

Alternative Construction of a Food Insecurity and Hunger Measure from the 1995 Current Population Survey Food Security Supplement Data

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Introduction

Since 1995, the US Department of Agriculture (USDA) has fielded a Hunger and Food Security Survey Module (HFSSM) as part of the Current Population Survey (CPS) to estimate the prevalence of food insecurity and hunger in the United States (Bickel, Carlson, & Nord, 1999). During the development of the HFSSM, 18 items were selected from a larger group of candidate items. Although the USDA worked with the questions and modified the questionnaire format and screening procedures during the first few years of the survey, the core 18-items that constitute the HFSSM have not changed since the original survey was fielded in April 1995 (Bickel, Nord, Price, Hamilton, & Cook, 2000). These 18 items were selected to meet certain statistical assumptions. The assumptions were:

- § the measure from the HFSSM should be expressed as a scale in a single dimension,
- § the scale should be composed of multiple items that range in severity,
- § severity should be primarily captured across items, not within items,
- § the items should further have a Guttman property (i.e., affirmation of a more severe item should mean that all less severe items were also affirmed), and
- § an indicator should be created by choosing cut-points along the scale.

Under these assumptions, households were classified into food security categories using Rasch modeling. Largely considered a subset of Item Response Theory (IRT), Rasch modeling (also known in IRT as the one parameter logistic model) assumes that household responses to questions are determined by a continuous latent (unobservable) variable measuring household food insecurity and hunger and by the severity of the question. The severity of a question and the level of household food insecurity and hunger can then be estimated using maximum likelihood techniques. Unlike other models in IRT (for example: the two parameter and three parameter logistic models), households with the same total score on the survey (the same number of questions responded to positively) are estimated to have the same level of household food insecurity and hunger. This means that Rasch modeling does not account for differences among the particular response patterns (which questions each household has responded to positively), but instead utilizes the total number of items answered affirmatively to estimate prevalence.

The 18 items include 10 items about household food insecurity and adults hunger and 8 items about child food insecurity and hunger. Households with children were asked all 18 items, while households without children were asked only the 10 items about household food insecurity and adult hunger. Using Rasch modeling, the severity of the 18 items was estimated using only households with children. The 18 items were ordered

by severity and cut-off points were placed on a scale according to substantive considerations. According to the Measuring Food Insecurity and Hunger Guidelines, households are thought to be "food insecure" if members are habitually concerned about their food situation or if the adult(s) in the family occasionally go without food (for example, skip meals) (Bickel, Nord, Price et al., 2000). A family will be categorized as "moderately hungry" if the adult(s) in the family go without food or a child is cutting the size of their meals or "not eating enough," but will not be categorized as "severely hungry" unless an adult in the family goes without food for a whole day or a child in the family ever goes without food (skips meals).

Using the number of items responded to positively by the household respondent, researchers place households in one of four categories (Bickel, Nord, Price et al., 2000):

Food secure (All households: positive responses to less than 3 items): Households show no or minimal evidence of food insecurity.

Food insecurity without hunger (Households without children: positive responses to 3-5 items; Households with children: positive responses to 3-7 items): Food insecurity is evident in the households' concern and in adjustments to household food management, including reduced quality of diets. Little or no reduction in the quantity of household members' food intake (hunger) is reported.

Food insecurity with moderate hunger (Households without children: positive responses to 6-8 items; Households with children: positive responses to 8-12 items): Food intake for adults in the household has been reduced to an extent that it implies that adults have repeatedly experienced the physical sensation of hunger. Such reductions are not observed at this stage for children in the household.

Food insecurity with severe hunger (Households without children: positive responses to 9-10 items; Households with children: positive responses to 13-18 items): Households with children have reduced the children's food intake to an extent that it implies that the children have experienced the physical sensation of hunger. Adults in the household with or without children have repeatedly experienced more extensive reductions in food intake at this stage.

While use of Rasch modeling has demonstrated that the HFSSM has good statistical "fit", and the estimates for food insecurity and hunger have remained stable over time, there are important issues to consider that may justify modifying the current scale and measurement methodology. Indeed, many authors have criticized the use of Rasch modeling with the HFSSM (Bavier, 2001; Froelich, 2002; Opsomer, 2003; Wilde, 2004). Critiques include: 1) the multi-dimensional nature of food insecurity and hunger; 2) the difficulty using the single dimensional scale to ascertain and understand the consequences of food insecurity and hunger for families, adults and children; and 3) a potential lack of concordance between the labels assigned to households using the current HFSSM scale and the meaning of the actual items that a household responded to positively.

One of the main assumptions made in Rasch modeling (as well as other IRT models) is the assumption of unidimensionality. Formally, unidimensionality occurs when household responses to each question are independent conditioned on the latent variable. Therefore, the latent variable contains all the information that influences household responses on the questions. When unidimensionality fails to hold, the severity estimates of the questions can be biased. Qualitative studies (refs) have found the phenomenon of food insecurity and hunger in households with children to have at least three dimensions, including: household hunger, adult hunger and child hunger. In addition, using the April 1995 CPS data, quantitative studies by Froelich (2002) and Nord and Bickel (2002) found two dimensions corresponding to household food insecurity and adult hunger, and child hunger. Further, in an analyses comparing the households with children (18 items) and without children (10 items), Wilde (2004) found that holding constant the approximate level of food insecurity, there are significant differences in response patterns to the adult-referenced items between the two household types, indicating that the Rasch model severity calibrations currently utilized cannot be used to equate the food security status of households with and without children. In response to this multidimensionality, Nord and Bickel (2002) have developed a separate scale for use with the HFSSM to assess child hunger.

Research delineating determinants and consequences of food insecurity and hunger for families, adults and children tell us why we care about food insecurity and hunger, and also can help us construct healthier food security policies. As currently constructed as a household scale, the HFSSM does not disclose how food is distributed among family members. For example, households that are characterized as severely hungry may have at least one adult in the household who is greatly restricted in the amount of food available to them, and/or at least one child in the household who is at least somewhat restricted in the amount of food available to them; the measure does not tell us which individuals and how severe the food restriction is for each person. Delineation of food distribution specific to each family member is important to understand consequences because, as will be described later on in the paper, each of the potential outcomes of food insecurity, including but not limited to hunger, may individually and/or collectively affect the health and capacity of citizens. Further characterization of the actual mechanisms through which these consequences occur can assist in targeting appropriate policy actions.

From a practical and political perspective, the lack of agreement between the labels assigned to households using the current HFSSM scale and the meaning of the actual items that a household may have affirmed might be the most problematic. Since the current scale is based on the total score on the survey (total number of questions answered affirmatively) and not the particular items positively affirmed, it is possible that household respondents could affirm child hunger by positively answering an item about whether a child was hungry but the family couldn't afford more food, but not be labeled "food insecurity with severe hunger" because less than 11 other items were affirmed positively. In order for concordance between item meanings and category labels to occur, the response pattern for a household must be "modal", which means that given a certain level of food insecurity and hunger, households will respond positively to all questions with severity less than this level, but will respond negatively to all questions with severity greater than this level. Ohls et al. (2001) found that only 28% of

households with children followed this modal response pattern in the April 1995 CPS survey, indicating that lack of concordance between item meaning and category labels may be prevalent.

The purpose of this paper is two-fold: First, it summarizes the current conceptualization of the phenomenon of food insecurity as it experienced by families in North America. This conceptualization demonstrates the multidimensional nature of not only household food insecurity, but also individual-level (adult and child) outcomes. Second, based on this current conceptualization, this paper examines the results of possible alternate ways of constructing a food security measure from the range of items (in addition to the currently-used 18 items) available in the 1995 CPS data, with methods other than Rasch modeling. In order to ensure conceptual clarity, this paper restricts its analyses and discussion to households with children.

Methods

To develop ideas about how to re-analyze the HFSSM, the first author reviewed the qualitative and quantitative literature relevant to the conceptualization of the determinants, characteristics, coping strategies, outcomes, and consequences of food insecurity as it is experienced in North America. At the same time, the second author conducted a cluster analysis of the CPS 1995 HFSSM data to understand how different types of questions group together. Out of the literature review, a conceptual model of the components of food insecurity and its possible determinants, mediators, and outcomes was developed and is summarized in Figure 1 in the Appendix. Using this model, the two authors then discussed the results of the cluster analyses and the meaning of each item included in the original 1995 CPS HFSSM to determine each item's location according to the conceptual model of food insecurity. The results of this classification are displayed in Table 2 in the Appendix.

Literature Review and Conceptual Model of Food Insecurity

Food security was defined at the 1996 World Food Summit as existing when “all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (World Food Summit, 1996). Food insecurity is “the limited or uncertain availability of nutritionally adequate and safe foods, or limited, or uncertain ability to acquire acceptable foods in socially acceptable ways” (Life Science Research Office Federation of American Societies for Experimental Biology, 1990). This Life Sciences Research Office (LSRO) definition of food insecurity is based upon a broad consensus that hunger, or food restriction that elicits the sensation of hunger, is not the only characteristic of a lack of food resources that matters to society. The definition encompasses the concepts of access, availability, and safety of food in addition to the social meaning of food acquisition methods.

The LSRO definition, along with the more comprehensive conceptual model developed for the purposes of this paper (Figure 1), draw from the rich ethnographic research conducted with low-income North American women and families since the 1980's. Radimer et al.'s qualitative work with low-income women in rural and urban

Upstate NY has long informed our understanding of the components of food insecurity, and also our ability to measure the phenomenon (Radimer, 1990; Radimer, 1992; Radimer, Olson, & Campbell, 1990). One of Radimer's primary insights was the understanding that the phenomenon of hunger can be conceptualized separately for both the household as a whole, and for individuals within that household. More recently, Hamelin et al. (1999, 2002) have described what they call "the core characteristics" of food insecurity through their analyses of in-depth interviews with 98 low-income respondents with children. While Hamelin et al.'s papers offer a richer description of how low-income families interpret their experiences with food insecurity, they propose what they call "a flexible characterization of food insecurity that could allow the phenomenon to be studied at different levels of analysis (households, individuals) and in different population groups without losing sight of its components" (Hamelin, 2002). We found this strategy somewhat problematic for the purposes of "measurement" of the phenomenon because it muddled together some household and individual level constructs. For this reason, the conceptual model developed and shown in Figure 1 follows Radimer's original conception most closely (JNE), with additional detail offered by other researchers (see references below) including Hamelin et al. (1999, 2002). The specific components of the Conceptual Model of Food Insecurity are described in detail below.

Components of Food Insecurity

Synthesizing Radimer et al. (1990; 1992;1990), Hamelin et al. (1999, 2002), and others' work (Campbell, 1989, 1991; Fitchen, 1981; Fitchen, 1998; Young, 1998), there are four key components to household-level food insecurity: 1) shortage of food or household food depletion; 2) a lack of quality food or suitable food for the household and/or a presence of a nutritionally inadequate monotonous diet; 3) preoccupation and/or worry about the present and future uncertainty of the household's food supply; and 4) a lack of control over the household's food situation which can be understood as the necessity of the household to acquire food by means thought by society to be unacceptable or demeaning.

Clearly, the main characteristic of food insecurity is a lack of food or a shortage of food for the household. The women that Radimer interviewed made statements such as, "The food that I bought just didn't last (or ran out)", and "It was hard to scrape together a meal" because they could not afford more food (Radimer, 1992).

The second characteristic entails being constrained to purchase or acquire food that was not considered acceptable quality or types. Hamelin et al. (2002) stated that both the lack of food in the home for lack of resources and also the presence of what the respondents' thought of as unsuitable food were of great concern. During their interviews, respondents "referred mainly to the monotony of the diet, but also to the safety and freshness of their food supply and the reduced nutritional value of intake" (Hamelin, 2002). Monotony of the diet was reflected through lack of intra-meal and inter-meal variety; the same foods were consumed for many meals, and meals consisted of few different food items. In addition, Hamelin et al. (2002) found that some respondents discussed acquiring food free or cheaply that was not safe or past the expiration date.

The experience of not having enough food at the household level often is manifested in what Radimer et al. (1992) called “food anxiety” and Hamelin, et al. (1999, 2002) labeled “preoccupation with access to enough food”. Respondents in both studies talked about their uncertainty about the sufficiency of the food available to them. “The last week of each month, it is an internal panic: what will I do to feed them (children), where will I get money (or food)?” (Hamelin, 1999, 2002). This uncertainty often was about the immediate situation, but could also include longer-term worry about the future, and could be cyclical in nature. Several research studies have shown that food supplies and intake among some low-income families, and food stamp program recipients in particular, declines throughout the month as food resources become increasingly unavailable (Taren, Clark, Chernesky, & Quirk, 1990; Thompson, Taren, Andersen, Casella, Lambert, Campbell et al., 1988; Wilde & Ranney, 1997; Wilde & Ranney, 2000).

The final component of household food insecurity described by Radimer et al. (1990; 1992; 1990), and an integral part of the definition of food insecurity, is the acquisition of food from socially unacceptable sources. Radimer et al. were specific: “When women talked about their food running out, they meant the food that they had obtained through normal, socially acceptable means. Ideally, this meant food purchased with wages, but also included food acquired with food stamps or WIC vouchers, and free or reduced price school meals. However, food that the women procured in what they considered to be unacceptable ways, for example from food pantries, family, or friends, was not included in their “normal” household food supply, because these sources were *only* approached after the normal food supply had run out” (Radimer, 1992).

Hamelin et al., on the other hand, described a core characteristic of food insecurity which she labels “alienation”: “Lack of control over the food situation”, and “the need to hide it”. They explained this as “a state of frustration due to being deprived of access to food and subjected to unmodifiable conditions. Because the adults could not feed their household properly and did not anticipate any improvement in the near future, they felt they did not have a fit place in society” (Hamelin, 2002). These two concepts are strongly related. Acquiring food from food banks, soup kitchens, friends or neighbors are strategies undertaken by households who no longer have other choices; further, there is a lack of choice in food type and quantity inherent in accepting food from these sources. Therefore, these two concepts have been combined together in Figure 1 as the final component of household food insecurity: a lack of control over the household’s food situation/acquiring food by means thought by society to be unacceptable or demeaning.

Many of the characteristics of food insecurity described above were thoroughly portrayed in Fitchen’s ethnographic work with low-income American families describing the food and eating patterns of poor Americans, including: cyclical food supplies and monotonous diets -- “Excessive in starches, fats and sugars, while being deficient in any or all of: meats and other proteins, vegetables and fruit, and milk products” (Fitchen, 1998). Furthermore, Fitchen also described the food anxiety that poor adults expressed particularly if they had grown up in a food insecure environment, leaving a “lifelong sensitivity to the problem of having sufficient and desirable food... [which] ... may cause some adults to overeat regularly and become obese” (Fitchen, 1998). Food anxiety also resulted in parents wishing to give their children desired foods such as high sugar items that they did not have themselves as children. Possibly Fitchen’s main insight for this discussion is her insight that the patterns of eating for low-income Americans result not

only from the economic constraints of poverty as would be expected, but also “from the fact that the poor, despite their limited economic resources, follow many dominant American cultural ideas and practices” (Fitchen, 1998).

Potential Individual Outcomes and Consequences of Food Insecurity

Although described somewhat differently, both Radimer et al. and Hamelin et al.’s work speak to the potential individual outcomes associated with a more severe level of household food depletion or food insecurity (Hamelin, 1999, 2002; Radimer, 1990; Radimer, 1992; Radimer, Olson, & Campbell, 1990). Radimer et al. (Hamelin, 1999, 2002; Radimer, 1990; Radimer, 1992; Radimer, Olson, & Campbell, 1990) labels these outcomes “individual-level components of hunger” -- insufficient intake, nutritional inadequacy, lack of choice and feelings of deprivation, and disrupted eating patterns -- while Hamelin et al. (2002) describes “potential reactions to food insecurity”: socio-familial perturbations, hunger and physical impairment, and psychological suffering.

Severe food shortage at the household level can cause drastic reduction or restriction of food intake among individuals within that household. This is depicted in Figure 1 as: Hunger – the sensation that occurs when one does not eat to satiation or satiety. In addition, there could be a decrease in the nutritional quality of food intake. While this has already been explored at the household level in terms of the food that is available to the household and the foods that are served as meals, eating food of poorer nutritional quality is also an individual level behavior of both adults and children within the household.

As stated previously, qualitative and quantitative research has described the prioritization of children’s food intake over their parents within households (Fitchen, 1998; McIntyre, 2003; Radimer, 1992; Tarasuk, 1999a, 1999b, 2001, 2003). In a recent article, McIntyre et al. (2003) studied the dietary intakes of 141 low-income single mothers and their children and determined that food insecure mother’s dietary intakes were consistently poorer than their children at specific times and throughout the month. The authors concluded that, in general, low-income single mothers compromise their own nutritional intake in order to preserve the adequacy of their children’s diets. This finding has been affirmed by a study of food insecure women in Toronto that found that severe or moderate hunger (as measured by the HFSSM) was associated with lower intakes of energy, several nutrients, vegetables and fruit, and meat and alternatives among women (Tarasuk, 1999a, 1999b, 2001, 2003). According to Tarasuk and Fitchen, at a more severe level of food insecurity, inadequate nutrient intake among women is more often a consequence of eating less rather than with choosing foods of poor nutrition quality.

Fitchen, describing her ethnographic work with low-income Americans during the 1980’s, also found that it was common for “the wife-mother [to] shortchange her own food needs. In many poor households the woman eats only starches without any of the meats or vegetables she serves to the rest of the family” (Fitchen, 1998). Interestingly, Fitchen found another distribution pattern not often talked about; the “vulnerable child pattern”. She explained, “Some individual children routinely have insufficient access to food, through differential size or order of serving, outright denial of certain foods, or parental failure to accommodate a child’s particular food needs. The vulnerable children

are often those who occupy problematic positions within the household, for example children of a previous marriage or handicapped children” (Fitchen, 1998).

A third individual outcome associated with food insecurity is described by both Radimer et al. (1992) and Hamelin et al. (2002) as disrupted or modified household eating patterns and disrupted household dynamics around food. Radimer et al. (1992) explain:

"The social component of individual hunger is disruption to the usual pattern of eating three meals a day, and was often referred to as "going without". This problem could be considered a subset of insufficient intake. Meal skipping (for children) and going a day without food (for a parent) seemed to be considered a problem distinct from the problem of eating too little. The problem definition seemed to stem from the fact that food isn't eaten as frequently as social norms indicate it should be eaten. Generally, the women talked about "going without food" as a problem for themselves when this occurred for a day or two, and called this a problem for their children when they went without specific meals" (p. 38S).

The final potential outcome is one that is least emphasized in the HFSSM, yet may be the most important or devastating to adults and children within food insecure households. Hamelin et al. (2002) label this outcome “psychological suffering” while Radimer et al. (1992) called this component of individual-level hunger, “lack of choice and feelings of deprivation”. Words that have been used by respondents to describe their feelings about their food situation include: loss of dignity, shame, embarrassment, guilt, powerlessness, fear and frustration. As one respondent stated: “Hunger is more than physical pain, it hurts inside” (Hamelin, 2002);

The key point of relevance here to the HFSSM is that, as it is currently written, the survey emphasizes only directly the actual sensation of hunger and indirectly, nutritional quality, and does not capture other potential outcomes that may be of equal or greater importance in terms of actual consequences of food insecurity. Recent research has described clear consequences of food insecurity and hunger for adults and particularly for children in North America. Among children, food insecurity and food insufficiency is associated with poorer health status, inadequate intake of certain nutrients, deficits in cognitive development, behavioral and emotional problems, difficulty relating to peers, and symptoms of depression (Alaimo, 2002; Alaimo, Olson, & EA Frongillo, 2001; Alaimo, Olson, Frongillo, & Briefel., 2001; Cook, Frank, Berkowitz, Black, Casey, Cutts et al., 2002; Cook, Frank, Berkowitz, Black, Casey, Cutts et al., 2004; Crooks, 1995; Weinreb, Wehler, Perloff, Scott, Hosmer, Sagor et al., 2002). Among adults, food insecurity is associated with poorer health status, overweight (among women), poor nutrition status, and depression (Nelson, Cunningham, Andersen, Harrison, & Gelberg, 2001; Olson, 1999; Siefert, Heflin, Corcoran, & Williams, 2001, 2004; Stuff, Casey, Szeto, Gossett, Robbins, Simpson et al., 2004; Townsend, 2001). It is hypothesized here that these and other potential, but not yet determined, consequences of food insecurity and hunger are a result of one or several of the individual level outcomes of food insecurity, including: poor nutritional quality of the diet, severe food restriction resulting in the sensation of hunger, distorted eating practices and household dynamics,

and the psychological outcomes associated with feelings of deprivation, including alienation, loss of dignity, shame, embarrassment, guilt, powerlessness, and frustration. For example, disordered eating is not measured in the HFSSM but may be a key to understanding the association between overweight and food insecurity found among low-income women (Olson, 1999).

Coping and the Determinants of Severity of Food Insecurity

Many risk factors that contribute to food insecurity and hunger are summarized in Figure 1 as *Severity and Accumulation of Household Risk Factors*. These risk factors are usually primarily financial, but sociodemographic risk factors, time, housing status, health status, food skills or capabilities, health insurance status, social support, and the immediate food environment (availability of affordable nutritious food), could also affect the food security of households (see for example, (Alaimo, Briefel, EA Frongillo, & Olson, 1998; Blank, 1997; Campbell, 1989; Danziger, Corcoran, Danziger, & Heflin, 2000; Edin & Lein, 1997; Mayer, 1998; Mayer & Jencks, 1988; Olson, Anderson, Kiss, Lawrence, & Seiling, 2004; Rose, 1999). An understanding of the importance of community food environments and of food costs and availability of healthy foods, particularly in inner city and rural areas, is gaining prominence in the literature (Morland, 2002; Morris, Neuhasuer, & Campbell, 1992; University of Newcastle upon Tyne, 2003). Further, it is increasingly recognized that elderly individuals and individuals with health impairments such as diabetes may face additional constraints because of special diet considerations, an inability to prepare food, and/or increased costs of medical care (Nelson, Cunningham, Andersen et al., 2001; Nelson & Harrison, 2000).

Radimer et al. (1992) described hunger as a “managed process”. As depicted in the figure, the adaptation, adjustment, resolution, and severity of food insecurity are mediated by the availability and acceptability of food acquisition and coping strategies for the household. Campbell and Desjardins (1989) described three “general provisioning approaches” to food undertaken by 20 low-income households they studied in Toronto, CA:

“Some families were self-reliant and focused on what they could do on their own within their own home and limited resources (i.e., they were not extensively involved in social exchange networks nor with the formal market/wage economy). Other relied on informal bartering of services among often extensive networks of friends and family. These families had no more than the necessary contact with the formal market/wage economy. The third approach was to rely primarily on formal institutions (banks, social service system) for resources and/or to work hard to enter the market/wage economy (via further education, intensive job searches). These households purchased rather than bartered services” (p.166).

In general, coping strategies or tactics used by families follow a priority system that is based on how acceptable and/or how invasive that tactic is for the family (young). The use of emergency food assistance, such as food pantries, is often a last resort for a family when there are no other choices. The initial discomfort may diminish with time, however, as described by Hamelin, et al. (2002), “...after some time, [use of food

pantries] clearly became part of one's way of living" (p.125). Availability, predictability and use of coping tactics, along with changes or maintenance of risk factors will determine if a family food insecurity problems are resolved, maintained (adaptation), or worsened either in the short-term or long-term (McCubbin, 1980). In studies of families' stress management processes, McCubbin and Patterson (1980) make a distinction between the family processes of *adjustment* and *adaptation*. Adjustment is the more short-term responses to manage or buffer family life changes, transitions, and demands; when these responses no longer are sufficient, and demands on the family system remain persistent, more long-term adaptation or restructuring becomes necessary. Financial risk factors are obviously primary in this process; however, many researchers have highlighted the importance of social networks and social support systems in household's ability to maintain food supplies (Martin, 2004; Young, 1998). Fitchen (1998) characterized this sharing of food among households "an informal security network".

Cluster Analysis of Items from 1995 HFSSM

As stated previously, the core 18-items that make up the HFSSM have not changed since the original survey was fielded in April 1995. However, the original survey from April 1995 contained several items that were not selected for inclusion in the core 18-item HFSSM. (See Table 1 in the Appendix for the list of items.) It was clear from the literature review that Questions 18 – 23 needed to be added to our cluster analyses in order to potentially account for characteristics of food insecurity. For example, Questions 22 and 23 from the April 1995 HFSSM ask respondents whether they obtained food from a church, pantry, or food bank or whether they ate any meals in a soup kitchen. These items directly assess the use of socially unacceptable means of obtaining food.

To look for potentially important components of Food Insecurity, the second author completed a cluster analysis of the April 1995 HFSSM data. The cluster analysis used for these data was a program developed for use in Item Response Theory. The HCA/CCPROX program, which stands for Hierarchical Cluster Analysis (HCA) based on a Conditional Covariance Proximity (CCPROX) matrix, begins by calculating a proximity measure between all item pairs in a data set based on the conditional covariance of the item pair. The conditioning of the covariance is on the severity of food insecurity as measured by the total number of items the household answered positively ignoring the item pair in question. The hierarchical cluster analysis uses the proximity matrix to place items in clusters. The first stage of the cluster analysis combines the two items with the smallest proximity into a new cluster. Each successive stage then combines the two clusters with the smallest proximity out of the remaining clusters into a new cluster. At the final stage of the cluster analysis, all items belong to the same cluster. The results of the HCA/CCPROX cluster analysis are located in Figure 2 in the Appendix. Each stage of the cluster analysis is a column in the table. Within each stage (column) of the cluster analysis, clusters are separated by a "***".

According to the theory of conditional covariances (Zhang, 1999), items that cluster early in the HCA measure the same or similar constructs than items that cluster late in the HCA. However, the HCA/CCPROX is completely exploratory in nature. No attempt is made using the HCA to determine where the true clustering of the items is located or whether different clusters actually measure the same or similar constructs.

With these limitations in mind, several important clusterings of items can be found in the HCA output in Figure 2. Questions 55, 56, 57 and 58 (and later Question 20) form a cluster early in the HCA and stay a separate cluster until late in the HCA. Questions 53 and 54 and Questions 18 and 21 form clusters separately and then combine into one cluster early in the HCA. The cluster with these items (and Question 19) does not combine with another cluster until late in the HCA. Questions 24, 32 and 35 form a cluster early in the HCA. This cluster combines with the Question 28 and 38 cluster and then stays a separate cluster until very late in the HCA. Finally, Questions 40 and 47 form a two item cluster and with the addition of Question 43 stay a three item cluster until late in the HCA.

Placement of Items from April 1995 HFSSM into Conceptual Model of Food Insecurity

Using the results of the cluster analyses, the two authors discussed the meaning of each item included in the original 1995 CPS HFSSM in order to determine its location according to the Conceptual Model of Food Insecurity displayed in Figure 1. The results of this classification are shown in Table 2 in the Appendix. The Food Insecurity categories include: Worry (Question 53), Socially Unacceptable Food Sources (Questions 22 and 23), Food Depletion (Questions 54, 24, and 32), and Household Quality (Questions 20, 55, 56, 57, and 58). Items associated with restriction of food intake for adults were placed together in the Adult Hunger category (Questions 35, 38, and 28), while those associated with child food restriction were categorized as Child Hunger (Questions 40, 43, 47, and 50).

Several item placements deserve discussion. First, although not included in the original 18-item scale, it was deemed important to include a classification of Socially Unacceptable Food Sources because this component is clearly described in the official definition of food insecurity (Life Science Research Office Federation of American Societies for Experimental Biology, 1990). In contrast, it was decided not to include other similar items that clustered together with Questions 22 and 23 – Questions 18, 19, and 21 -- because it was felt that a positive response to these items may not signify socially unacceptable means of food acquisition, but may instead be thought of as common strategies that families use to stretch their food resources. These strategies more closely fit in with the food acquisition and coping strategies box described in the Theoretical Model of Food Insecurity (Figure 1).

Second, several of the Household Quality items specifically ask about quality of the children's diet (Questions 56, 57, and 58) and could have been placed under a new Outcome category of Child Diet Quality (see Figure 1). However, very early in the cluster analyses, these items clustered with Questions 55 and 20, which ask more generally about the quality of diet available to the household. In addition, according to the literature review, when thinking about providing meals for the family, adults are most often primarily concerned about the children rather than the family as a whole and may not separate the two concepts conceptually (Hamelin, 2002). Therefore, it was decided to place the items in the Household Quality category, rather than creating a new category of Child Diet Quality.

Lastly, two items in the Household Food Depletion category asked about adult food restriction (Questions 24 and 32). According to the cluster analysis, these items clustered with other adult hunger items: Questions 28, 35 and 38. However, in a desire to stay in somewhat agreement with the definition of Moderate Hunger used in the original analyses of the CPS, Questions 24 and 32 were grouped with the other Household Food Depletion items because it was felt that they were not severe enough to signify the presence of adult hunger, but instead represent food depletion.

Analysis of the 1995 HFSSM Data

Using the placement of the questions from the April 1995 HFSSM in Table 1, households were labeled as being Food Insecure, experiencing Adult Hunger, and/or experiencing Child Hunger according to their responses to the items in those categories. Households were labeled as experiencing Adult Hunger if they responded positively to at least one of the Adult Hunger items (Questions 28, 35 and 38). Households were labeled as experiencing Child Hunger if they responded positively to at least one of the Child Hunger items (Questions 40, 43, 47 and 50). Unlike the HFSSM measure currently in use, households could be labeled as experiencing Child Hunger while not be labeled as experiencing Adult Hunger.

The labeling of households as Food Insecure was somewhat more problematic. According to the Conceptual Model of Food Insecurity in Figure 1, any positive response to the Food Insecurity questions (Questions 20, 22, 23, 24, 32, 53, 54, 55, 56, 57 and 58) should result in the household be labeled as food insecure. However, this interpretation of food insecurity will result in many more households being labeled as food insecure. In addition, since the HFSSM measure currently in use employs a much more restrictive interpretation of food insecurity (households must respond positively to at least 3 of the 18-core items), comparing the results of this analysis to the HFSSM measure currently in use would not be possible.

To alleviate this problem, two levels of Household Food Insecurity were created. For Food Insecurity Level 1, households were labeled as Food Insecure if they responded positively to at least one Food Insecurity question. Thus, Level 1 matches the interpretation of food insecurity from Figure 1. For Food Insecurity Level 2, households were labeled as Food Insecure if they responded positively to at least three Food Insecurity Items. Level 2 thus more closely corresponds to the HFSSM measure currently in use.

Finally, households were labeled as having one or more of the four components of food insecurity if they responded positively to at least one item in that category. Using the overall definition of Food Insecurity from Level 1, no households labeled as food secure can be labeled as having any component of Food Insecurity. Using the definition of Food Insecurity from Level 2, some households labeled as food secure could be labeled as having one or two components of food insecurity. However, no households labeled as food secure can be labeled as having three or more components of Food Insecurity.

One area of concern with this model was the possibility that a household could be labeled as having Adult and/or Child Hunger and not be labeled as Food Insecure. Since the conceptual model in Figure 1 considers Hunger as a possible outcome of Food

Insecurity, households with Adult Hunger and/or Child Hunger must be, by definition, Food Insecure. Therefore, both Household Food Insecurity definitions (Level 1 and 2) were augmented from those above to include all households having Adult and/or Child Hunger. The final operational definitions of Food Insecurity and Hunger are:

Food Insecure Level 1: Households are considered to be Food Insecure if they respond positively to at least one of the following questions: Q20, Q22, Q23, Q24, Q32, Q53, Q54, Q55, Q56, Q57, Q58, or have Adult or Child Hunger.

Food Insecure Level 2: Households are considered to be Food Insecure if they respond positively to at least three of the following questions: Q20, Q22, Q23, Q24, Q32, Q53, Q54, Q55, Q56, Q57, Q58, or have Adult or Child Hunger.

Adult Hunger: Households are considered to have Adult Hunger (Restriction) if they respond positively to at least one of the following questions: Q28, Q35, Q38.

Child Hunger: Households are considered to have Child Hunger (Restriction) if they respond positively to at least one of the following questions: Q40, Q43, Q47, Q50.

Prevalence Estimates

Using the definition above, the data from the April 1995 HFSSM was used to estimate the prevalence of Food Insecurity and Hunger during the previous 12 month period in households with children in the United States. Of the 44,286 households that completed the April 1995 CPS HFSSM, 16,885 were households with at least one person under the age of 18. While it is possible the household respondent was under the age of 18, Nord and Bickel (1999) indicate this occurrence in the April 1995 CPS was rare. The households completing the HFSSM were given questions meant to screen food secure households out of the full survey. Of the 16,885 households with children, 7,888 of them passed the screener and were administered the full HFSSM. Using the responses to the items on the HFSSM, each household with children was labeled either Food Secure, Food Insecure (Levels 1 and 2), having Adult Hunger, or having Child Hunger according to the definitions discussed above.

Prevalence estimates of each Food Insecurity component, and the labels Food Insecure (Levels 1 and 2), Adult Hunger and Child Hunger were determined using the HFSSM household weights from the April 1995 CPS. Each prevalence estimate is a weighted average of the household weights of the households belonging to that category divided by the sum of the weights of all 16,885 households with children from the CPS. Thus, the prevalence estimates are an estimate of the percentage of households with children in the United States in that particular category.

Results

Using the definitions above and the April 1995 CPS data, the prevalence estimates for the percentage of all households with children in the United States labeled

as Food Insecure Level 1, Food Insecure Level 2, having Adult Hunger, and/or having Child Hunger were calculated and are displayed in Table 3 below.

Table 3. Prevalence Estimates for US Households with Children

Household Food Security Status	Prevalence Estimates
Total Food Insecure Level 1	28.36%
With No Adult or Child Hunger	21.85%
Total Food Insecure Level 2	18.34%
With No Adult or Child Hunger	11.83%
Hunger (Child and/or Adult)	6.50%
Total Adult Hunger (Restriction)	5.30%
Total Child Hunger (Restriction)	3.05%
Adult Hunger but not Child Hunger	3.46%
Child Hunger but not Adult Hunger	1.21%
Both Child and Adult Hunger	1.85%

Using the definitions of the four Food Insecurity components and the April 1995 CPS data, the prevalence estimates for the percentage of all households with children in the United States falling into each category were calculated and are displayed in Table 4 below.

Table 4. Prevalence Estimates for each Food Insecurity Category for US Households with Children

Food Insecurity Category	Prevalence Estimates
Worry	22.79%
Socially Unacceptable Food Sources	4.78%
Food Depletion	19.70%
Household Quality	21.22%

The conceptual model in Figure 1 includes obtaining food from unacceptable sources as one of the four aspects of food insecurity. The questions concerning this aspect, Questions 22 and Question 23, were not included in the final 18 item HFSSM scale currently in use. In the April 1995 CPS data, only 730 of the 7,888 households passing the food security screener responded positively to either one of these questions. Since these sources of food are not available to all households (for example, some households are not located in areas where food banks are available), new prevalence estimates for Food Insecurity Levels 1 and 2 were calculated without these items. Without these questions, the prevalence of Food Insecurity Level 1 in US households with children decreases from 28.33% to 27.85% and the prevalence of Food Insecurity Level 2 decreases from 18.34% to 18.00%. Since the inclusion of these questions on Socially Unacceptable Food Sources does not greatly affect the prevalence estimates of Food Insecurity and the conceptual model includes this as a component of Food Insecurity, these questions were included in the analysis above.

Analysis of the Components of Food Insecurity

While the conceptual model in Figure 1 separates the concept of Food Insecurity into four smaller categories, the labeling of households as being Food Insecure does not depend directly on these categories. However, one can study the placement of Food Insecure households into these categories to determine if there are overall trends that could aid in the understanding of the phenomenon of Food Insecurity. Table 5 below gives the prevalence estimates of each combination of the Food Insecurity components Worry, Food Depletion and Household Quality within all households with children labeled as Food Insecure Level 1. Table 6 below contains the same analysis for all households with children labeled as Food Insecure Level 2. Since the overall prevalence of the Socially Unacceptable Food Sources category was low, this category was omitted from the analyses below.

Table 5. Prevalence Estimates of Each Combination of the Food Insecurity Categories Worry, Food Depletion and Household Quality (Socially Unacceptable Food Sources omitted) within Food Insecure Level 1 US Households with Children.

		Food Depletion			
		No		Yes	
		No H. Quality	H. Quality	No H. Quality	H. Quality
Worry	No	1.81%	8.59%	3.63%	5.61%
	Yes	11.67%	8.47%	8.06%	52.17%

Table 6. Prevalence Estimates of Each Combination of the Food Insecurity Categories Worry, Food Depletion and Household Quality (Socially Unacceptable Food Sources omitted) within Food Insecure Level 2 US Households with Children.

		Food Depletion			
		No		Yes	
		No H. Quality	H. Quality	No H. Quality	H. Quality
Worry	No	0.17%	1.74%	0.34%	5.94%
	Yes	0.11%	4.38%	6.65%	80.67%

**Note: A household will be labeled as Food Insecure Level 2 if the respondent answered affirmatively three or more Food Insecurity Questions and/or experienced Child or Adult Hunger. This definition explains in part the low percentages in some of the cells in Table 6 above.

The analysis in Tables 5 and 6 indicate the food insecurity component Worry is common in households labeled as Food Insecure. Approximately 80% of all Food Insecure Level 1 US households with children and 92% of all Food Insecure Level 2 US households with children are estimated to worry about running out of food before having enough money to purchase more. Conversely, around 6% of all Food Insecure Level 2

US households with children are estimated to exhibit problems with both the quality and quantity of food available (Household Quality and Food Depletion) but not worry about running out of food before having enough money to purchase more. This result suggests these households may have become acclimated to the reduced availability and quality of food and no longer worry about running out of food. It is possible that if the household respondent knows the food will run out before there is money to buy more, they may be less likely to worry about something they know will happen.

By far, the highest prevalence estimates for both Food Insecure Level 1 and Food Insecure Level 2 households are for the combination of all three components of Food Insecurity (Worry, Household Quality and Food Depletion). Approximately 52% of all Food Insecure Level 1 and 81% of Food Insecure Level 2 households with children are estimated to exhibit all three components of food insecurity. Therefore, many households with children experiencing the phenomenon of food insecurity will experience all three components of food insecurity.

Comparison of Prevalence Estimates Between Proposed and Current Measure for 1995 HFSSM

Using the definitions given in the Introduction of this paper, the current HFSSM measure assigns households to one of four food insecurity and hunger categories according to the number of the core 18-items the household positively affirmed. The prevalence estimates for each category were then calculated using the same method as the prevalence estimates given in Table 3. Table 7 below gives the prevalence estimates from Hamilton et al. (1997) and the corresponding prevalence estimates from our analysis (reported in Table 3).

Table 7. Comparison of Food Insecurity and Hunger Prevalence Estimates for all US Households with Children

Food Insecurity Category	Prevalence Estimates		
	Current	Proposed (Level 1)	Proposed (Level 2)
Food Secure	82.40%	71.64%	81.67%
Food Insecure with No Hunger	12.30%	21.85%	11.83%
Food Insecure with Hunger	5.30%	6.50%	6.50%
Food Insecure with Moderate Hunger	4.40%	N/A	N/A
Food Insecure with Severe Hunger	0.90%	N/A	N/A

Two main differences between the current and proposed measures in terms of the prevalence estimates are apparent in Table 7. First, Level 1 of the proposed measure follows the definition of food insecurity more closely than the current measure. For a household with children to be labeled as food insecure, the current measure requires the household to respond positively to at least three of the 18-core items while the proposed Level 1 measure only requires the household to respond positively to at least one of the 11 Food Insecurity items from Table 2. Consequently, the proposed Level 1 measure estimates many more food insecure US households with children, from a total of 17.6%

of all households with children using the current measure up to a total of 28.35% of all households with children. Second, the current measure uses a different definition of hunger than the proposed measure. Using the current measure, households must respond to at least eight of the 18-core items to be labeled as having Hunger while the proposed measure only requires the household to respond positively to at least one of the Adult or Child Hunger items from Table 2. Consequently, the proposed measure estimates more US households with children to have Hunger, from 5.30% of all households with children using the current measure to 6.50% of all households with children using the proposed measure.

Household Comparisons Between Proposed and Current Measure for 1995 HFSSM

The results in Table 7 clearly show differences in the food insecurity and hunger prevalence estimates of US households with children between the proposed and current measures. The question then arises about the amount of agreement on the household level of the food insecurity and hunger classifications of the two measures. Since the current and proposed measures use two different hunger classifications each, the comparison of the two measures was made by collapsing these classifications into a single hunger classification. Table 8 below gives the prevalence estimates for all US households with children classified as Food Secure, Food Insecure with No Hunger and Food Insecure with Hunger for each combination of the current and proposed (Level 1) measures. Table 9 below gives the same analysis but for the combination of the current and proposed (Level 2) measures.

Table 8. Comparison of the Prevalence Estimates in the Combination of Food Insecurity Categories from the Proposed (Level 1) and Current Measure.

Proposed Measure	Current Measure		
	Food Secure	Food Insecure with No Hunger	Food Insecure with Hunger
Food Secure	71.62%	0.02%	0.00%
Food Insecure with No Hunger	10.91%	10.21%	0.73%
Food Insecure with Hunger	0.12%	1.93%	4.47%

Table 9. Comparison of the Prevalence Estimates in the Combination of Food Insecurity Categories from the Proposed (Level 2) and Current Measure.

Proposed Measure	Current Measure		
	Food Secure	Food Insecure with No Hunger	Food Insecure with Hunger
Food Secure	81.53%	0.14%	0.00%
Food Insecure with No Hunger	1.00%	10.10%	0.73%
Food Insecure with Hunger	0.12%	1.93%	4.47%

From Table 8, an estimated 86.3% of all US households with children would have the same food insecurity and hunger status under both the current and proposed measure with the Level 1 definition of Food Insecurity. Less than 1% of all households are estimated to receive a less severe food insecurity and hunger classification under the proposed measure. Almost of these households would move from the Food Insecurity with Hunger classification to the Food Insecurity without Hunger classification. However, under the proposed measure, approximately 13% of all households are estimated to receive a more severe food insecurity and hunger classification. Most of these households would move from the Food Security classification to the Food Insecurity without Hunger classification. This analysis adds to the results of Table 7 that more US households with children would be classified as Food Insecure using the proposed Level 1 measure.

From Table 9, an estimated 96% of all US households with children would have the same food insecurity and hunger classification under both the current and proposed measure with the Level 2 definition of Food Insecurity. Again, less than 1% of all households are estimated to receive a less severe food insecurity and hunger classification under the proposed measure with almost all of these households moving from the Food Insecurity with Hunger classification to the Food Insecurity without Hunger classification. Under the proposed measure, approximately 3% of all US households with children are estimated to receive a more severe food insecurity and hunger classification. However, unlike the previous comparison, most of these households would move from the Food Insecure with No Hunger classification to the Food Insecure with Hunger classification. This analysis adds to the results of Table 7 that more US households with children would be classified as Food Insecure with Hunger using the proposed Level 2 measure.

Hunger Prevalence Estimates

When first developed, the current measure made no attempt to differentiate between Adult and Child Hunger in US households with children. According to the

definitions of the four food insecurity and hunger labels, US households with children who were experiencing Child Hunger were thought to fall into the Food Insecure with Severe Hunger category. The prevalence estimate of this category for US households with children from the 1995 HFSSM was very low (0.9%). This low estimate called into question using the category Food Insecure with Severe Hunger as a stand-in for Child Hunger.

In an attempt to alleviate this problem, Nord and Bickel (Nord, 2002) developed the Child Hunger measure based on the same Rasch modeling used to develop the current measure. By obtaining item difficulty estimates of the eight child-only items of the total 18-item core and matching these estimates to the overall current measure, Nord and Bickel defined households as having Child Hunger if they responded positively to at least 5 of the 8 child-only items. Using this definition, the prevalence estimate of Child Hunger from the April 1995 HFSSM was 1.25% of all US households with children.

The conceptual model of Food Insecurity in Figure 1 places the child-only items (Questions 56, 57 and 58) into the Household Quality component of Food Insecurity (see Table 2). These questions specifically refer to the quality of the food consumed by the children in the household. The other five child-only items (Questions 40, 43, 44, 47 and 50) specifically refer to the restriction of the quantity of food for children in the household and are placed into the Child Hunger outcome of Household Food Insecurity. Under the definition of Child Hunger developed by Nord, a household who responded that their “children were hungry but they couldn’t afford more food” (Question 47) would not necessarily be labeled as having Child Hunger. However, the proposed measure labels any household that responded positively to this question as having Child Hunger. As a result, the proposed measure results in a prevalence estimate of Child Hunger from the April 1995 HFSSM of 3.05% of all US households with children.

Shielding Children from Hunger

In the definition of the four food insecurity and hunger levels from the current measure, there is an implicit assumption that adults in the household will shield children from hunger. The adults in the household will experience more severe levels of hunger before restricting the quantity of food for the children in the household. The proposed measure, by calculating separate estimates of hunger for both adults and children in the household, does not make this assumption. From Table 3, approximately 6.50% of all US households with children are estimated to have either Child or Adult Hunger. Of these households, approximately 81% were labeled as having either Child and Adult Hunger or Adult Hunger but not Child Hunger, following the assumption that children in the household were shielded from hunger. However, approximately 19% of all households with Hunger are labeled as having Child Hunger but not Adult Hunger. Using the current measure, many of these households would be labeled as either having Food Insecurity without Hunger or having Food Insecurity with Moderate Hunger, essentially ignoring the information given by the respondent that at least one child in the household experienced the sensation of hunger, but was not fed, or went w/o food (skipped or cut the size of meals).

Discussion

The creation and implementation of the U.S. Hunger and Food Security Survey Module (HFSSM) represents a significant achievement in American society's willingness to recognize and address hunger and food insecurity among American families. The measure was developed with wide consensus among anti-hunger advocates, researchers, academics, and government officials and is broadly accepted, used, and disseminated by each of these sectors, including the Federal government.

While not discounting, and in fact building on, these achievements, this paper demonstrates that it may be possible to further improve and refine the HFSSM to better serve its current and future uses by modifying some of the core assumptions made in the original creation of the measure. Primarily, this paper re-analyzes the original 1995 HFSSM data without the assumption that food insecurity and hunger, especially in US households with children, can be expressed as a scale in a single dimension.

There are two key benefits associated with our alternate construction of the food insecurity and hunger measure. First, our re-analyses matches the results within each category (food insecurity and hunger) to the conceptual meaning of the items responded to positively by the respondent, rather than basing the result on the number of items responded to positively and the assumption of a modal response pattern. With this method, if a household responded positively to a question specifically about the presence of hunger in the household, this household will be classified as having hunger. Thus, our method fundamentally strengthens the face validity of each food security and hunger category.

Second, the re-analyses is based (as much as was possible with the items available) on a conceptual model of the processes and outcomes of the experience of food insecurity for American families. This model takes into account past research and also research that has become available since the development of the HFSSM, and demonstrates the multidimensional nature of household food insecurity and its individual outcomes. While the current measure considers adult and then child hunger to be on a continuum with food insecurity, the conceptual model and our measure define child and adult hunger to be two of several possible outcomes of household food insecurity.

The re-analyses presented here was limited to the items available in the 1995 CPS. However, the development of a comprehensive Conceptual Model of Food Insecurity allows us to discuss future priorities for measurement of the phenomenon of food insecurity in order to enhance our full understanding of the experience, outcomes, and consequences, and to suggest innovative policy options. The conceptual model describes a potentially testable hypothesis that the mechanisms for each of the consequences associated with food insecurity result from one or more distinct individual-level outcomes. As the measure is currently constructed, hunger, or food restriction, is the only individual-level outcome measured. Yet other outcomes, such as distorted eating practices, diminished nutritional quality of the diet, and psychological suffering associated with deprivation may be of equal or more importance in terms of possible health and nutrition consequences, reduction in functional capacity of citizens, and lower academic achievement in children. Understanding of these outcomes of food insecurity and their effects on consequences can be critically important to policy discussions of ways to enhance the well-being of low-income Americans.

For example, numerous studies have found an association between food insecurity and depression among teen-agers and women (Alaimo, 2001; Siefert, Bowman, Heflin, Danziger, & Williams, 2000; Siefert, Heflin, Corcoran et al., 2001, 2004). At this time, it is unknown if food insecurity is acting through a physiological response to food restriction (hunger), the psychological sense of deprivation and inadequacy that can come from being food insecure, a specific nutrient deficiency, distorted eating practices, a combination of one or more of the above, or some other mechanism. Success of policies to address depression among those living in food insecure households may depend on a full understanding of these mechanisms. To cite one scenario, policies that encourage low-income families' to rely on food banks in place of Federal assistance programs such as the Food Stamp Program may not increase actual hunger, but also may not mediate the psychological suffering associated with food insecurity (i.e., feelings of shame, powerlessness and frustration) which may be equally or more important as a cause of depression.

Another example is the increasingly clear association found between food insecurity and overweight among women (Townsend, 2001). One hypothesis is that overweight is mediated by disordered eating practices, not by food restriction (hunger) (Alaimo, 2001; Olson, 1999). Another is that overweight is mediated or confounded by the women's depression, which is also associated with food insecurity. Research confirming or disproving these hypothesis has not been conducted, primarily because of a lack of datasets with measures of these potential outcomes of food insecurity: hunger, disordered eating practices, and the psychological sense of deprivation.

It is useful to chronicle and elaborate on key decisions and issues yet to be worked through in regards to this re-analyses. First, this paper proposes two different cut-off points for the determination of the existence of household food insecurity. Based on the Conceptual Model, the definition of food security, and qualitative research with low-income families, the presence of any of the following components signifies the absence of food security, or the presence of food insecurity: household food depletion; lack of quality preoccupation and/or worry about the household's food supply; a lack of control over the household's food situation or the necessity of the household to acquire food through unacceptable sources. The Food Insecurity Level 1 definition requires only one positive response to the Food Insecurity Items from Table 1, and is closely aligned with the definition of food insecurity from the conceptual model. The current use of the HFSSM scale, and Level 2 of this analyses, requires three or more positive responses to food insecurity items. In parallel, just one positive response to a hunger item was required to classify a household as experiencing adult and/or child hunger, again following the definition in the conceptual model. Justification for whichever cut-points are chosen for food insecurity and hunger categorizations are chosen need to be clearly articulated.

Further, although not included in the original 18-item scale, we included a category for Socially Unacceptable Food Sources within our construction of the food insecure measure. The Conceptual Model includes the lack of control over the food situation and necessity to rely on socially unacceptable food sources as a main component of food insecurity because society cares not just about how much food low-income Americans have, but also how they are able to acquire their food – through the mainstream food and economic system, or through handouts. Fitchen's (1998) work is instructive here; she

reminds us that our food behaviors and practices are embedded in our cultural and social worlds, and do not just fulfill our metabolic needs. Poor Americans desire to eat and purchase food through normal legal channels -- as other Americans do -- because they see themselves as Americans first, and poor second.

However, the inclusion of Questions 22 and 23 only in this category is problematic for three reasons. First, as Hamelin et al. (1999) explain, social acceptability is a moving target and sadly, the use of food banks (handouts) has become increasingly “acceptable” in the past 20 years. Second, soup kitchens and food pantries may not be available to all low-income Americans; availability is subject to geographic distribution and a myriad of eligibility rules. Finally, these particular indicators of lack of control over the household food situation could also (or instead) be thought of as food acquisition and coping strategies. Further thinking on the best way to measure this component is needed, and future questionnaires may want to include additional items that ask about other socially unacceptable food sources, or more directly about the lack of control felt by the household over their food situation.

Another issue that arose was where to classify Question 57, as a household quality item, where it clustered, or as a child hunger item, because it asks whether the children were “eating enough”. Alaimo (1997) found multiple interpretations or meanings of the words “eating enough” during cognitive testing of food insecurity and hunger questionnaire items. In that study, 16 low-income respondents were asked to describe the meaning of and contrast the following questions, “My children are not eating enough because I just can’t afford enough food,” and “Were your children ever hungry because you just couldn’t afford more food?” Most respondents believed that “eating enough” referred to quantity of food, but some understood it to mean both lack of adequate quantity and the right quality of food in terms of nutrition, or simply inadequate quality, while the word “hunger” was always interpreted to mean inadequate quantity of food. Hamelin et al. (2002) asked over 150 low-income respondents the question, “What does enough food mean to your family?”. Twenty-five different elements of the definition of “enough food” were catalogued and regrouped into three overriding concepts: “consumption for survival” or enough quantity (77 respondents), “adequacy for self-respect”, which included consumption of balanced meals, access to a variety of food groups – quality of food (87 respondents), and “higher order needs”, or the capacity to assume social responsibilities and observe rituals (10 respondents). Because of these observed variations in interpretation, classifying “eating enough” as a strictly quantitative item (Child Hunger) would be misleading. Therefore, we decided to characterize this item according to its placement in the cluster analysis, as a household quality item.

Similarly, we were unsure where to place Questions 24 and 32 in the conceptual model, and the assignment of these questions to the Food Insecurity or Adult Hunger categories. According to the cluster analysis, these items clustered with other adult hunger items: Questions 28, 35 and 38. However, for these analyses, Questions 24 and 32 were grouped with the other Household Food Depletion items because we did not feel that they were severe enough to signify the presence of adult hunger, but instead represent food depletion. Both Radimer et al. (1992) and Hamelin et al. (2002) explain that *household food depletion* is often expressed by parents, and mothers in particular, as adults “going without” in order to ensure that their children have enough food to eat.

Hamelin et al. stated, “The child was central to the life of households to the point where it influenced the way adults interpreted a lack of food, as well as how they distributed and managed food resources within their household... Often parents, particularly women, would deprive themselves to protect their children against hunger. Parents’ needs clearly came second” (p. 127). Parents often economized food by cutting the size of or skipping meals, or by not sharing equally in the variety of foods served. Another possible approach to this issue would be to categorize Questions 24 and 32 with adult hunger, yet increase the number of positive responses needed for a household to be classified as experiencing adult hunger.

In contrast to the above discussion, this re-analysis discovered the existence of households that exhibit Child Hunger without Adult Hunger. This is an important finding that has not been previously exposed -- that parents do not *always* report restricting their food intake before they allow children to go hungry. In fact, approximately 19% of all households with Hunger are labeled as having Child Hunger but not Adult Hunger. It may be that adult food restriction in these families has become so normalized that the respondent failed to connect it with the adult hunger questions, or it may be a real phenomenon. However, considering that an estimated 896,000 children in the U.S. were determined to be victims of child abuse during 2002, and that the most common form of child abuse is neglect, it is imperative that this issue be explored further (U.S. Department of Health and Human Services, 2004).

Lastly, this analysis did not take into consideration follow-up questions available for some items on the frequency of occurrence. Future work should look at the best approach to the measurement of food insecurity and hunger may want to take these response patterns into consideration.

Conclusions

This paper summarized the current conceptualization of the phenomenon of food insecurity as it is experienced by families in North America. Using the cluster analysis of items from the 1995 CPS HFSSM and substantive concerns, the items from the 1995 HFSSM were placed into the components of food insecurity and its outcomes, based on this conceptualization of food insecurity. A re-analysis of the 1995 CPS HFSSM data using these new sources of information was then conducted. These findings enhance the information currently available about how best to measure the prevalence, determinants, outcomes and consequences of food insecurity and hunger as it is experienced by families in the United States.

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Appendix

Figure 1 Here

Table 1. 18-item core questions from April 1995 HFSSM and additional questions under consideration.

18 item core	Q24: In the last 12 months, did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn't enough money for food?
	Q25: In the last 12 months, did (you/you or other adults in your household) ever cut the size of your meals or skip meals in three or more months because there wasn't enough money for food?
	Q28: In the last 12 months, did (you/you or other adults in your household) ever not eat for a whole day because there wasn't enough money for food?
	Q29: In the last 12 months, did (you/you or other adults in your household) ever not eat for a whole day in three or more months because there wasn't enough money for food?
	Q32: In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?
	Q35: In the last 12 months, were you every hungry but didn't eat because you couldn't afford enough food?
	Q38: In the last 12 months, did you lose weight because you didn't have enough money for food?
	Q40: In the last 12 months, did you ever cut the size of (your child's/any of the children's meals because there wasn't enough money for food?
	Q43: In the last 12 months, did (child's name/any of the children) ever skip meals because there wasn't enough money for food?
	Q44: In the last 12 months, did (child's name/any of the children) ever skip meals in three or more months because there wasn't enough money for food?
	Q47: In the last 12 months, (was your child/ were your children) hungry but you just couldn't afford more food?
	Q50: In the last 12 months, did (your child/any of the children) ever not eat for a whole day because there wasn't enough money for food?
	Q53: (I/We) worried whether (my/our) food would run out before (I/we) got money to buy more.
	Q54: The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more.
	Q55: (I/We) couldn't afford to eat balanced meals.
	Q56: (I/We) couldn't feed (my/our) (child/the children) a balanced meal, because (I/we) couldn't afford that.
	Q57: (My/Our child was/The children were) not eating enough because (I/we) just couldn't afford enough food.
	Q58: (I/We) relied on only a few kinds of low-cost food to feed (my/our) (child/the children) because (I was/we were) running out of money to buy food.
Additional Items	Q18: In the last 12 months, did you ever get or borrow food from others because you didn't have enough money to buy food?
	Q19: In the last 12 months, did you ever send your children to a relative or friend's house to eat because you didn't have enough food to feed them?
	Q20: In the last 12 months, did you ever serve only a few kinds of low-cost foods – like rice, beans, macaroni products, bread or potatoes – for several days in a row because you couldn't afford anything else?
	Q21: In the last 12 months, did you ever put off paying a bill in order to buy food?
	Q22: In the last 12 months, did you (or other adults in your household) ever get food from a church, a food pantry, or food bank?
	Q23: In the last 12 months, did you (or other adults in your household) ever eat meals at a soup kitchen?

Table 2. Placement of the items from the HFSSM from the April 1995 CPS into the Conceptual Model of Food Insecurity

Food Insecurity	
Worry about Household Food Supply	Q53
Socially Unacceptable Food Sources	Q22, Q23
Food Depletion	Q54, Q24, Q32
Household Quality	Q20, Q55, Q56, Q57, Q58
Adult Hunger (Restriction)	Q35, Q38, Q28
Child Hunger (Restriction)	Q40, Q43, Q47, Q50

Figure 2. HCA/CCPROX Cluster Analysis Output for April 1995 CPS HFSSM Data. Clusters within each level (column) are separated by “”.**

Level of hierarchical cluster:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
**	**	**	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
55	55	55	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56	56
**	56	56	**	**	**	**	**	20	20	20	20	20	20	20	20	20	20	20
56	**	**	20	20	20	20	20	**	**	**	**	**	**	**	40	40	40	40
**	20	20	**	**	**	**	**	40	40	40	40	40	40	40	47	47	47	47
20	**	**	40	40	40	40	40	**	**	47	47	47	47	47	43	43	43	43
**	40	40	**	**	**	**	**	47	47	**	**	**	**	43	**	**	**	24
40	**	**	47	47	47	47	47	**	**	43	43	43	43	**	24	24	24	32
**	47	47	**	**	**	**	**	43	43	**	**	**	**	24	32	32	32	35
47	**	**	43	43	43	43	43	**	**	24	24	24	24	32	35	35	35	28
**	43	43	**	**	**	**	**	24	24	32	32	32	32	35	28	28	28	38
43	**	**	24	24	24	24	24	32	32	35	35	35	35	28	38	38	38	50
**	24	24	**	**	32	32	32	35	35	**	28	28	28	38	**	**	50	**
24	**	**	32	32	**	35	35	**	**	28	38	38	38	**	50	50	**	53
**	32	32	**	**	35	**	**	28	28	38	**	**	**	50	**	**	53	54
32	**	**	35	35	**	28	28	**	38	**	50	50	50	**	53	53	54	18
**	35	35	**	**	28	**	**	38	**	50	**	**	**	53	54	54	18	21
35	**	**	28	28	**	38	38	**	50	**	53	53	53	54	18	18	21	19
**	28	28	**	**	38	**	**	50	**	53	54	54	54	18	21	21	19	22
28	**	**	38	38	**	50	50	**	53	54	18	18	18	21	19	19	22	23
**	38	38	**	**	50	**	**	53	54	18	21	21	21	19	**	22	23	
38	**	**	50	50	**	53	53	54	18	21	**	19	19	**	22	23		
**	50	50	**	**	53	54	54	18	21	**	19	**	**	22	23			
50	**	**	53	53	54	**	18	21	**	19	**	22	22	23				
**	53	53	54	54	**	18	21	**	19	**	22	**	23					
53	**	54	**	**	18	21	**	19	**	22	**	23						
**	54	**	18	18	21	**	19	**	22	**	23							
54	**	18	**	21	**	19	**	22	**	23								
**	18	**	21	**	19	**	22	**	23									
18	**	21	**	19	**	22	**	23										
**	21	**	19	**	22	**	23											
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