sorted by the insufficiency/insecurity parameter in a one-parameter Rasch model. Column 1 of Table 19 lists the item number as it appears in Tables 4 and 5 (and Appendix 1), column 2 provides a brief label, column 3 shows a difficulty score for the insufficiency scale, column 4 shows a difficulty score for the insecurity scale, columns 5 and 6 show the insufficiency and insecurity parameters, and column 7 shows the difference (insufficiency minus insecurity).

The items that are least difficult to answer affirmatively sort to the bottom of Table 19. Nearly all of the ten least-difficult items (Q20, Q32, Q21, Q1, Q22, Q23, Q26, Q11, Q2, Q27) tap food insecurity (see the discussion above about items Q1 and Q2). The items that are most difficult to answer affirmatively (Q10, Q25, Q8, Q30, Q31, Q17, Q14, Q9, Q33, Q15, Q16, Q7, Q18, Q6), sort to the top of the table; nearly all are food insufficiency questions, and many of them are items that ask about food intake deficits for children in the household.

The Scale and Its Meaning. What can we conclude about forming a single scale with these two constructs? A single scale requires a single underlying construct or unit of measure. In educational assessment this unit is extent of ability. In hunger assessment the unit presumably would be extent of

TABLE 19
Questionnaire Items Sorted by Insufficiency/Insecurity Parameter in One-Parameter Rasch Model

Ques. #	Variable Label	INSUF Scale	INSEC Scale	Parameter Insufficiency	Parameter Insecurity	Difference
Q10	C not eat for whole day	5.74		5.74	5.56	0.18
Q25	Dilute formula	4.01		4.01	3.96	0.05
Q8	C goes to bed hungry	3.82		3.82	3.79	0.03
Q30	Soup kitchen use		3.57	3.56	3.57	-0.01
Q31	Buy food on credit		3.56	3.56	3.56	0.00
Q17	Family not eat enough at times	3.55		3.55	3.56	-0.01
Q14	C skips meals	3.54		3.54	3.55	-0.01
Q9	C eat breakfast			3.10 d	3.17	-0.07
Q33	Get discarded food		3.12	3.04	3.12	-0.08
Q15	R skipped meals yesterday	2.96		2.96	3.04	-0.08
Q16	R not eat for whole day	2.36		2.36	2.53	-0.17
Q7	C report hunger	2.19		2.19	2.37	-0.18
Q18	Any days last month no food	2.15		2.15	2.34	-0.19
Q6	C cut/skip meals	2.09		2.09	2.28	-0.19
Q28	Send C to eat with F & R		2.28	2.08	2.28	-0.20
Q5	C eat less than should	2.05		2.05	2.25	-0.20
Q13	Cut size C meals	1.89		1.89	2.10	-0.21
Q34	Get food other ways			1.17 d	1.43	-0.26
Q29	Use food pantry		1.37	1.10	1.37	-0.27
Q12	Worry food not nutritious		0.80	0.55	0.80	-0.25
Q4	A eat less than should	0.40		0.40	0.64	-0.24
Q3	A cut/skip meals	0.27		0.27	0.49	-0.22
Q27	Get food from F & R		0.24	0.05	0.24	-0.19
Q2	Run out of $ for food	0.02		0.02	0.21	-0.19
Q11	Worry not enough food		0.20	0.01	0.20	-0.19
Q26	Borrow $ for food		0.03	-0.14	0.03	-0.17
Q23	C meals not balanced		-0.33	-0.44	-0.33	-0.11
Q22	A eat different foods than C		-0.36	-0.46	-0.36	-0.10
Q1	Limited number of foods			-0.65 d	-0.59	-0.06
Q21	Serve less nutritious foods		-0.69	-0.73	-0.69	-0.04
Q32	Bills not paid on time		-0.75	-0.75	-0.75	-0.03
Q20	Serve less expensive foods		-2.77	-2.42	-2.77	0.35

hunger if the analogy were to hold. Let us imagine for a moment that extent of hunger is in fact the underlying unit of measurement. Do the items sort on an underlying yardstick of extent of hunger?

If that were so, then the results, reading from the bottom to the top of Table 19, could be taken to mean that food-insecure households with no hunger present are characterized by anxiety about food shortages and by reliance on a variety of coping strategies to stretch the food supply and augment resources. Signs of food insufficiency appear when adults experience food intake deficits and a few other resource augmentation strategies are invoked. In households where food shortages appear as intake deficits for children, hunger is manifest in a number of different behaviors showing reduced food consumption among children and for the respondent. In the rarest cases, household members eat at soup kitchens, children go to bed hungry, infants receive diluted formula, and children do not eat for a whole day.

If that were so, these results would represent a continuum ranging from food security (households answering all items negatively) through food insecurity with no hunger present through food insecurity with hunger (food insufficiency mainly in adults) to severe hunger (adding in food insufficiency among children and desperate coping measures).

The results can be interpreted this way if and only if food insecurity and food insufficiency are the same underlying unit of measurement. But they are not. Food insecurity exists in a measurement unit of resource insufficiency; specifically, it is the effect on the household food supply resulting from impoverishment, mediated by coping strategies. Food insufficiency exists in a measurement unit of food consumption throughout a time duration; specifically it is a function of eating too little food for a duration of time because of constrained resources (no coping strategies are available or all have failed to augment the food supply). For the two constructs to reflect the same underlying unit of measure, food insufficiency would have to be a more intense or severe level of food insecurity. It is not.

To see why not, consider the following hypothetical example. Imagine that food insecurity were measured strictly by household food supply. If food insecurity were to become more severe, household food supply would decrease. At some threshold level, lack of food in the household would manifest itself as food intake deficits among persons in the household and thereby become food insufficiency or hunger. Insecurity and insufficiency would be measured by the same yardstick—household food supply.

We know, however, that food insecurity is not measured strictly by household food supply. Rather, when household food supply is in danger of decreasing, adults who manage the food supply turn to a variety of strategies to forestall, if possible, reaching that threshold where food intake deficits would begin. They intervene to minimize or mediate the consequences of household food shortages by stretching the supply or augmenting resources. So food insecurity does not consist of an underlying continuum of food shortage that eventuates in food insufficiency as imagined in the previous paragraph. In the discussion of the temporal typology, this point was made earlier, and it bears emphasizing: **Food insecurity measures what people do in an effort to prevent food insufficiency.**

If researchers measured food insecurity in geographic locales that were extremely poor or characterized by widespread food shortages and a complete lack of social, governmental, or private food assistance, then food insecurity might indeed consist only of anxiety about food shortages and attempts to stretch (versus augment) the food supply. No coping mechanisms involving extrahousehold resource augmentation would be available to the household food supply manager. In this situation, which can occur in hunger studies in developing nations, measures of food supply per capita can capture a great deal of information about hunger useful to policy makers. The conditions of that situation do not apply as a matter of course to studies of places where coping mechanisms are a live option or even a normative way of life, places like the United States.

We return next to the second reason why Rasch modeling cannot make a meaningful, continuous scale—the meaning attributed to item weights is different for educational assessment than for hunger

assessment. Consider how the model works in educational testing (see Wright, 1967, for a more comprehensive treatment). Educational tests are designed to measure the test taker's ability to know. This trait is latent—it is a potential, which is expressed or elicited in response to test questions. Each test taker has some level of ability. A test should elicit and read off a score of that potential at precisely its level. Educational tests are made up of items (questions that can be answered correctly or incorrectly). Some of the items are more difficult to answer correctly than others. A test taker with more ability would be more likely to answer correctly any item, including a more difficult item, than a person with less ability.

How is this analogous to hunger? A test taker's ability is akin to a person's hunger. A knowledge question is akin to a hunger question. A correct answer to a knowledge item is akin to an affirmative answer to a hunger item. In principle, the greater the level of a person's hunger, the more likely she/he is to answer any item measuring hunger affirmatively. Also in principle, the higher the level of hunger an item assesses, the more difficult it is to answer affirmatively.

Thus, the difficulty of an item to be answered correctly in a knowledge test corresponds to the rarity of an item to be answered affirmatively in hunger measurement. Does rarity equate with severity? Are items that have the least prevalent affirmative responses to be taken as items measuring the most severe extent of hunger? There are two reasons why rarity ought not be understood as severity.

First, to answer whether rarity equates with severity, researchers would need to know that food supply management practices are uniform or nearly so across households. There is some evidence on these management practices (Radimer, 1990; Wehler, Scott, and Anderson, 1991; Wehler et al., 1995). That suggests a temporal sequence in which the manager becomes aware of a food shortage, becomes anxious about it, begins stretching and augmenting the food supply where possible, and, when food begins to get short and there is no more money for food, shields the children by having the adults cut back on food intake and skip meals before finally serving less food or fewer meals to the children.

If such a process unfolded in this manner in all food-insecure households, this might mean that the presence of childhood hunger (which is rarer) could be construed as severity of hunger. The problem with this interpretation is that the above depiction of the management process is almost entirely based on inferences from cross-sectional interviews about a temporal sequence of events. No data yet exist to estimate how common or widespread this process is, or what variables affect it when it differs.

There is a second and more fundamental problem. It was noted earlier that educational tests measure latent traits, such as the ability to know. Hunger "tests" do not measure latent traits; rather they measure reports of occurrences. Because of this key difference, hunger measurement is more akin to crime victimization measurement than educational assessment. (For a more complete discussion of the methodology on crime victimization surveys, see Criminal Victimization in the United States in 1992 (1994), appendix 3.) Respondents are asked whether a crime occurred against them or their household property. Crime happened or not, just as food intake deficits happened or not.

Can crime victimization be considered on a continuum of severity? Does the number of victimization occasions within the time period being surveyed indicate severity? Does the number of members of the household who have been victimized indicate victimization severity? Is it more severe victimization if children are the victims rather than adults? Do physical assaults indicate more severe victimization than theft or damage of property? Notice that each of these questions could be rephrased to reflect corresponding indicators of hunger severity.

For the Bureau of Justice Statistics, households in which more than one member has been victimized by crime during the time period surveyed are not counted as experiencing a greater severity of victimization. Multiple-member victimization is counted as a single episode. Nor are types of crime weighted by rarity or degree of harm caused or by any other metric in an effort to measure severity of criminal victimization. If a respondent is victimized more than once during the period under survey, each

episode is counted separately.[7] Victimization rates are calculated by dividing the number of incidences

by the number in the sample. Victimization severity is not assessed. Crime victimization rates and raw

number of crime victimization incidents are reported separately by type of incident.

To extend the analogy further, calculating victimization rates for geographic areas would allow

researchers to identify places characterized by "residential insecurity." A household located in a

residentially insecure part of town would face increased probabilities of victimization; nevertheless, any

given household in a residentially insecure neighborhood need not have been the victim of a crime during

a given reporting period. This means that residential insecurity need not eventuate in crime victimization.

Coping strategies (protective interventions such as alarm systems or traveling the streets at more secure

times of day and with companions) could mediate between insecurity and victimization. Coping

strategies are designed to prevent the occurrence of victimization.

Arguably, it is difficult to decide what the notion of severity of crime victimization even means

at the household level, especially in the context of survey research measurement done to assess

residential security. It is our argument that it is also difficult to decide what the notion of severity of

hunger means at the household level in the context of survey measurement. Households are either hungry

or they are not.

The main implication of this point about the meaning of weights relates to the establishment of a

status indicator of hunger. How many and which facets of insufficiency or even insecurity are necessary

to call a household hungry? Of what does a hunger threshold consist? Put differently, how does one

establish the cutting point in a multi-item scale that marks the presence of hunger? The problem is not

insurmountable, but the solution relies heavily on definitions (face validity), expert judgment, and

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[7]The choice by researchers of the Bureau of Justice Statistics to count separate incidences of victimization as distinct episodes hints at an approach hunger researchers could consider to quantify severity. Counting the number of "hunger days" during a time period under survey might allow the concept of severity to be framed as chronic (or recurring episodes of) food insufficiency. Even so, how the concept of chronicity of hunger can be equated with severity of hunger would require further critical scrutiny.

predictive validity analysis. Any attempt to explore the point more thoroughly here is beyond the scope of this paper's analysis.

The main point of this paper's analysis is to provide a thorough answer to the question of whether food insecurity and food insufficiency participate in a common unit of measurement. Despite the clear desirability of an affirmative answer to this question for researchers, policy makers, food assistance providers, public health workers, and governmental agencies charged with monitoring food issues in the population, the conclusion is straightforward. Food insecurity and food insufficiency do not represent a common unit of measurement. Consequently, items from these two different units of measurement cannot meaningfully be scaled together no matter the scaling technique.

We next explore whether separate scales whose items do share an underlying unit of measure benefit from item weighting provided by Rasch modeling. The four scales introduced earlier in the paper are now formed into one-parameter Rasch scales (items Q9, Q31, and Q34 are dropped from any Rasch scale in which they would have appeared—see the earlier discussion of Figure 3). The next series of tables presents correlations among the Rasch versions of the four scales, as well as between the Rasch versions and the factor analytic versions.

Table 20 displays intercorrelations of the four one-parameter Rasch scales. The three scales made up predominantly of food insufficiency items (CCHIP1, USDA1, INSUF1) are strongly intercorrelated, with correlations ranging from 0.94 to 0.97. Their correlation with the one-parameter Rasch food insecurity scale is weaker, with correlations ranging from 0.69 to 0.76. These results are quite similar to the respective intercorrelations seen in Table 18 of the unweighted additive scales.

Table 21 shows the correlations among the weighted one-parameter Rasch scales and their unweighted, additive counterparts. Looking at how the two versions of each scale correlate, note that the coefficients range from 0.94 (CCHIP with CCHIP1 and USDA with USDA1) through 0.96 (INSEC with

TABLE 20
Correlation Analysis of Rasch Model 1-Parameter Scales

Scale	USDA1	INSUFF1	INSEC1
CCHIP1	0.94182	0.96681	0.76364
USDA1	1.00000	0.96773	0.69389
INSUF1	0.96773	1.00000	0.70852

TABLE 21

Correlation Analysis of Additive Scales with Rasch Model 1-Parameter Scales

Scale	CCHIP	USDA	INSUFF	INSEC
CCHIP1	0.94322	0.98201	0.96535	0.79750
USDA1	0.96654	0.94364	0.96984	0.72014
INSUF1	0.96790	0.95265	0.98573	0.73521
INSEC1	0.69825	0.76751	0.70155	0.95831

INSEC1) to 0.98 (INSUFF with INSUF1). It would appear that the item weighting in the Rasch models does not substantially alter the measurement properties of the scale, at least in this data set.

<u>Research Question 4</u>

The fourth research question pertains to construct validity. How do the four one-parameter Rasch scales perform in an operationalized model of the antecedents and consequences of household food problems? The scales are assessed with variables measuring risk factors and an outcome.

Table 22 displays the correlations between the scales and four risk factors—household income expressed as percentage of poverty, percentage of income spent on shelter, food expenditures as a percentage of the Thrifty Food Plan, and number of bills in arrears—along with an outcome, number of child health problems in the past 6 months.

All of the risk factors and the outcome correlate in the expected direction with each of the four one-parameter Rasch scales. Specifically, the higher the level of household income (expressed as a percentage of poverty), the lower the scale score; the greater the percentage of income spent on shelter, the higher the scale score; the greater the food expenditure (expressed as a percentage of the Thrifty Food Plan), the lower the scale score; the greater the number of bills in arrears, the higher the scale score; and the greater the number of health problems in the past 6 months for a randomly selected child, the higher the scale score. Note that because the insecurity scale measures food resource insufficiency, it performs in a similar fashion with the food insufficiency scales. All of the scales demonstrate good construct validity. No particular combination of items seems to cohere better than others with the risk factors or outcome variable tested.

TABLE 22

**Correlation Analysis of Risk Factors and Outcomes
with Rasch Model 1-Parameter Scales**

Variable / Scale	CCHIP1	USDA1	INSUF1	INSEC1
% Poverty	-0.182	-0.165	-0.190	-0.137
% Inc. - shelter	0.127	0.117	0.132	0.095
Food expenses as % TFP	-0.037	-0.039	-0.034	-0.024*
# bills in arrears	0.350	0.334	0.345	0.365
# health prob. - 6 mo.	0.259	0.230	0.254	0.266

* not significant at the $p < 0.01$ level.

SUMMARY

This report presents an analysis of different scales used to measure the presence of food problems in low-income households. During the past decade, and with increasing convergence in the past half decade, researchers concerned with documenting the population prevalence of hunger have been forging a consensus about the concept of hunger. With the development of a Food Insecurity/Hunger Scale, the USDA Food Security Measurement Project has become the focal point for discussions and debates about the finer points of the consensus that has emerged.

In this paper, a careful argument has been rendered about the difference between two constructs central to hunger measurement, namely, food insecurity and food insufficiency. Though bolstered by empirical assessments that use a uniquely suited data set, the argument turns primarily on a set of definitional distinctions. Food insufficiency is construed to be the preferable construct for hunger because its meaning is exhausted precisely in terms of insufficient food intake. Food insecurity is understood to extend beyond and before and after food insufficiency, so that it encompasses efforts to delay or avoid food intake deficits by stretching or expanding the food supply. Food insufficiency means eating too little. Food insecurity means trying to avoid doing just that when resources are insufficient and a food shortage crisis is impending or is upon the household.

The import of this argument affects decisions about which items to include in a questionnaire module to measure hunger. A scale that mixes items from each construct cannot pass a test of face validity, and poor face validity, as a consequence, diffuses the precision of a measurement. Results from linear and nonlinear scaling techniques are marshaled as indirect support. In the final analysis, researchers must debate the issue of face validity before making a lasting decision about the core items. The typological analysis herein is offered as a contribution to that debate.

The report concludes by discussing two analogies to measuring hunger—educational testing and crime victimization. The analogy between hunger measurement and educational testing does not hold

well because the former indexes episodic occurrences while the latter assesses a latent trait (ability). The relation between measurement of hunger and crime victimization is far more analogous, because each counts discrete self-reports of a traumatic event or events. The implication of this point pertains to how hunger severity ought best to be conceptualized and measured. Ultimately, the issue here is how best to decide what constitutes a hunger threshold.

It is important to note that Rasch modeling, in a general population survey, appears to have a discernible advantage over linear scaling techniques. This is because of its ability to mesh a scale aimed at households with children with a scale (of fewer items) aimed at childless households. Like all scales, however, Rasch scales must have face validity, which means here that only a single construct can be measured with a single summary score. In fact to mix constructs violates a basic assumption of Rasch modeling. Mixing food insecurity with food insufficiency is an instance of mixing constructs.

Research is needed that further documents the management processes identified by Radimer (1990) and inferred by CCHIP to enhance understanding of its interhousehold variation. A temporal, ethnographic data set would be an important complement to the cross-sectional survey data already in existence. Together these data could be used to answer questions about a temporal or multi-member concept of severity of hunger, including questions about how best to measure it.

APPENDIX 1

**Questionnaire Items Providing Database for Analysis
of Food Insufficiency and Food Insecurity Concepts**

1.   Do you ever rely on a limited number of foods to feed your children because you are running out of money to buy food for a meal? (HNGR25)

2.   Does your household ever run out of money to buy food to make a meal? (HNGR1)

3.   Do you or adult members of your household ever cut the size of meals or skip meals because there is not enough money for food? (HNGR9)

4.   Do you or adult members of your household ever eat less than you feel you should because there is not enough money for food? (HNGR5)

5.   Do your children ever eat less than you feel they should because there is not enough money for food? (HNGR13)

6.   Do you ever cut the size of your children's meals or do they ever skip meals because there is not enough money for food? (HNGR17)

7.   Do your children ever say they are hungry because there is not enough food in the house? (HNGR21)

8.   Do any of your children ever go to bed hungry because there is not enough money to buy food? (HNGR30)

9.   During the past 7 days, how many days did Child With Most Recent Birthday (CWMRB) eat breakfast? (BRKFST)

10.   Thinking about the past 12 months, did Child With Most Recent Birthday not eat for a whole day because you had no food or money for food? (CHGR1)

11.   Do you worry that the food you can afford to buy for your children will not be enough? (WORRY1)

12.   Do you worry that the food you can afford to buy for your children is not healthy and nutritious? (WORRY2)

13.   Thinking about the past 12 months, did you ever cut the size of your children's meals because there was not enough money for food? (HGR1)

14.   Thinking about the past 12 months, did your children ever skip meals because there was not enough money for food? (HGR2)

15. Did you skip any meals yesterday because there wasn't enough food or money to buy food? (HGR12)

16. Thinking about the past 12 months, did you ever not eat for a whole day because you had no food or money for food? (HGR13)

17. Which of the following statements best describes the food eaten by your family? Do you have enough food to eat, sometimes not enough to eat or often not enough to eat? (HGR9)

18. Thinking about the past month, how may days did your family have no food or money to buy food? (HGR10&11C)

19. Which of the following reasons explain why your family has had this problem: you did not have transportation, you did not have working appliances for storing or preparing foods (such as stove or refrigerator), you did not have enough money, food stamps, or WIC vouchers to buy food or beverages, or some other reason? (HGR10&11C) People do different things to stretch their food or food money when they are running short of money. Thinking about the past 12 months, please tell me how often you did each of the following things:

20. How often did you buy and serve less expensive foods? (DVCOPE4)

21. How often did you buy and serve foods that were not as nutritious as you would like because you were trying to stretch your food money? (DVCOPE5)

22. How often did you feed your child(ren) a meal but you ate something else to make sure they got the food they needed? (DVCOPE6)

23. How often were you not able to give your child(ren) a balanced meal because you could not afford it? (DVCOPE7&8)

24. How often did you (or other adult members of your household) not eat balanced meals because you could not afford to eat that way? (DVCOPE7&8)

25. [IF CHILD UNDER 2] How often did you dilute your child(ren)'s formula or substitute Kool-Aid or sugar water? (DVCOPE9)

People sometimes go to others to get enough food to go around when they are running short of money. Thinking about the past 12 months, please tell me how often you did each of the following things:

26. How often did you borrow money for food from friends or relatives? (DVCOPE10)

27. How often did you get food from friends or relatives? (DVCOPE11)

28. How often did you go or send the children to the homes of friends or relatives for meals? (DVCOPE12)

People sometimes go to different places to get enough food to go around when they are running short of money. Thinking about the past 12 months, please tell me how often you did each of the following:

29.   How often did you get food from a food pantry? (DVCOPE13)

30.   How often did you get meals from a soup kitchen or church? (DVCOPE14)

People do different things to have enough food to go around when they are running short of money. Thinking about the past 12 months, please tell me how often you did each of the following things:

31.   How often did you buy food on credit? (DVCOPE15)

32.   How often did you choose not to pay bills on time so that you had money to buy food? (DVCOPE16)

33.   How often did you get food that was left over or discarded by others such as stores, restaurants, schools, or other people? (DVCOPE17)

34.   How often did you maybe get food some other way; what other way did you get food? (DVCOPE18)

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