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Measuring Children's Food Security in U.S. Households, 1995-99

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Abstract

The capacity to accurately measure the food security status of children in household surveys is an essential tool for monitoring food insecurity and hunger at the most severe levels in U.S. households and for assessing programs designed to prevent or ameliorate these conditions. USDA has developed a children's food security scale to meet this measurement need. The scale is calculated from 8 questions in the 18-item food security survey module that ask specifically about food-related experiences and conditions of children. The scale measures the severity of food insecurity among children in surveyed households and identifies—in the most severe range of the scale—households in which children have been hungry at times because of a lack of household resources for food. The reliability of the children's food security scale is assessed, and the scale is compared with the household-level food security scale. Details are provided on how to calculate the children's food security scale from the questions in the standard food security survey module. The prevalence of hunger among children in U.S. households is estimated by applying the newly developed children's food security scale to data from the nationally representative Current Population Survey Food Security Supplements for the years 1995-99. Prevalence estimates are presented for all U.S. households and for subgroups defined by household structure, race and ethnicity, income, and rural/urban residence.

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Summary

The ability to accurately measure the food security status of children in household surveys is an essential tool for monitoring food insecurity and hunger at the most severe levels in U.S. households and for assessing programs designed to prevent or ameliorate these conditions. A tool for this purpose, the "children's food security scale" has been developed by USDA. The children's food security scale is based on 8 questions in the 18-item food security survey module that ask specifically about food-related experiences and conditions of children. It measures the severity of food insecurity among children in surveyed households and identifies households in which children were hungry at times during the previous year because the household lacked enough money for food.

Applied to survey data from the nationally representative Current Population Survey Food Security Supplements, the new measure indicates that during the year ending in April 1999, children were hungry at times in 219,000 U.S. households, or 0.6 percent of all households with children. The corresponding statistic for the year ending in August 1998 was 331,000 households, representing 0.9 percent of all households with children.

To provide more stable prevalence estimates for subpopulations, statistics are averaged across 2 years, 1998-99. The average annual prevalence of hunger among children during this 2-year period was 0.7 percent. The prevalence of hunger among children was higher in single-mother families (1.8 percent) and in families headed by Blacks (1.3 percent) and Hispanics (1.4 percent).

The prevalence rate of children's hunger declined from 1995, when household food security and hunger were first measured nationally in the United States, to 1999. During this period, the prevalence of children's hunger declined by about half, from 1.1 percent of all households with children in 1995 to 0.6 percent in 1999. The fall in hunger prevalence among children extended to all major demographic and income categories, including those most vulnerable to hunger.

The children's food security scale is assessed statistically and found to be adequately reliable and to be stable across years. The scale is compared with the household-level food security scale, and discrepancies between the two scales are found to result from identifiable household characteristics, especially the ages of children. Details are provided on how to calculate the children's food security scale from the questions in the standard food security survey module.

Measuring Children's Food Security in U.S. Households, 1995-99

Mark Nord and Gary Bickel

Introduction

An important objective of public policy in the United States for more than 50 years has been to reduce, and ultimately to eliminate, childhood hunger in America. Food sufficiency and diet quality have long been recognized as vital for children's health, development, and general well-being. Beginning with the National School Lunch Program in 1946, several of the major Federal food assistance programs have been aimed specifically at assuring adequate nutrition for children. The capacity to accurately measure the food security status of children in household surveys and to identify the occurrence of resource-constrained hunger among children is an essential tool for monitoring the prevalence of children's hunger and for assessing programs designed to address it. Developing appropriate methods to meet this need has been a prime objective of the Federal interagency food security measurement project in recent years.[1]

The Federal Government has measured and reported the extent and severity of food insecurity and hunger in U.S. households annually since 1995, including estimates of the number of children in food-insecure households and in households with one or more members going hungry at times because of lack of money for food. However, the total number of children in all households with hunger substantially overstates the number of *children* experiencing hunger. In most such households, only adult members go hungry, while the children—especially young children—are shielded by adults from that more severe level of food deprivation (Hamilton et al., 1997a).

On the other hand, the initial effort made to identify households in which children had been hungry by means of a more severe category of the household scale had the opposite bias, i.e., it *understated* the number of households with hunger among children. Hamilton et al. (1997a; 1997b), in the initial development of the household-level food security measure, specified a "severe hunger" category that was intended primarily to identify households with hunger among children. This effort to find such a proxy measure for children's hunger was consistent with the objective of the project at that time to develop a single, unified, household-level measure of severity. A substantial body of earlier research had found that, in the United States, children are generally shielded from hunger at less severe levels of household deprivation, including some level of hunger among adults. Typically, children begin to experience hunger only when hunger among adults in the household reaches more severe levels, e.g., when adults go whole days without eating. The household-level data from the Current Population Survey (CPS) Food Security Survey strongly confirmed these earlier findings, lending support to the idea that a "severe hunger" category of the general household measure could provide an acceptable proxy for households with children's hunger.[2] However, further examination showed that not all households with children conform to the modal pattern of not reporting hunger among

[1] The Federal interagency food security measurement project was organized in response to the National Nutrition Monitoring and Related Research Act of 1990, and the Ten-Year Plan developed under the Act. The project, under the leadership of USDA and DHHS, was assigned the task of developing "a standardized mechanism and instrument(s) for defining and obtaining data on the prevalence of 'food insecurity' or 'food insufficiency' in the U.S. and methodologies that can be used across the [National Nutrition Monitoring] Program and at State and local levels." For further information on the project, see Hamilton et al. (1997a) and Carlson, Andrews, and Bickel (1999).

[2] The CPS Food Security Survey is fielded annually as the Food Security Supplement to the Census Bureau's regular Current Population Survey (CPS). USDA sponsors collection of the Food Security Supplement while the Bureau of Labor Statistics sponsors the monthly labor-force core of the CPS. The shorter "CPS Food Security Survey" designation is used throughout this report for ease of communication.

children until adult hunger in the household reaches a severe level (such as adults going a whole day without eating). Evidence of children's hunger is reported in a substantial number of households that have only moderate hunger among adults. It became apparent, therefore, that the prevalence of children's hunger is understated by the prevalence of "severe hunger" as measured at the household level (Carlson et al., 1999).

To address this concern and to achieve valid estimates of the prevalence of hunger among children, a new children's food security scale has been developed, building on 5 years of analysis of CPS Food Security Survey data.[3] This children's food security scale is calculated from eight survey items that ask specifically about food-related experiences and conditions of children in the household. The scale's purpose is to measure the food security status of children and, specifically, to identify households in which one or more children have been hungry at times during the year because there was not enough money for food in the household.

The 8 child-referenced items are a subset of the 18 survey items on which the household food security scale is based (see appendix A for the full food security survey module). Like the household- and adult-referenced items in the scale, the child-referenced items ask about food deprivation experiences and conditions across a wide range of severity. For example, the least severe child-referenced item is:

"We relied on only a few kinds of low-cost food to feed the children because we were running out of money to buy food." Was that often, sometimes, or never true for you in the last 12 months?

An item at midrange is:

In the last 12 months, did you ever cut the size of the children's meals because there wasn't enough money for food?

And the most severe item is:

In the last 12 months, did any of the children ever not eat for a whole day because there wasn't enough money for food?

Households that affirmed five or more of the eight child-referenced items are classified as having hunger among children. Typically, a household just past the threshold of this severity range will have affirmed all of the following:

1. They relied on only a few kinds of low-cost food to feed the children because they were running out of money to buy food;
2. They couldn't afford to feed the children balanced meals;
3. The children were not eating enough because the household just couldn't afford enough food;
4. They cut the size of children's meals because there wasn't enough money for food;
5. The children were hungry but they just couldn't afford more food.

All of the items in the scale are presented and discussed in detail in chapter 2.

Two aspects of the scale should be kept in mind when interpreting the prevalence rates in this report. First, although this new measure is child-specific, it is still a household-level scale. That is, it identifies *households* with hunger among children. More precisely, it identifies households in which *at least one* child (age 0-17) has been hungry at times during the year because of constrained household resources. This does not mean that all children in the household necessarily were hungry. Research described in later chapters shows that younger children are protected from hunger and reduced food intake at much more severe levels of adult deprivation than are older children. The CPS Food Security Survey does not ask about the experience of each child separately, but only about whether *any* child in the household experienced the various forms of food deprivation. Thus, when a household with several children of varying age affirms items evidencing children's hunger, this may mean that all the children were hungry at times because of constrained household resources, or it may mean that an older child was hungry while younger children were shielded from hunger.

[3] This children's food security scale was initially described in Nord and Bickel, 1999.

Thus, the number of children living in households with children's hunger provides an upper-bound estimate of the actual number of hungry children in the Nation. A lower-bound estimate is provided by the number of households with hungry children, since at least one child in each of these households has been hungry because of a lack of money for food. The substantial difference between these upper- and lower-bound estimates are inherent in the CPS Food Security Survey design. Thus, while the statistics presented in this report are the most reliable currently available, they do not provide a highly precise answer to the question, "How many hungry children are there in the Nation?"

The second aspect of the scale that should be kept in mind is that it describes experiences and conditions over the entire 12-month period preceding the survey. Nationally, children in 219,000 U.S. households were hungry at times during the year that ended in April 1999 because of the households' food insecurity. This does not mean that these households were unable to provide enough food for the children every day, or even every month.

Research reported elsewhere suggests that the number of households with hunger among children some time during an average month is about 60 percent of the annual prevalence rate, while the daily prevalence is lower still—about 13 percent of the annual rate (Nord, Andrews, and Winicki, 2000).

Chapter 1 summarizes the annual prevalence of hunger among children in U.S. households, based on the children's food security scale. Prevalence rates of hunger among children in 1998 and 1999 are presented for all U.S. households with children and by household structure, race and ethnicity, income, and rural/urban residence. Annual trends are summarized from 1995 to 1999. Information from the household food security scale is then combined with information from the children's food security scale to provide a broader picture of the food security situation of the Nation's children.

The remainder of the report documents the measurement methodology. Chapter 2 describes the children's food security scale and discusses theoretical, statistical, and methodological issues regarding it. Chapter 3 explores the relationship between the hunger range of the children's food security scale and the conceptually similar "severe-hunger" range of the household scale. Appendix A presents the questions in the food security core survey module, and appendix B describes how to calculate the children's food security scale from the child-specific items in the core module.

Chapter 1

The Prevalence of Hunger Among Children in U.S. Households

Overview

During the year ending in April 1999, one or more children were hungry at times in 219,000 U.S. households, or 0.6 percent of all households with children (table 1). The comparable statistic for the year ending in August 1998 was 331,000 households, representing 0.9 percent of all households with children.

The difference between the 2 years represents, in part, a decline in the prevalence of hunger among children,

Table 1—Households with hunger among children, 1998 and 1999

Household characteristics	Total households with children			Households with hunger among children					
	1998	1999	Average	1998	1999	Average	1998	1999	Average
	1,000						*Percent*		
All households with children	38,036	37,884	37,960	331	219	275	0.9	0.6	0.7
Household structure:									
Married-couple families	26,306	26,303	26,305	105	75	90	.4	.3	.3
Female head, no spouse	8,807	8,744	8,775	193	123	158	2.2	1.4	1.8
Male head, no spouse	2,153	2,187	2,170	20	17	19	.9	.8	.9
Other households with child[1]	770	650	710	14	3	9	1.8	.5	1.2
With children under age 6	17,087	17,231	17,159	85	69	77	.5	.4	.4
Race and ethnicity:[2]									
White non-Hispanic	25,750	25,431	25,591	145	95	120	.6	.4	.5
Black non-Hispanic	5,645	5,413	5,529	98	54	65	1.7	1.0	1.3
Hispanic[3]	4,844	5,373	5,109	76	54	76	1.6	1.0	1.4
Other non-Hispanic	1,797	1,667	1,732	13	15	14	.7	.9	.8
Household income-to-poverty ratio:									
Under 1.00	6,012	5,701	5,857	178	111	144	3.0	1.9	2.5
Under 1.30 (includes under 1.00)	8,162	7,583	7,872	238	129	184	2.9	1.7	2.3
Under 1.85[4] (includes under 1.30)	12,777	11,702	12,239	282	177	229	2.2	1.5	1.9
1.85 and over[4]	21,943	22,504	22,224	37	38	38	.2	.2	.2
Area of residence:									
Inside metropolitan area	30,729	30,790	30,759	251	193	222	.8	.6	.7
In central city[5]	9,160	9,004	9,082	112	64	88	1.2	.7	1.0
Not in central city[5]	16,210	16,616	16,413	118	104	111	.7	.6	.7
Outside metropolitan area	7,308	7,094	7,201	80	26	53	1.1	.4	.7

[1] Households with children in complex living arrangements, e.g., children of other relatives or of unrelated roommate or boarder.

[2] Race/ethnicity of household reference person.

[3] Hispanics may be of any race.

[4] Subtotals do not add to national total because income is not reported for 8.7 percent of households.

[5] Subtotals do not add to metropolitan area total because central city residence is not identified for some households.

Source: Calculated by ERS from Current Population Survey Food Security Supplement data, August 1998 and April 1999, based on the children's food security scale.

and in part a seasonal difference (Andrews et al., 2000). The CPS Food Security Survey has been administered in the spring and fall in alternate years. Even though the questions ask about experiences and conditions over the past 12 months, there is evidence of a moderate seasonal effect in the measured prevalence rates of household food insecurity and hunger, with rates being somewhat higher in the fall (Andrews et al., 2000). For this reason, average rates for the 1998 and 1999 surveys are presented in table 1 and are the main reference for the rest of the discussion in this section. In addition to smoothing out any seasonal component, these 2-year averages are less affected by sampling variability, which can be problematic for some of the smaller subpopulations for which prevalence rates are reported.

Prevalence of Children's Hunger, by Household Characteristics

Single-parent families, and especially single-mother families, are at higher risk of children's hunger than are two-parent families. The prevalence of children's hunger was six times as high in single-mother families as in two-parent families (1.8 percent compared with 0.3 percent). Single-mother families comprised 23 percent of all households with children, but accounted for 57 percent of households with hunger among children. The prevalence of hunger among children was also above the national average in single-father families (0.9 percent), although this rate was only half that of single-mother families.

Children's hunger is nearly three times more prevalent among racial and ethnic minorities than among the majority population. Children were hungry at times during the year in 1.3 percent of Black households and 1.4 percent of Hispanic households, compared with 0.5 percent of White non-Hispanic households. These differences are associated primarily with the lower incomes and higher poverty rates of minority households.

Hunger, as measured by the CPS Food Security Survey, is specifically "resource constrained" hunger. Every question in the scale specifies lack of money to buy food as the reason for the experience or condition. Hunger is expected, therefore, to be strongly associated with income, and this is, indeed, the case. Children's hunger was about 10 times as prevalent among households with incomes below 185 percent of the official poverty line as for those with incomes above that line. In households below this income threshold, children are eligible for reduced-cost meals under the USDA School Lunch and School Breakfast Programs; infants, young children, and pregnant or breast-feeding mothers are eligible for WIC supplemental foods; and children's meals in the Child and Adult Care Food Program are reimbursed at higher levels.[4] At still lower levels of income, hunger was yet more prevalent; 2.5 percent of households with annual incomes below the official poverty line reported that children were hungry at times during the year, compared with 0.2 percent of households with incomes above 185 percent of the poverty line.

Rural and urban areas reported similar prevalence rates of children's hunger overall (0.7 percent), although the rate in central cities of metropolitan areas was somewhat higher (1.0 percent). The prevalence of hunger might be expected to be higher in nonmetropolitan than in metropolitan areas because the poverty rate is higher in nonmetropolitan areas. However, the metropolitan-nonmetropolitan pattern of children's hunger is consistent with that for food insecurity and hunger of all households (Andrews et al., 2000; Bickel, Carlson, and Nord, 1999). Lower costs of living in rural areas probably account for part of this hunger/poverty disjuncture. Poverty calculations do not take cost-of-living differences among areas into account while measures of food insecurity and hunger directly gauge the severity of food deprivation resulting from lack of purchasing power. If living costs, on the whole, are lower in rural areas, even a poverty level income could stretch farther there, resulting in less food deprivation than in urban areas.

How Many Children Were Hungry?

Larger families are somewhat more vulnerable to hunger than smaller families, so the proportion of the Nation's *children* who live in households with children's hunger is slightly higher than the proportion of *households* with children's hunger. On average in 1998 and 1999, some 613,000 children (0.9 percent of all children) lived in the 275,000 households (0.7 percent of all households with children) where children's hunger occurred (table 2).

[4] The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides targeted supplementary foods in conjunction with health care to women during and after pregnancy, to infants, and to children through age 4.

Table 2—Children in households with hunger among children, 1998 and 1999

Household characteristics	Total children in all households			Children in households with children's hunger[1]					
	1998	1999	Average	1998	1999	Average	1998	1999	Average
	1,000						*Percent*		
All children	71,282	71,418	71,350	716	511	613	1.0	0.7	0.9
Household structure:									
Married-couple families	50,688	50,819	50,753	250	203	226	.5	.4	.4
Female head, no spouse	16,012	16,134	16,073	395	261	328	2.5	1.6	2.0
Male head, no spouse	3,452	3,526	3,489	52	29	41	1.5	0.8	1.2
Other households with child[2]	1,130	939	1,035	19	18	19	1.6	2.0	1.8
Race and ethnicity:[3]									
White non-Hispanic	46,515	45,934	46,224	256	191	223	.5	.4	.5
Black non-Hispanic	10,753	10,733	10,743	231	111	171	2.1	1.0	1.6
Hispanic[4]	10,685	11,485	11,085	193	147	170	1.8	1.3	1.5
Other non-Hispanic	3,329	3,266	3,298	36	63	50	1.1	1.9	1.5
Household income-to-poverty ratio:									
Under 1.00	13,801	13,301	13,551	416	297	357	3.0	2.2	2.6
Under 1.30 (includes under 1.00)	18,481	17,475	17,978	547	342	445	3.0	2.0	2.5
Under 1.855 (includes under 1.30)	27,381	25,840	26,610	621	429	525	2.3	1.7	2.0
1.85 and over[5]	38,950	40,472	39,711	80	73	76	.2	.2	.2
Area of residence:									
Inside metropolitan area	57,452	57,735	57,593	576	434	505	1.0	.8	.9
In central city[6]	17,552	17,231	17,392	249	148	198	1.4	.9	1.1
Not in central city[6]	30,190	31,002	30,596	281	238	260	.9	.8	.8
Outside metropolitan area	13,831	13,683	13,757	140	77	108	1.0	.6	.8

[1]Not all children were hungry in some households with hunger among children.

[2]Households with children in complex living arrangements, e.g., children of other relatives or of unrelated roommate or boarder.

[3]Race/ethnicity of household reference person.

[4]Hispanics may be of any race.

[5]Subtotals do not add to national total because income is not reported for 8.7 percent of households.

[6]Subtotals do not add to metropolitan area total because central city residence is not identified for some households.

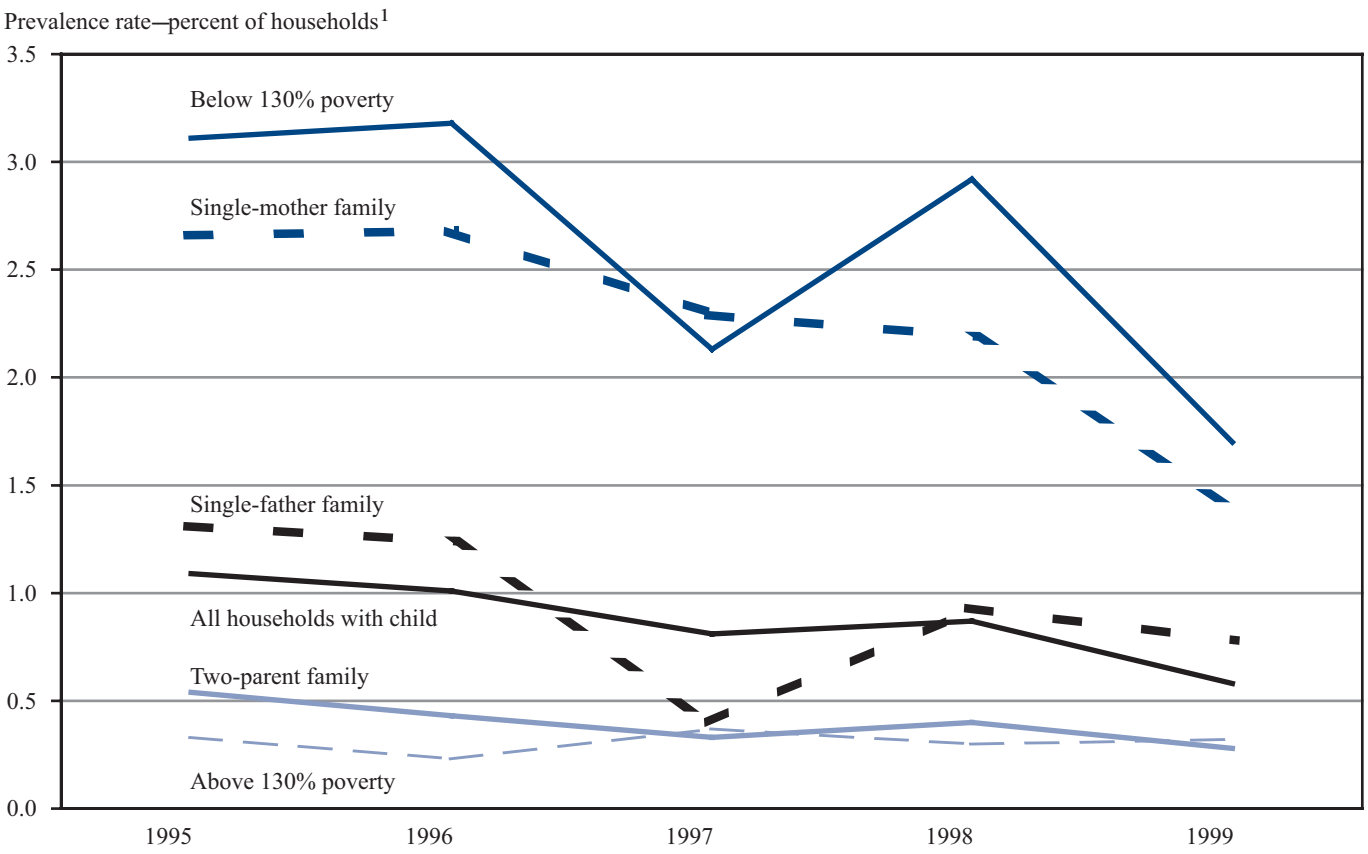
Source: Calculated by ERS from Current Population Survey Food Security Supplement data, August 1998 and April 1999, based on the children's food security scale.

However, as noted earlier, not every child in households reporting children's hunger experienced this resource-constrained hunger. The CPS Food Security Survey does not ask about the experience of each child separately, but rather whether any child in the household experienced various forms of food deprivation. In some households classified as having hunger among children, only the older children were hungry, while younger children were protected from hunger. Thus, the number of children living in households with children's hunger (613,000) provides an upper bound estimate of the actual number of hungry children in the Nation in this period. A lower-bound estimate is provided by the number of households with hungry children during the year (average 275,000 in 1998-99), since at least 1 child was hungry within each of these households.

Trends in the Prevalence of Children's Hunger, 1995-99

The prevalence rate of children's hunger declined substantially from 1995, when household food security and hunger were first measured nationally in the

Figure 1
Prevalence of children's hunger, 1995-99



[1]Households without children were excluded from the denominators.

Source: Calculated by ERS based on data from Current Population Survey Food Security Supplements 1995-99.

United States, to 1999 (fig. 1). Overall the prevalence of children's hunger declined by about half, from 1.1 percent of all households with children in 1995 to 0.6 percent in 1999.[5]

The fall in hunger prevalence among children extended to all major demographic and income categories, including those most vulnerable to hunger. The prevalence rate of children's hunger among single-mother families declined from 2.7 percent in 1995 to 1.4 percent in 1999. Even among low-income households, the prevalence of children's hunger declined by almost half from 3.1 percent in 1995 to 1.7 percent in 1999. The decline for two-parent families was similar in proportion, although the percentage-point decline was much smaller (0.5 percent in 1995 to 0.3 percent in 1999). Only in households with incomes above 130 percent of the poverty line was the prevalence of hunger unchanged from 1995 to 1999, remaining at about 0.3 percent.

[5] To avoid bias in the trend analysis due to seasonal differences in food insecurity, statistics from 1995 were compared with those from 1999 only, rather than to the 1998-99 averages. The food security survey was conducted in April in both 1995 and 1999. Data in figure 1 were not adjusted for inter-year differences in screening (Andrews et al., 2000; Bickel et al., 1999). These adjustments have a negligible effect on estimates of children's hunger because very few households with levels of deprivation this severe were affected by the screening protocol used in any year. In 1999, for example, the estimated prevalence of children's hunger based on the data as collected (the "full information" or "maximum sample" estimate presented in figure 1) was 0.58 percent, while the estimate for 1999 based on the common screen for strict comparability across all years 1995-99 was 0.55 percent.

Children in Food-Insecure Households

Children may be adversely affected by less severe levels of personal and household food deprivation than the range in which the children themselves experience resource-constrained hunger (Cook et al., 2001). A more comprehensive picture of children's food security status is provided by combining information from the household food security scale and the children's food security scale.[6] Households with hunger among children are a subset of households with hunger among adults, which, in turn, are a subset of food-insecure households.

A tabulation of households with children by these combined measures of food security is presented in table 3. In 1998, 82.4 percent of households with children were food secure, 13.3 percent were food insecure without hunger, 3.5 percent were food insecure with hunger among adults, but not children, and 0.9 percent were food insecure with hunger among both adults and children. In 1999, the corresponding percentages were 85.2 percent food secure, 11.5 percent food insecure without hunger, 2.7 percent food insecure with hunger among adults, but not children, and 0.6 percent food insecure with hunger among both adults and children.[7]

[6] An alternative approach, discussed in more detail in chapter 2, is to specify a less severe threshold on the children's food security scale and classify households vis-à-vis that threshold as well as the children's hunger threshold.

[7] A fourth category is logically possible, "food insecure with hunger among children but not adults." In data analyzed to date, no households were found in this category provided that the full 18-item scale is used to identify households with hunger among adults. However, if only the 10 adult and household items are used to identify hunger among adults (using the scale that is normally applied to households without children), then a small proportion of households are classified as having hunger among children but not among adults.

It should be noted that this tabulation combines information from two scales and does not represent a single underlying continuous scale of severity combining household-level and child-specific items. No such scale can adequately represent both household and child-specific food insecurity because these two phenomena, while closely related, lie on slightly different dimensions. See chapter 3 for a full discussion of the bidimensionality in the 18-item set.

Table 3—Food security and hunger status of households with children, 1998 and 1999

Household characteristics	Total	Food secure		Food insecure					
				Without hunger		With hunger among adults, but not children		With hunger among adults and children	
	1,000	*1,000*	*Percent*	*1,000*	*Percent*	*1,000*	*Percent*	*1,000*	*Percent*
	Panel A: Households with children, 1998								
All households with children	38,036	31,335	82.4	5,049	13.3	1,321	3.5	331	0.9
Married-couple families	26,306	23,284	88.5	2,468	9.4	449	1.7	105	.4
Female head, no spouse	8,807	5,692	64.6	2,183	24.8	739	8.4	193	2.2
Male head, no spouse	2,153	1,727	80.2	308	14.3	98	4.6	20	.9
Other households with child[1]	770	632	82.1	89	11.6	35	4.5	14	1.8
Household income < 130% poverty	8,162	4,556	55.8	2,581	31.6	787	9.6	238	2.9
	Panel B: Households with children, 1999								
All households with children	37,884	32,290	85.2	4,340	11.5	1,035	2.7	219	0.6
Married-couple families	26,303	23,771	90.4	2,105	8.0	353	1.3	75	.3
Female head, no spouse	8,744	6,146	70.3	1,890	21.6	586	6.7	123	1.4
Male head, no spouse	2,187	1,817	83.1	280	12.8	72	3.3	17	.8
Other households with child[1]	650	556	85.6	66	10.1	25	3.8	3	.5
Household income < 130% poverty	7,583	4,525	59.7	2,278	30.0	651	8.6	129	1.7

[1]Households with children in complex living arrangements, e.g., children of other relatives or of unrelated roommate or boarder.

Source: Calculated by ERS from Current Population Survey Food Security Supplement data, August 1998 and April 1999.

Chapter 2

The Children's Food Security Scale

The 18 items in the household food security scale include:

- 3 items that ask about experiences of the entire household
- 7 items that ask about experiences and behaviors of the adult members of the household as a group, or of the adult respondent individually
- 8 items that ask about experiences and conditions of the children in the household as a group.

The eight child-referenced items are used to calculate the children's food security scale, a graduated, continuous measure of the severity of food insecurity among children in the household. The scale provides the framework for a corresponding categorical measure of households with children's hunger. This latter measure classifies households as to whether or not the severity of food deprivation reported over the previous 12 months gives clear evidence of hunger among the children in the household. We begin this chapter with a conceptual description of the children's food security scale and of the categorical threshold that identifies households with children's hunger. We then describe statistical assessments of the scale items and of the overall reliability of the scale. The conceptual description is intended to be accessible to all interested readers. The description of the statistical model and its applications is somewhat technical and a moderate level of statistical knowledge is required to understand that section. Detailed information on implementing the children's food security scale is presented in appendix B.

Conceptual Basis of the Children's Food Security Scale

An essential characteristic of both the household food security scale and the children's food security scale is that the items comprising them vary across a wide range of severity of food insecurity. The precise severity level of each item (the "item calibration," discussed below) is estimated empirically from the overall pattern of response to the scale items by U.S. households. However, the range of severity of the conditions identified by the items is also intuitively evident from inspection of the items. In the children's food security scale, for example, the item, *children not eating for a whole day*, is a more severe manifestation of food insecurity than is the item, *cutting the size of children's meals*, and the latter indicates a more severe level of food insecurity than does the item, *relied on a few kinds of low-cost food to feed the children*. These differences in severity are observed in the response patterns of surveyed households. The more severe items are less frequently affirmed than less severe items. Moreover, a household that affirms an item of midrange severity is likely to have also affirmed all items that are less severe. Similarly, a household that denies an item at midrange is likely to deny all items that are more severe. These typical response patterns are not universal, but they are predominant. And among households that do deviate from the typical patterns, the extent of deviation tends to be slight.

This highly regular pattern of severity ordering of the food security indicator items is the basis of the statistical model used to calculate and assess the food security scales. The statistical model expresses and summarizes in succinct quantitative form the consistently ordered pattern that exists in the U.S. population of the diverse conditions, experiences, and behavioral responses that identify, and to some extent constitute, the phenomenon of food insecurity.[8] This underlying ordering of the items measuring food insecurity through successive levels of severity also provides a framework for relating

[8] While the indicator items are diverse in nature, reflecting the inherent multidimensionality of the phenomenon of food insecurity, the highly ordered response pattern among the items reveals an underlying unifying dimension as well—the severity of the phenomenon, as experienced by the surveyed households. This empirical property—the ordered character of the responses—enables the response data to be fitted to unidimensional scale measures of severity both at the household and child-specific levels. The importance of these unidimensional severity scales is, first, that they represent a higher order of measurement than simple categorical or ordered measures, and second, that they provide a methodologically sound basis for estimating the prevalence of specified ranges of severity of food insecurity.

the total number of items affirmed by a household (the household's "raw score") to the conditions existing within the household. For example, households with a raw score of 5 can be characterized as having affirmed the five least severe items and having denied the remaining three more severe items. We can draw on this property of the item set to select an appropriate threshold, in terms of household raw score, to identify households with children's hunger. Table 4 lists the 18 items in the household food security scale, ordered by severity as measured in 1998. The item calibration (described in more detail later in this chapter) is a measure of the severity of each item as inferred statistically from the pattern of responses of all households to all items.

The items in the children's food security scale are particularly strongly ordered. In 1995, among households that affirmed at least one item but not all items, 78 percent conformed exactly to the most typical, or modal, pattern described above.[9] That is, these "modal households" affirmed one or more items, beginning with the least severe and continuing in order of increasing severity until, beginning at some particular level of severity for each household, they then denied all of the more severe items. Furthermore, among all households with children, few of the responses that were not perfectly ordered departed very far from this characteristic pattern.

Identifying Households with Children's Hunger—The Categorical Measure

The strong ordering of the indicator items justifies using the household raw scores to identify households with children's hunger. We set the threshold for identifying

[9] Data from 1995 were used for this assessment of modality because the 1998 and 1999 questionnaires included internal screens to reduce respondent burden that also had the effect of artificially suppressing highly nonmodal responses.

Table 4–Item calibrations based on August 1998 Current Population Survey Food Security Supplement data

Reference	Item description	Item calibration[1]
Household	Worried food would run out	1.488
Household	Food bought didn't last	2.793
	Food-insecurity threshold on household scale	
Child	Relied on a few kinds of low-cost food for children	3.268
Household	Couldn't afford to eat balanced meals	3.669
Child	Couldn't feed the children a balanced meal	5.040
Adult	Adult cut size of meals or skipped meals	5.374
Adult/respondent	Respondent ate less than felt he or she should	5.534
	Hunger threshold on household scale (identifies households with hunger among adults)	
Adult	Adult cut or skipped meals, 3 or more months	6.424
Child	Children were not eating enough	6.661
Adult/respondent	Respondent hungry but didn't eat	7.545
Adult/respondent	Respondent lost weight	8.613
Child	Cut size of child's meals	8.791
	Severe hunger threshold on household scale; children's hunger threshold on children's food security scale	
Adult	Adult did not eat for whole day	9.122
Child	Child hungry but couldn't afford more food	9.240
Adult	Adult did not eat for whole day, 3 or more months	9.934
Child	Child skipped meal	9.935
Child	Child skipped meals, 3 or more months	10.627
Child	Child did not eat for whole day	11.944

[1] Calibrations are based on the standard computational metric (i.e., with discrimination parameter of 1 and mean item calibration of 7; see Bickel et al., 2000).

Source: Calculated by ERS based on August 1998 Current Population Survey Food Security Supplement data.

children's hunger at a raw score of five items affirmed. Thus, a household just below this threshold level of severity—almost, but not quite, severe enough to be classified as having hunger among children—will have affirmed four items, typically the four least severe items. That is, the household will report that:

- They often or sometimes relied on only a few kinds of low-cost food to feed the children because they were running out of money to buy food.
- They often or sometimes couldn't feed the children a balanced meal because they couldn't afford that.
- The children were not eating enough because they just couldn't afford enough food.
- They cut the size of the children's meals because there wasn't enough money for food.

A typical household just beyond the threshold—just severe enough to be classified as having hunger among children—will have affirmed those same four items, *and in addition* will have reported that:

- The children were hungry but they just couldn't afford more food.

This last item may be described as the "threshold item" for the range of severity on the measurement scale that corresponds to the category, "food insecure with children's hunger." The subsequent items within that range, children skipping meals and children not eating for a whole day, are measurably more severe as indicators of children's hunger than the threshold item. Thus, all of the households classified by this method as having children's hunger will have affirmed one or more child-hunger items that are at least as severe as the threshold item. A small proportion (around one-fourth) of the borderline households—those whose response pattern places them just within the children's hunger category—will have denied the threshold item and instead will have affirmed an item that is *more severe* than the threshold item.

In the original work to develop the U.S. household food security scale, Hamilton et al. (1997a) made the first effort to identify households with hunger among children by defining a "severe hunger" category on the 18-item household scale. This household-level severe-hunger category was developed by first identifying the range of severity of children's hunger in households with children, establishing the same line of reasoning that is followed in the current study. That is, a "shadow" threshold for children's hunger was first identified in the sequence of child-referenced items, as these were combined with the household- and adult-referenced items in the 18-item scale. The "shadow" threshold item was *The children were hungry but we just couldn't afford more food*, which is the same item we have identified as the threshold for the children's hunger range. Then, since an objective of the household scale was that it be consistently applied across all households—both with and without children—the adult-referenced item most nearly corresponding in severity to the "shadow" threshold was designated as the household-level threshold indicator defining the severe-hunger range, or severe-hunger category, for all household types. The threshold item selected was *Adult did not eat for whole day*.

With regard to the child-referenced items, the original severe-hunger threshold corresponds exactly to the children's hunger threshold specified in the current report. However, even though the thresholds are the same in the two scales, the children's food security scale identifies a substantially larger number of households with hungry children. In chapter 3, we discuss the reasons for this difference in prevalence estimates and classification between the severe-hunger category on the household scale and the children's hunger category on the children's food security scale.

Not only is the children's hunger threshold specified in this report consistent with the corresponding severe-hunger threshold in the household-level scale, it also is conceptually consistent with the operational principles developed in setting the household-level hunger threshold on the 18-item scale—in effect, the corresponding adult-hunger threshold. The operational rule of thumb that emerged in the development of the original scale and its associated categorical measure (Hamilton et al., 1997a, 1997b) required that a household affirm multiple indicators of reduced food intake to be classified "food insecure with hunger." This extent of reduced food intake and disruption of eating patterns indicates the likelihood of the direct experience of hunger—i.e., "the uneasy or painful sensation caused by a lack of food" (Anderson, 1990, following the *Oxford English Dictionary*). This is a methodologically conservative decision rule, designed to minimize false-positive classifications. Similarly, to pass the children's hunger threshold, at least three indicators of reduced food intake among children are required: the children were not eating enough, the size of children's meals was cut, and the children were hungry.

It is important to keep this methodological conservatism in mind when interpreting statistics from either the children's food security scale or the household-level food security scale. Although households beyond the respective thresholds can be labeled quite confidently as "food insecure," or "food insecure with hunger," or "food insecure with hunger among children," households with scores just below the thresholds cannot be described with as much confidence as "food secure," or "not having hunger," or "not having hunger among children." For example, some proportion of the households classified as not having hunger among children do, in fact, affirm one or two items indicating reduced food intake among children due to constrained household resources. In 1998, just under 1 percent of households were classified as food insecure with hunger among children. An additional 4.6 percent of households affirmed one or more items indicating reduced food intake among children. In some of these households, children may have been hungry at times because the family lacked money to buy food, yet these households are classified as not having hunger among children.

There are several detailed respects in which the child-hunger threshold is not precisely parallel to the adult-hunger threshold, due in each case to slight differences between the adult- and child-hunger indicator items available in the CPS food security data. One of these is that the third indicator of reduced food intake among adults—the threshold item for adult hunger—is an item indicating a *repeated pattern* of reduced food intake in 3 or more of the past 12 months. This represents an additional, temporal dimension indicative of increased severity of food insecurity. It also reflects a secondary formal conceptual definition of hunger presented in the 1990 Life Sciences Research Office report: "The recurrent and involuntary lack of access to food" (Anderson, 1990). A strictly parallel procedure in identifying the children's hunger threshold was not possible given the available data. Among the child-specific items, frequency information was collected only for the "skipped meals" question, which is comparatively a more severe indicator item than the threshold item for adult hunger, cutting the size of meals or skipping meals in 3 or more months.[10] In another sense, the children's hunger threshold might be viewed as relatively more severe than the adult threshold in that the children's hunger threshold item explicitly affirms that children were hungry, whereas the adult hunger threshold does not require this explicit affirmation for adults.

The discussion of the children's hunger threshold has, to this point, focused primarily on households located just beyond the threshold, those that affirmed exactly five items. However, most of the households classified as having children's hunger affirmed more than five items, indicating that they had experienced still higher levels of food stress. The distribution of response patterns of the households classified as having children's hunger provides a more accurate picture of the conditions and experiences of children in these households (table 5). Almost all households classified as having hunger among children affirmed the three least severe scale items. Nearly 83 percent affirmed the item that asked directly about whether children were hungry; 71 percent reported that children skipped meals because there wasn't enough money for food; and in one-fifth of the households with children's hunger, children went a whole day without eating.

Identifying a Less Severe Threshold of Food Insecurity Among Children

Children may be adversely affected by levels of food insecurity that are less severe than the hunger level (Cook et al., 2001), and may also be affected indirectly by food insecurity and hunger experienced by adults in the household. In an earlier paper (Nord and Bickel, 1999), we specified experimentally a less severe threshold on the children's food security scale that identified households in which the quality and variety of children's diets were reduced. Households that affirmed two or more of the child-referenced items—typically that they relied on a few kinds of low-cost food for the children and that they couldn't feed the children a balanced meal—were classified in that paper as having "reduced quality and variety of children's diet." Based on that threshold, 8.9 percent of households with children would be assigned to the category of reduced quality and variety of children's diets in 1998-99. We have not presented detailed statistics based on that threshold in the current report because there is as yet no expert consensus on whether such a boundary represents a meaningful increment in severity of children's food insecurity, and if it does, what language should be used to describe it. For example, it is not clear that the *nutritional quality* of

[10] The item that asks about adult hunger also differs from the parallel child item in being referenced only to the respondent, not to "you or other adults in the household."

Table 5–Proportion of households that affirmed child-referenced items, average 1998-99

Item	In all households with children	In households with hunger among children
	Percent	
Relied on a few kinds of low-cost food for children	15.4	98.8
Couldn't feed the children a balanced meal	8.9	96.0
Children were not eating enough	4.8	91.0
Cut size of child's meals	1.3	78.1
Child hungry but couldn't afford more food	1.0	82.8
Child skipped meal	0.7	70.8
Child skipped meals, 3 or more months	.5	58.4
Child did not eat for whole day	.2	20.2
Affirmed no items, or were screened out	83.5	0
Affirmed 1 item	7.6	0
Affirmed 2 items	4.2	0
Affirmed 3 items	3.2	0
Affirmed 4 items	.7	0
Affirmed 5 items	.3	43.8
Affirmed 6 items	.2	24.8
Affirmed 7 items	.2	24.1
Affirmed 8 items	.1	7.3

Note: Prevalences are based on household supplement weights to represent the national population.

Source: Calculated by ERS based on August 1998 and April 1999 Current Population Survey Food Security Supplement data.

children's diets is necessarily or significantly reduced beyond that particular threshold. More research and discussion are needed to establish a threshold that adequately represents a meaningful range of severity of food stress among children.[11]

An alternative approach, used in chapter 1 of this report, is to combine information from the household food security scale with information from the children's food security scale to provide a more comprehensive representation of the entire range of food stress and food deprivation in households with children. Households with hunger among children are a subset of households with hunger among adults, just as the latter are a subset of all food-insecure households.[12] Thus, combining the two scales provides a four-level categorical measure: food secure, food insecure without hunger, food insecure with hunger among adults but not children, and food insecure with hunger among both adults and children.

It is important to note, however, that this tabulation does not represent or reflect a single underlying continuous scale combining household-level and child-specific items. No such scale can adequately represent both household and child-specific food insecurity because these two aspects, while closely related, lie on slightly different dimensions of the general phenomenon. See chapter 3 for a full discussion of the bidimensionality in the 18-item set.

[11] The thresholds, or severity-range boundaries, specified with respect to the household food security scale were set, and language was selected to describe the resulting categories, by a team of experts on nutrition and food behavior (Carlson et al., 1999). These thresholds are necessary to create the categorical form of the food security measure (i.e., food secure, food insecure without hunger, food insecure with hunger) needed for monitoring changes in the prevalence of food insecurity and hunger. For this monitoring use, the designated categorical ranges are meaningful in their own right. However, whether these identifiable ranges of severity in the underlying phenomenon provide meaningful indicators for variation in the nutritional and health consequences of food stress and food deprivation is not yet known.

[12] It is logically possible for a household to register hunger among children but not among adults, but in the data sets examined to date—including 6 CPS Food Security Supplements and 3 other nationally representative data sets—no instance of this has been observed, provided that the full 18-item scale is used to identify households with hunger among adults. However, if only the 10 adult and household items are used to identify hunger among adults (using the scale that is normally applied to households without children), then a small proportion of households are classified as having hunger among children but not among adults.

Rasch Measurement Model: Basic Concepts

The 18-item household food security scale was developed through the use of Rasch modeling methods, and we used the same methods to create the 8-item children's food security scale. The Rasch measurement model provides powerful analytic tools to assess the suitability of a set of items for scale construction. We used it to assess the scalability of the child-referenced items and to assess the stability and reliability of the children's food security scale. In essence, the Rasch model formalizes the concept of the severity-ordering of items as discussed above and provides standard statistical measures of the extent to which the response patterns observed in a data set are consistent with this concept. A basic understanding of the Rasch statistical model will help to clarify the meaning of item severity and of other statistics used to assess the children's food security scale and the items that comprise it.

The Rasch model was developed primarily in the educational testing field, where multiple correct/incorrect items, varying in difficulty, are used to measure an individual's level of knowledge or skill. More generally, the model can be used to assess the location of an individual or household along a continuum—in the current case, a continuum of the severity of deprivation in the basic need for food—by combining information from multiple dichotomous (yes/no) items that vary as to the point on the continuum that each one uniquely reflects. This corresponds exactly to the character of the food insecurity/hunger measurement construct. There is no commonly used language that describes the entire continuum of food insecurity and hunger. People do not ask, "On a scale of 1 to 10, how food insecure is your household?" But people do speak readily about specific experiences, such as running out of money for food, and the specific behaviors and conditions that result, such as being forced to cut back on quality or quantity of food. Information about these experiences, behaviors, and conditions then, can be elicited by well-designed survey questions.

The food security scale works well as a measure because the behaviors and experiences represented by the 18 items in the scale correspond closely to the most prevalent experiences and responses of the U.S. population in coping with inadequate resources for food. This result was achieved by basing the questions upon a substantial body of research among low-income U.S. families regarding their experiences of food deprivation and how they described and coped with them. (Wehler et al., 1992; Radimer et al., 1990; Radimer et al., 1992; Fitchen, 1981; Fitchen, 1988). The questions reflect familiar conditions, experiences, and behaviors, and use natural language derived from the qualitative research to describe them. This set of conditions, experiences, and behaviors reflects the range of variation in severity across the continuum of food insecurity and hunger, just as the set of questions in a well-designed test vary in difficulty across an appropriate range in order to reflect accurately the level of knowledge of the test-taker.

Using the Rasch model to create a measure of food insecurity and hunger assumes that both the indicator items making up the scale and the households responding to the items can be located on the same underlying continuum of severity of food insecurity. It further assumes that the probability of a specific household affirming a specific item depends on the *difference* between the severity level of that household and the severity of that item. The single-parameter Rasch model, which is used to create the household food security scale as well as the children's food security scale, assumes specifically that the log of the odds of a household affirming an item is proportional to the difference between the "true" severity level of the household and the "true" severity level of the item. Thus, the odds that a household at severity level h will affirm an item at severity level i is:

$$p_{h,i}/q_{h,i}=e^{(h-i)}$$

where p is the probability of affirming the item, q is 1-p, that is, the probability the household will deny the item, and e is the base of the natural logarithms. The probability that the household will affirm the item is:

$$p_{h,i}=e^{(h-i)}/(1+e^{(h-i)})$$

The severity of an item, then, can be thought of as the severity level of households that are just at the threshold of affirming or denying that item. The odds that a household will affirm an item right at the "true" severity level of the household is 1, corresponding to a probability of 0.5. The odds that a household will affirm an item with a severity score 1 unit lower than that of the household is e^1, or about 2.7, corresponding to a probability of 0.73 [i.e., 2.7/(1+2.7)]. The probability that the household will affirm an item 2 units lower than its own severity measure is 0.88, and for an

item 3 units lower, it is 0.95. Since it is the *difference* between the household and item severity levels that determines the probability of affirmation, it is clear that the metric of the severity scale can be transformed by adding a constant to both household and item scores without changing the character of the scale. That is, the size of the intervals on the scale conveys meaningful information, but the zero point is arbitrary. The Federal interagency food security measurement project has adopted a standard computational metric for the 18-item scale based on a mean item score of 7 for the 18 items in order to keep all item and household scores positive (Bickel et al., 2000). This results in household scores that range from about 1.5 to 13.[13]

Software that implements the Rasch model begins with the household-by-item matrix of responses. Maximum-likelihood methods are then used to estimate simultaneously the household and item severity scores most consistent with the observed responses under the Rasch assumptions. The resulting household scores are a continuous interval-level measure of the extent of food insecurity or hunger in the households. These scores are appropriate for associative analyses such as correlation and regression, with the caveat that the score for households that denied all items or were screened out cannot be estimated by the Rasch model. The score of zero assigned to such households in some datasets is purely nominal. While Rasch modeling produces an interval scale, the size of the interval between households that denied all items and those that affirmed one item cannot be determined statistically. The Rasch model also provides the basis for "fit" statistics that assess how well each item, each household, and the overall data conform to the assumptions of the measurement model.

Severity of Items in the Children's Food Security Scale

To create the continuous children's food security scale, responses to the eight child-referenced items by all households with children were submitted to Rasch modeling software without the adult-specific and household items. The severity order of the eight child-referenced items when scaled without the adult and household items was identical to their order in the all-items scale (table 6; fig. 2).[14] This was expected, since the calibrations of these items in both scales depend only on the responses of households with children. The relative severities of the eight items were also nearly perfectly proportional in the two scales. The correlation of the item calibrations in the two scales in 1995 was 0.997. However, the range of severity of the items was greater when they were scaled alone. This can be seen in figure 2 and can be expressed statistically by

[13] For some communication purposes, the Federal project further transforms the scale to a 0-10 metric by multiplying the scores from the standard computational metric by 10/14. While the 0-10 scale is more intuitively accessible, researchers need to keep in mind that the natural logistic interval length has been modified in this transformation.

[14] The metric of the child scale in figure 2 was adjusted by adding a constant so that the mean of the calibrations of the 8 child items was equal to the mean of the same 8 items in the 18-item scale.

Table 6—Calibration of items in the children's food security scale[1]

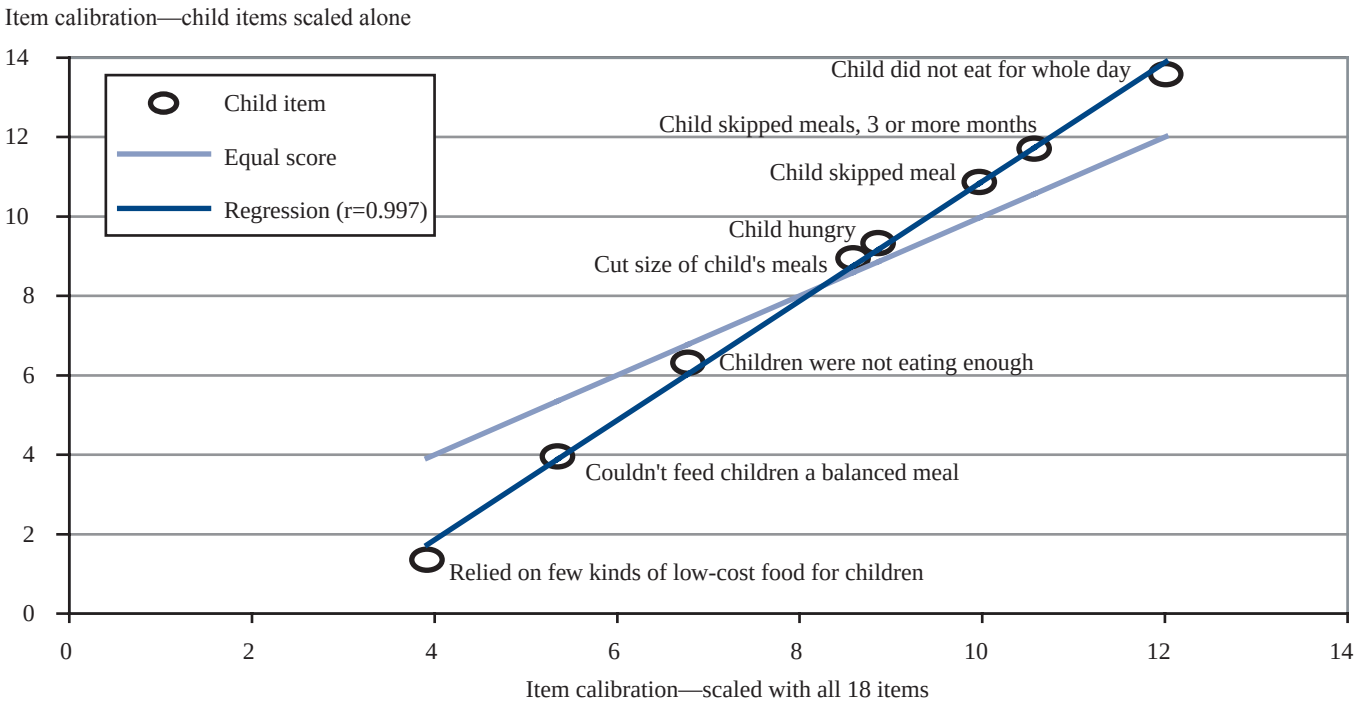
Item	1995		1998	
	Scaled with all 18 Items	Child items scaled alone	Scaled with all 18 items	Child items scaled alone
Relied on a few kinds of low-cost food for children	3.92	1.36	3.27	-.23
Couldn't feed the children a balanced meal	5.35	3.95	5.04	3.49
Children were not eating enough	6.78	6.32	6.66	6.43
Cut size of child's meals	8.59	8.95	8.79	9.39
Child hungry but couldn't afford more food	8.86	9.33	9.24	9.99
Child skipped meal	9.97	10.87	9.94	10.93
Child skipped meals, 3 or more months	10.57	11.70	10.63	11.87
Child did not eat for whole day	12.01	13.58	11.94	13.65
Mean	8.26	8.26	8.19	8.19
Standard deviation	2.56	3.85	2.76	4.35

[1]Calibrations were calculated under Rasch-model assumptions using joint maximum likelihood methods. The discrimination parameter was set at unity, and mean item score was set at the mean of the eight child items in the standard scale as described in Bickel and Nord (2000).

Source: Calculated by ERS based on April 1995 and August 1998 Current Population Survey Food Security Supplement data.

Figure 2

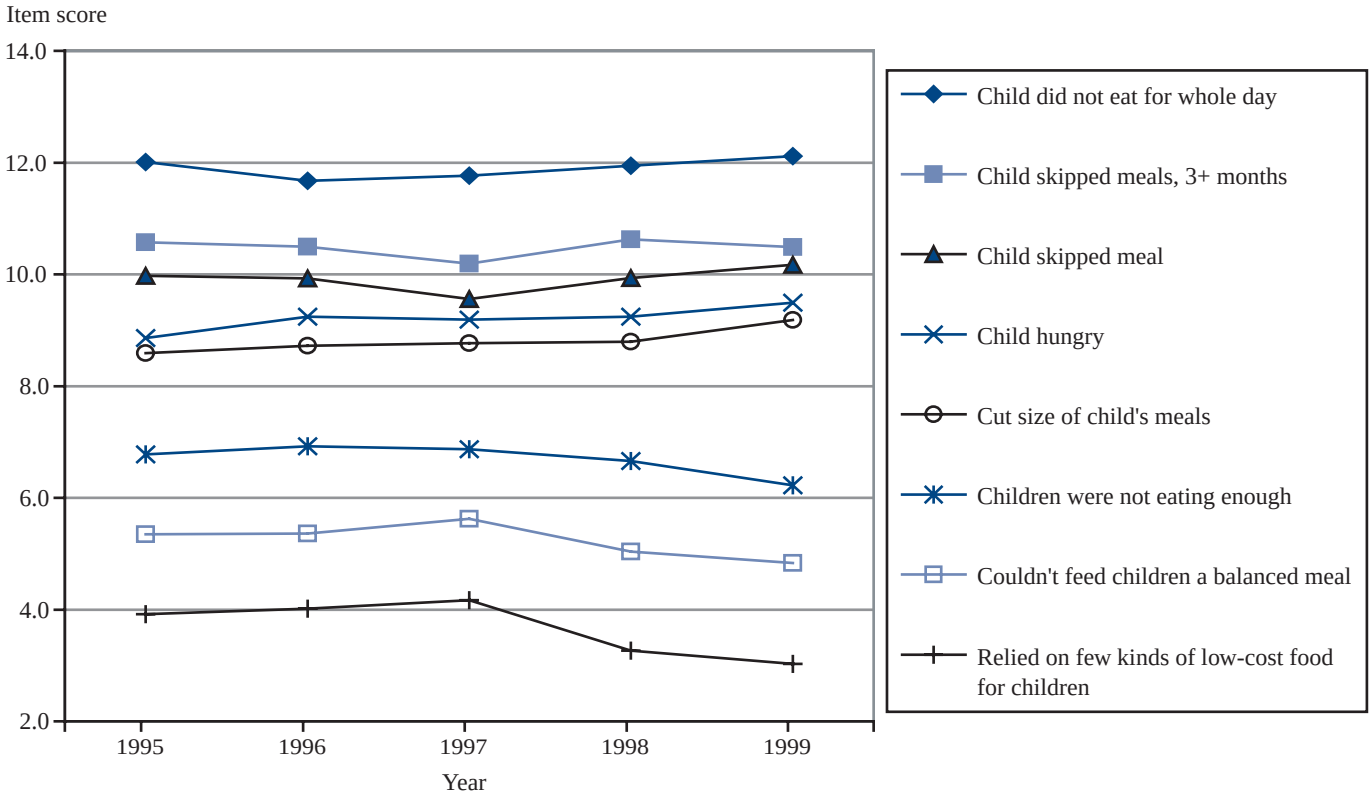
Item calibration (severity) of child-referenced items scaled alone compared with calibration when scaled with all 18 items



Source: Calculated by ERS based on data from Current Population Survey Food Security Supplements 1995-1999.

Figure 3

Item scores of child items scaled with all 18 items, by year



Source: Calculated by ERS based on data from Current Population Survey Food Security Supplements 1995-1999.

comparing the standard deviation of the items in the two scales. In 1995, the standard deviation of the child-specific items when scaled with all 18 items was 2.56. When scaled alone, the standard deviation of the same items was about 50 percent greater at 3.85. A similar pattern is seen in 1998. This greater range indicates a more consistent ordering of the child items when they are scaled alone, which translates statistically to higher "discrimination"—i.e., sensitivity—of the items. This is a result of the greater homogeneity of these items as a set compared with the modest bidimensionality (i.e., an adult hunger dimension and a children's hunger dimension) present in the 18-item set. This slight bidimensionality is, in fact, the reason the severe hunger category of the household scale does not perform well in identifying households with hunger among their child members. We explore this issue further in chapter 3.

The children's food security scale was highly stable from year to year. The severity-order of the items was invariant across years and relative item severities were quite consistent (fig. 3). The stability of the measurement construct over time increases confidence in the stable relationship of the items to the underlying phenomenon of food insecurity and validates cross-year comparisons of prevalence estimates based on the scale. The greater item range in 1998 and 1999 as compared with earlier years probably resulted largely or entirely from a change in the questionnaire structure of the CPS Food Security Survey and in the screening procedures followed during survey administration. Beginning in 1998, items were administered in approximate order of severity. Households that did not affirm any item in the least severe block (five items for households with children) were skipped over the remaining items and deemed to have denied them. A second, similar screener was inserted after an additional six items. This screening protocol reduces respondent burden and avoids the awkwardness of asking questions that are inappropriate in light of earlier responses. However, screening out a small proportion of highly atypical response patterns that would otherwise be observed also improves the fit of items to Rasch model assumptions.[15]

[15] The patterns that are screened out are both improbable statistically and highly unlikely given what we know about households' normal patterns of behavioral responses to food insecurity. However, it is not known to what extent these are data or survey errors in the form of miscoding by the interviewer or incorrect responses due to misunderstanding or inattention by the respondent, and to what extent they represent actual, but highly unusual, circumstances.

The Children's Food Security Scale: A Graduated Measure of Food Deprivation Among Children

The categorical measure of hunger among children described earlier in this chapter is appropriate for calculating prevalence rates of children's hunger and for some analytic purposes. However, a continuous, interval-level measure providing more precise information about the level of severity of food deprivation among children in households is desirable for many associative analyses (correlation, regression, etc.) of the causes and consequences of food deprivation among children. The children's food security scale—the household severity score derived from fitting the Rasch model to the child-specific items—provides this more detailed and precise measure of food insecurity among children.

A characteristic of the single-parameter Rasch model is that, for households with no missing items, each raw score corresponds to a unique household severity score, irrespective of which items are affirmed to achieve the raw score. The advantage of using the Rasch scores rather than raw scores is that the Rasch-based scores are linear with respect to the underlying phenomenon of food insecurity, while the raw scores are not. As such, the Rasch-based scores are more appropriate for use in linear models such as correlation and regression analyses.

It is desirable to put the children's food security scale on the same metric, or unit of measure, as used in the household food security scale. We accomplished this by "anchoring" the item calibrations at their values from the 18-item scale and calculating household scores based on these fixed item scores.[16] This assures maximum comparability of the two scales and eliminates the need for a separate set of item calibrations for the children's food security scale. It introduces no distortion into the children's food security scale, since the relative item severities of the child items were found to be the same whether they were scaled with or without the adult and household items. Household scale scores and categorical assignments from the children's food security scale based on data from the 1998 national CPS Food Security Survey are presented

[16] For this calculation, we set the item discrimination at the ratio of the standard deviations of the items in the two scales to reflect the higher discrimination of the child-referenced items taken alone.

in table 7. We selected 1998 data because the core food security module recommended by the *Guide to Measuring Household Food Security, Revised 2000* incorporates the item order and screening first introduced to the national CPS Food Security Survey in 1998, and the household food security scale scores provided by the *Guide* are also based on the 1998 data.

Technically, table 7 is only applicable for households that provide valid responses to all items in the child hunger scale. For households that have missing responses for one or more items, the scale score depends on the number of items affirmed and on which items were omitted. In practice, missing responses to items in the core food security module are rare, so this limitation has slight importance. Further, in most surveys, (including the national CPS Food Security Survey), missing items can be imputed based on valid responses to other items (appendix B), raw scores can be recalculated based on these imputed responses, and household scores can then be assigned from table 7. Thus, for most surveys, the standard methods described in appendix B can be used to assign food security scale scores and status categories, and no Rasch modeling software is required.

Statistical Assessment of the Children's Food Security Scale

Two statistics commonly used to assess how well responses to items correspond to the Rasch-model assumptions (or "fit" the model) are "infit" and "outfit." After item calibrations and household scores have been estimated, the probability of an affirmative response in each cell of the household-by-item matrix is calculated. The infit and outfit statistics are then calculated by comparing the actual responses to the probabilistically expected responses in each cell of the matrix. Infit is an "information weighted" fit statistic for each item that is sensitive to general item fit within the range near the severity level of the particular item. (See appendix A for further information about Rasch model fit statistics.) Outfit is sensitive to unexpected responses from households with severities much higher or lower than that of the item—that is, to highly improbable responses (outliers). Both statistics compare observed deviations of responses from those expected under Rasch assumptions, so the expected value of the statistics is 1. The single-parameter Rasch model, which is used in creating the food security scales, assumes that all items discriminate equally sharply, so fit-statistic values (especially infit) that are far from unity call into question the suitability of the item for use in the scale.[17]

[17] The discrimination of an item refers to the rapidity with which the probability of affirmation of the item increases or decreases as household scores diverge from the item score. For the average item in a scale that is fit on the logistic metric, the probability of affirmation by a household with severity one unit above the severity of the item is 0.73. For an item in the same scale that has unusually high discrimination, the probability might be 0.9.

Table 7—Household scores on the children's food security scale

Number of items affirmed (raw score)	Scale score: Standard computational metric	Scale score: Standard 0-10 metric	Children's hunger status
0 items (or screened out) [1]	0	0	
1 item	4.1	2.9	No evidence, or
2 items	5.9	4.2	insufficient evidence, of
3 items	7.5	5.4	hunger among children
4 items	8.8	6.3	
5 items	9.6	6.9	
6 items	10.4	7.5	Clear evidence of hunger
7 items	11.5	8.2	among children
8 items[1]	12.2	8.7	

[1]Scores for households that affirmed no items or all eight items are not defined under the assumptions of the Rasch model. Here the score for households that affirmed no items is, by convention, shown as zero, but researchers should make allowance in associative models for the fact that the distance between this score and that of households that affirmed one item is not meaningful. The score for households that affirmed all eight items is calculated at a raw score of 7.5. This score can be used for most analyses without distorting the fit of associative models, since these households typically represent a very small proportion of all households.

Source: Calculated by ERS based on August 1998 Current Population Survey Food Security Supplement data to be consistent with the national benchmark scores presented in Bickel et al., 2000.

Item fit statistics for the child items scaled with all 18 items and scaled alone are presented in table 8. Data from the 1995 Food Security Supplement were used to calculate these statistics because there were no internal screeners in that year that might affect fit statistics. Infit can be thought of as a measure of how sharply the item discriminates compared with other items in the model. Except for the two items about skipping meals (a special case discussed below), infits of the child-referenced items when scaled as part of the 18-item scale ranged from 0.92 to 1.14. As a conventional criterion, infits between 0.8 and 1.2 are considered quite good, and 0.7 to 1.3 are acceptable. Thus, the observed infits of the child items indicate that their discrimination characteristics were all near the average of the entire 18-item set. The item that asks directly about whether the children were hungry discriminated somewhat more sharply than the average item. That is, affirmations by households with severity scores lower than that of the item and denials by households with scores higher than that of the item were somewhat rarer than for the average item in the 18-item scale.[18]

Infit statistics for the child items scaled alone (i.e., without the household and adult items) were somewhat less consistent. The statistics are not quite comparable between the two scales because many households with children that are included in calculating the 18-item scale are excluded from calculation of the children's food security scale because they are "extreme" on the latter scale. That is, they did not affirm any item in the child scale, so their responses provide no information about relative item severities and are excluded from the Rasch model fitting. Further, the children's food security scale, because it is based on fewer items, provides a less precise measure of severity (rather like rounding off a length measurement to the nearest inch). This lower precision also tends to inflate fit statistics. Four items in the children's food security scale, the first two, the fourth, and the fifth had infits near unity. The item about children not eating enough discriminated somewhat more sharply than the average, and the most severe item, children not eating for whole days, did not discriminate as sharply as the other items.

The lower infit statistics (on both scales) for the two items on children skipping meals result in part from a violation of Rasch model assumptions. The Rasch model assumes that items are independent. These two items clearly are not. If a household denies that children skipped meals, they are not asked how often this occurred, and that item is imputed as a denial. There are three sets of such dependencies in the 18-item scale. Analysis (not shown) demonstrates these dependencies have only a negligible effect on item calibrations, but they depress the item fit statistics for the dependent items, and slightly inflate the item fit statistics for the other items in the scale (by artificially increasing the average discrimination). To calculate unbiased fit statistics for the two items about children skipping meals, we reestimated the children's food security scale and fit statistics with each of the two dependent items excluded in turn. The resulting infit statistics were 0.91 for *Child skipped meal* and 0.85 *Child skipped meals in 3 or more months*, much nearer unity than the values shown in table 8 (0.78 and 0.69 respectively). These analyses also reduced the infit statistic of the most severe item, *Child did not eat for whole day*, to about 1.25. Thus, when the biases associated with the item

[18] It might be thought tempting to use just this single item to categorize households as to children's hunger. However, the discrimination of the scale at a selected threshold is substantially higher than the discrimination of any single item taken alone.

Table 8—Fit statistics of items in children's food security scale, 1995

	Scaled with all 18 Items, all households		Child items scaled alone	
Item	Infit	Outfit	Infit	Outfit
Relied on a few kinds of low-cost food for children	1.14	1.25	1.08	14.65
Couldn't feed the children a balanced meal	1.04	.88	.85	2.71
Children were not eating enough	1.07	.87	.74	.81
Cut size of child's meals	1.00	1.07	1.00	2.71
Child hungry but couldn't afford more food	.92	.82	.95	3.29
Child skipped meal	.88	.64	.78	4.56
Child skipped meals, 3 or more months	.81	.25	.69	.56
Child did not eat for whole day	1.14	7.95	1.42	30.70

Source: Calculated by ERS based on April 1995 Current Population Survey Food Security Supplement data.

dependencies are removed, infit statistics for the children's food security scale were quite good for six items and acceptable for all eight.

Outfit statistics for the child-referenced items in the 18-item scale were, with one exception, smaller than 1.3, indicating that highly improbable responses were rare. The exception was the most severe item. The higher outfit for that item indicates that a few households affirmed that a child went a whole day without eating, but affirmed very few other items. When the child items were scaled alone, outfits were much less consistent, and those for the least severe and most severe items were quite high. However, outfit can be very sensitive to a very few highly improbable responses. Further analysis (not shown) found that the high outfit of the least severe item, *Relied on a few kinds of low-cost food for children*, was almost entirely a result of responses of five households out of the 2,583 non-extreme households used for calculating the scale. These households affirmed 4, 5, or 6 items, but denied this particular item. Similarly, the high outfit for the most severe item, *Child did not eat for whole day*, was entirely the result of responses of just two households. One affirmed this item but denied all other child items. The second affirmed only this item and the least severe item. These highly improbable responses may result from miscoding by an interviewer, inattention or misunderstanding on the part of the respondent, or from genuine differences in how food deprivation is experienced in different households. Further investigation of characteristics of these households may cast more light on their responses. The rarity of these responses, however, suggests that even the highest outfit statistics seen in the children's food security scale do not seriously undermine the reliability of the overall scale.

Another statistic that can be compared across the two scales is the mean household measurement error. This is the expected mean measurement error of the severity score assigned to households with a given raw score if the data conformed probabilistically to the model expectations. To make the statistics for the two scales comparable, we calculated them across a common group of households—those that were non-extreme on the children's food security scale in 1995. The model error is expressed in the measurement metric, so we adjusted the metric of the children's food security scale so that the item calibrations had the same standard deviation as the child-specific items on the household-level scale, thus making the error estimates comparable. The larger number of items in the household-level scale provides a more reliable measure of households' food security status, but this is partially offset by the higher discrimination of the child-specific items when they are scaled alone. The mean household standard error was 0.80 for the 18-item scale and 1.02 for the children's hunger scale. The size of the household measurement error varies across the range of each scale, however, and on both scales the threshold relevant for the identification of children's hunger falls in the range of minimum measurement error. Thus, the discrimination of both scales is highest at the severity level most critical for estimating the prevalence of children's hunger, and in this range, the measurement errors were nearly the same, 0.70 for the household-level scale and 0.73 for the child-specific scale.

Summary

A continuous, interval-level, scale measuring the extent of food insecurity among children, and also a categorical measure that identifies households with hunger among children, can be calculated from the eight items in the Food Security Core Survey Module that ask specifically about experiences and conditions of children in the household. The interval-level children's food security scale is appropriate for use as a research tool in associative analyses, while the categorical measure is appropriate for prevalence estimation and for comparing the prevalence of children's hunger among subpopulations.

The children's food security scale is reasonably reliable and is quite stable across years. The eight items in the children's food security scale are strongly ordered in terms of severity. Both descriptive and Rasch-model-based statistical analyses indicate that these items form a coherent scale for measuring the extent of food insecurity—i.e., deprivation in basic food need—among children in households. The severity-order and relative severity of the items were stable over 5 years in spite of a major restructuring of the questionnaire.

The threshold for identifying households with children's hunger is consistent—both conceptually and in terms of the specific response patterns of households near the threshold—with earlier work on identifying households with hunger among children. The measure is methodologically conservative: households classified as having hunger among children have affirmed at least five items, including at least three items indicating reduced food intake by the children.

Chapter 3

Why the Children's Food Security Scale Is More Reliable than the Household Scale for Identifying Hunger Among Children

From its inception, the Federal interagency food security measurement project has had a strong interest in reliably identifying households with hunger among children by means of the survey and measurement method it developed. Such identification is needed in order for research to provide information on the extent of hunger among children in the U.S. and on the causes and consequences of this condition. The Food Security Supplement questionnaire developed by the project includes a number of items intended to measure the extent of food deprivation among children as well as items that ask about coping mechanisms and strategies used by households to avoid or ameliorate food deprivation among children.

The team charged with developing measures of household food security based on data from the first CPS Food Security Survey in 1995 developed a single, unidimensional household food security scale and identified three thresholds on the scale (Hamilton et al., 1997a; Hamilton et al., 1997b; Price, Hamilton, and Cook, 1997). The least severe threshold identifies households that are food-insecure. The second identifies households in which one or more members (mostly adults) were hungry at times during the year because of insufficient resources to buy food. The third threshold identifies households in which children (if any in the household) were hungry at times during the year, and in which adults experienced more severe and frequent food deprivation, such as going whole days without eating. Thus, although the "severe hunger" threshold was specified to identify households with hunger among children, a combination of child-referenced items and adult-referenced items was used to classify households vis-à-vis the threshold. This was consistent with earlier research findings that, in the United States, children were generally shielded from hunger at less severe levels of household deprivation and began to experience hunger only when hunger among adults in the household reached this more severe level.

A single scale calculated from both child- and adult-referenced items is appropriate for identifying households with hunger among children, provided that the two sets of items measure primarily the same dimension of the complex phenomenon of food insecurity. The preliminary work to develop the household food security scale included exploration of the issue of dimensionality among the items that were considered candidates for the scale using both linear and nonlinear factor analysis (Hamilton et al., 1997b). The nonlinear factor analysis indicated that the set of 18 food insecurity and hunger items that are included in the food security scale lie fairly well on a single dimension.

Nevertheless, the children's food security scale, calculated from only the child-referenced items, identifies a larger proportion, and somewhat different set, of households as having hunger among children than does the household food security scale, even though equivalent thresholds were used for the two scales. This suggests that the assumption of unidimensionality of the 18-item set, while a reasonable and useful approximation, may not be strictly accurate.

In this chapter, we document the extent of misclassification of households with hunger among children produced by the household food security scale and the bias in prevalence rates of children's hunger that results. We then revisit the dimensionality question and find that there is a nontrivial bidimensionality in the item set, and that the second dimension measures the extent to which children share in the food deprivation that exists at the household level. We then examine characteristics of households that are misclassified as

regards hunger among children by the household food security scale and find that there are intuitively sensible reasons for the misclassification, the most important of which is the age of children.

Bias and Misclassification by the Household Food Security Scale

The prevalence of hunger among children as measured by the children's food security scale was higher than that measured by the severe hunger category of the household food security scale in every year from 1995 to 1999 (table 9). There were 14 to 24 percent fewer households (with children) in the severe hunger category of the household food security scale than were identified as having hunger among children by the children's food security scale. On average across the 5 years, the estimated prevalence rates differed by 20 percent, or about 0.2 percentage points.

The household scale not only fails to identify children's hunger in some households that do have hunger among children (based on the children's food security scale), it also classifies some households in the severe hunger category even though the children's scale indicates an absence of hunger among children in those households. Thus, the two scales identify somewhat different sets of households as having hunger among children. Table 10 shows the extent of these differences in 1999. If we take the children's food security scale as the standard, the household scale (severe range) misclassifies as not having hunger among children (false negatives) 88,000 households of the 219,000 households with hunger among children and misclassifies as having hunger among children (false positives) 51,000 households that did not have hunger among children. Taking as denominator the 219,000 households with hunger among children based on the children's food security scale, these misclassifications amounted to 40.2 percent false negatives, and 23.3 percent false positives. Analysis (not shown) of 1995 and 1998 data found proportions of false negatives and false positives almost identical to those in 1999.

Some difference in classification results from the lower level of precision of the children's food security scale. Because it has only eight items, it is somewhat less precise than the household scale. Analysis not presented here shows that this lower level of precision accounts for about half of the false negatives, most of the false positives, and somewhat less than one-fourth of the bias.

Re-examining the Dimensionality Question

The substantial difference in prevalence rates of severe household hunger and children's hunger imply that the child and adult items in the scale do not, in fact, lie on a single dimension. Hamilton et al. assessed the dimensionality issue in terms of whether all of the items related strongly enough to the same dimension to justify including them in a scale to measure that dimension. They concluded that, "… the RMSR [root mean square residual] was well within the acceptable range with a single factor, and was not materially improved by adding further factors, making the single-factor model the most parsimonious solution" (Hamilton et al., 1997b, p. 10). We do not dispute this finding. The 18 items do, in fact, measure *primarily* a single phenomenon—household food security—and it is appropriate to include the child-referenced items in the measure of that phenomenon. What we want to investigate further, however, is whether any multidimensionality that does

Table 9—Estimated prevalence of households with hunger among children, 1995-99, based on the children's food security scale and on the household food security scale

Year	Based on children's food security scale		Based on severe hunger category of household food security scale		Difference	
	1,000	*Percent*	*1,000*	*Percent*	*Percentage points*	*Percent*[1]
1995	416	1.09	325	0.85	-0.24	-21.88
1996	384	1.01	329	.86	-.15	-14.32
1997	310	.81	239	.63	-.18	-22.90
1998	331	.87	252	.66	-.21	-23.87
1999	219	.58	182	.48	-.10	-16.89

[1]Difference, as a percentage of estimated prevalence based on children's food security scale.

Source: Calculated by ERS based on Current Population Survey Food Security Supplement data.

Table 10—Misclassification of households with hunger among children by the severe hunger category of the household food security scale, 1999

Food security status based on household food security scale	Children's hunger status based on children's food security scale		
	No hunger among children	Hunger among children	Total
	1,000		
Food secure	32,290	0	32,390
Food insecure, without hunger	4,340	0	4,340
Food insecure with moderate hunger	984	88 (False negative: 0.23% of households, 40.2% of households with hunger among children)	1,072
Food insecure with severe hunger	51 (False positive: 0.13% of households; 23.3% of households with hunger among children)	131	182 (0.48%)[1]
Total	37,665	2,191 (0.58%)[1]	37,884

[1]Prevalence rates of households with children's hunger as measured by the two scales, i.e., percentage of all households with children.

Source: Calculated by ERS based on April 1999 Current Population Survey Food Security Supplement data.

exist in the 18 items compromises the reliability of the scale for identifying households with hunger among children. The dimesionality issue is somewhat different in this case. Even a modest extent of bidimensionality could be problematic. If even a small proportion of "moderate hunger" households have hunger among children, the proportional error in the estimated prevalence of children's hunger could be substantial because there are many more households classified with moderate hunger than with severe hunger.

To investigate the extent and character of a second dimension in the 18 items, we carried out a principle components analysis of the standardized residuals of the items after extracting the first factor by fitting the items to a Rasch model. In this procedure, the items and households are first scaled by Rasch maximum likelihood methods. Then, for each household, the residual—the deviation of each item from its expected value given the household total score—is calculated.[19] Each item's residual is then standardized by dividing by the model standard error for the item-household combination.[20] Then principal components are extracted from a correlation matrix of the standardized residuals.

The principal components analysis reveals a second factor that is correlated negatively with all child-specific items and positively with all adult-specific items (table 11).[21] The highest positive correlations are with the most severe adult items, while correlations are close to zero for two of the three (least severe) general household items. This second factor can be interpreted, then, as the extent to which households protect children

[19] The observed value of the item is 1 if affirmed, 0 if denied. The expected value is the probability of the household affirming the item given the difference between household and item score, calculated as $p=e^{(h-i)} / (1+e^{(h-i)})$, where h is the scale score (severity of food insecurity) of the household, i is the calibration score (severity level) of the item, and e is the base of the natural logarithms.

[20] The model standard error of the item-household combination depends only on the probability of the household affirming the item (see previous footnote). The model standard error is the square root of the model variance, which is calculated as $v = p(1-p)^2 + (1-p)p^2 = (p-p^2)$. Conceptually, this model variance is the sum of two terms: (1) the squared deviation if the item is affirmed, weighted by the probability of it being affirmed, plus (2) the squared deviation if the item is denied, weighted by the probability of it being denied.

[21] This is actually the first factor extracted from the principal components analysis of the item deviations, but the scale itself should be considered the first factor in the raw data, although it is extracted using a nonlinear model.

Table 11—Factor loadings of the first factor extracted by principal components from the correlation matrix of the standardized deviations of items from their expected values given the household score

Item	Loading
Household items:	
Worried food would run out	0.04
Food bought didn't last	.03
Couldn't afford to eat balanced meals	-.24
Adult-specific items:	
Adults cut size of meals or skipped meals	.42
Respondent ate less than felt he/she should	.30
Adult cut size of meals or skipped meals, 3 or more months	.40
Respondent hungry but didn't eat	.38
Respondent lost weight	.33
Adults did not eat for whole day	.62
Adults did not eat whole day, 3 or more months	.60
Child-specific items:	
Relied on a few kinds of low-cost food for children	-.26
Couldn't feed the children a balanced meal	-.57
Children were not eating enough	-.56
Cut size of child's meal	-.35
Child hungry but couldn't afford more food	-.31
Child skipped meal	-.43
Child skipped meals, 3 or more months	-.38
Child did not eat for whole day	-.03

Notes: The analysis is based on households with children who answered at least one food security or hunger question affirmatively (N=4,340). The factor explained 15 percent of the total shared variance, or about 2.7 times the proportion expected under random conditions.

Source: Prepared by ERS based on data from the Current Population Survey Food Security Supplement, April 1995.

from hunger by accepting more severe levels of adult hunger. The factor is of only modest strength, accounting for about 15 percent of the shared variance of the residuals. This is consistent with the assessment by Hamilton et al. (1997b) that the phenomenon represented by these items is largely unidimensional. Still, the factor is strong enough to account for the fact that some households with hunger among children do not register severe household-level hunger.[22]

[22] In principle, this bidimensionality also affects the accuracy with which the household scale represents hunger among adults. However, this effect is negligible at the household-level (i.e., adult) hunger threshold except in households with only very young children. Analysis (not shown) found that for all households with children, the prevalence rate of hunger among adults based on the 18-item household scale differed by only 0.1 percentage point from that based on the 10-item scale that excludes the child items (i.e., the standard scale used for households without children). However, among households in which the oldest child was 2 years old or younger, the 18-item scale understated the prevalence of adult hunger by about 20 percent compared with the 10-item scale.

Which Households Are Misclassified by the Household Scale?

Differences between the prevalence of children's hunger based on the children's food security scale and the prevalence of severe hunger based on the household scale varied among demographic and economic categories of households, and the differences shed some light on why the two measures differ (table 12). Data from the 2 years, 1998 and 1999, were combined for these calculations to reduce sampling variation.

The most notable variation is across categories based on the age of the oldest child in the household. The severe range of the household scale overestimates by 48 percent the prevalence of children's hunger in households with no child older than 5 years, and underestimates by 33 percent and 20 percent the prevalence of children's hunger in the two older age groups. This indicates that younger children are protected from hunger at much more severe levels of food deprivation among adults than are older children. The bivariate association of the prevalence bias with age is nonmonotonic—it is highest for the middle of the three age categories. However, as will be seen below in the regression analysis, this is an artifact of associations with other household characteristics. The relationship becomes monontonic when other characteristics are controlled. Table 12 also points to substantial bivariate associations of bias of the household scale with family structure, number of children, race and ethnicity, household income, and metropolitan/nonmetropolitan residence.

The characteristics that mediate the relationship between severity as measured by the household scale and severity as measured by the children's scale are interrelated, and their effects are therefore better assessed in a multivariate context. This was accomplished by estimating a logistic regression of hunger among children, as measured by the children's food security scale, on severe hunger, as measured by the household scale, and a set of dummy variables for the household characteristics (table 13). A dummy was also added for year of survey, since the observed prevalence of children's hunger was substantially lower in 1999 than in 1998.

With controls for the household classification vis-à-vis the severe hunger threshold and other relevant characteristics, the effects of almost all the characteristics make intuitive sense. The age of the oldest child in the

Table 12—Difference between prevalence rates of children's hunger estimated from the household food security scale and the children's food security scale, average 1998-99, by household characteristics

Household characteristics	Households with hunger among children based on children's food security scale	Households with severe hunger based on household food security scale	Difference: household scale less children's scale	
			As proportion of all households with children	As proportion of households with children's hunger
		Percent		
All households	0.72	0.57	-0.15	-20.8
Family structure:				
Two-parent family	.34	.24	-.10	-29.4
Single mother with children	1.80	1.49	-.31	-17.2
Single father with children	.85	.59	-.26	-30.6
Number of children:				
One	.63	.58	-.05	-7.9
Two	.58	.46	-.12	-20.7
Three or more	1.17	.75	-.42	-35.9
Age of oldest child:				
0-5	.25	.37	.12	48.0
6-14	.69	.46	-.23	-33.3
15-17	1.2	.96	-.24	-20.0
Sex of children:				
Boys only	.72	.62	-.10	-13.9
Girls only	.58	.48	-.10	-17.2
Both	.85	.61	-.24	-28.2
Race/ethnicity of reference person:				
White non-Hispanic	.47	.43	-.04	-8.5
Black	1.37	1.07	-.30	-21.9
Hispanic	1.27	.87	-.40	-31.5
Income of household:				
Below 130% of poverty line	2.33	1.83	-.50	21.5
Above 130% of poverty line	.31	.27	-.04	-12.9
Residence:				
Metro	.72	.55	-.17	-23.6
Nonmetro	.73	.65	-.08	-11.0

Notes: Tabled values are population estimates based on household weights prepared by the Census Bureau for the Food Security Supplement. The unweighted number of cases is 27,377.

Source: Prepared by ERS based on data from the U.S. Census Bureau Current Population Survey Food Security Supplements, August 1998 and April 1999.

household has a very strong effect. All other things equal (including the severity level of household hunger), the odds of observing hunger among children in which the oldest child is age 6-14 are 5 times the odds of observing hunger among children in households in which the oldest child is age 0-5. That odds ratio increases to 7 for households in which the oldest child is age 15-17. Younger children, especially those age 5 and under, are protected from hunger at more severe levels of adult hunger in the household than are older children. It should be noted, nevertheless, that even in households with older children, hunger among the children was registered in only about one-fourth of the households with adult hunger (i.e., moderate or severe household-level hunger).[23]

[23] The statistics for this comparison are not shown in the table. In 1998 and 1999, among households in which the oldest child was age 15-17, 4.7 percent registered adult hunger (i.e., moderate or severe household hunger), while only 1.2 percent registered hunger among children on the children's food security scale.

Table 13—Logistic regression of children's hunger on severe household hunger and household characteristics

Household characteristics	Coefficient	Odds ratio	Significance
Intercept	-8.66		
Household severe hunger	6.58	718.00	<0.001
Two-parent family (reference)			
Single mother with children	0.63	1.88	.008
Single father with children	.61	1.84	.121
Other household with children[1]	.50	1.65	.421
One child in household (reference)			
Two children in household	.10	1.11	.718
Three or more children in household	.37	1.45	.267
Oldest child age 0-5 (reference)			
Oldest child age 6-14	1.60	4.97	<.001
Oldest child age 15-17	1.96	7.08	<.001
Boys only	.13	1.14	.666
Girls only	.20	1.22	.519
Both boys and girls (reference)			
White non-Hispanic (reference)			
Black	.66	1.94	.017
Hispanic	.95	2.59	.001
Other non-Hispanic	1.37	3.92	<.001
Below 130% of poverty line	1.10	3.00	<.001
Above 130% of poverty line (reference)			
Metro (reference)			
Nonmetro	-.07	.93	.775
1998 sample (reference)			
1999 sample	-.21	.81	.316

[1]Children in this category are not related to the reference person. These include children of an unmarried housemate or partner, foster children, and other unrelated children.

Logistic regression analysis was based on unweighted household data. Households with no children or with missing income information were excluded. Number of cases was 25,620.

Source: Prepared by ERS based on data from the U.S. Census Bureau Current Population Survey Food Security Supplements, August 1998 and April 1999.

Household income also has a strong effect on the extent to which children are protected from hunger. All other things equal (including the severity level of household hunger), the odds of observing hunger among children in households with income below 130 percent of the poverty line are 3 times the odds of observing hunger among children in households with income above that level. Households with higher incomes are likely to experience shorter spells of food stress and are thus better able to avoid hunger among children. Higher income households also may have more resources to draw on to avoid hunger among children. Adults may "tighten their belts" and skip a few meals to avoid selling assets, refinancing a home, or taking an undesirable job, but they may resort to these exigencies to avoid subjecting their children to hunger.

Household structure also affects the extent to which children are protected from hunger, although the effects are not as strong as those of household income and the age of children. All other things equal (including the severity level of household hunger), the odds of observing hunger among children in households headed by a single parent are 1.8 times the odds of observing hunger among children in two-parent households. In part, this effect results from income effects not captured by the single dummy variable. In a logistic

regression analysis (not shown) with income-to-poverty ratio entered as a third-order polynomial instead of the single dummy variable, the effects of single-parent household structure declined by about one-third. Even after controlling more adequately for income, however, it still appears that single parents may be less able than two parents to protect their children from hunger, even by accepting more severe levels of hunger themselves.

Race and Hispanic ethnicity have surprisingly strong effects on the relationship between hunger among children and severe household hunger. All other things equal (including the severity level of household hunger), the odds of observing hunger among children in minority households are 1.9 to 3.9 times those in non-Hispanic White households. Analysis (not shown) revealed that about one-third of this effect also resulted from income effects not captured by the single dummy variable. The remainder may result from cultural differences associated with race and ethnicity that affect either the way food deprivation is managed or the way it is discussed and described (Nord and Jemison, 1999).

Neither sex of children nor metropolitan/nonmetropolitan residence had substantial effects on children's hunger once the severity level of household hunger and other characteristics were controlled. The small effects observed were not nearly statistically significant.

Summary

Accurate measurement of the extent to which children are affected by resource-constrained food shortage is important for understanding the causes and consequences of children's hunger. Children do not usually experience resource-constrained hunger until hunger among adults in the household has reached quite severe levels. But the extent to which children are protected from, or share in, the food deprivation in a resource-constrained household is not the same in all households. There is convincing evidence that a non-trivial second dimension exists in the 18 items in the food security scale, a dimension measuring the extent to which children are protected from hunger at the cost of more severe hunger among adults. As a result, the 18-item food security scale misclassifies a substantial proportion of households with regard to the level of severity of food deprivation among children and understates the prevalence of hunger among children by about 20 percent at the national level. The children's food security scale, based on the eight questions in the food security scale that ask specifically about conditions among children in the household, identifies households with hunger among children more reliably than does the household food security scale.

The extent to which children are protected from hunger at the cost of more severe adult deprivation is associated with household characteristics in ways that are, for the most part, intuitively sensible. In particular, younger children, especially those age 5 and under, are protected from hunger up to more severe levels of adult hunger than are older children. Children in households with higher income are protected from hunger up to more severe levels of adult hunger than are children in lower income households. Children in two-parent households are protected from hunger up to more severe levels of adult hunger than are children in single-parent households. These associations provide a reasonable explanation of the difference between prevalence rates based on the two scales. They also underscore the superiority of the children's food security scale for comparing prevalence rates of children's hunger across demographic and economic groups, since the extent of bias associated with the household scale varies across many of the groups of interest.

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Appendix A

U.S. Household Food Security Survey Module: 3-Stage Design (2 Internal Screeners)

Questionnaire transition into module—administer to all households: These next questions are about the food eaten in your household in the last 12 months, since (current month) of last year, and whether you were able to afford the food you need.

General food sufficiency question/screener: Questions 1, 1a, 1b (OPTIONAL: These questions are NOT used in calculating the food security scale.) Question 1 may be used as a screener: (a) in conjunction with income as a *preliminary* screen to reduce respondent burden for *higher income households only*; and/or (b) in conjunction with the 1st stage internal screen to make that screen more "open"—i.e., provide another route through it.

1. [IF ONE PERSON IN HOUSEHOLD, USE "I" IN PARENTHESES, OTHERWISE, USE "WE."]

   Which of these statements best describes the food eaten in your household in the last 12 months: –enough of the kinds of food (I/we) want to eat; –enough, but not always the kinds of food (I/we) want; –sometimes not enough to eat; or, –often not enough to eat?

   [1] Enough of the kinds of food we want to eat [SKIP 1a and 1b]

   [2] Enough but not always the kinds of food we want [SKIP 1a; ask 1b]

   [3] Sometimes not enough to eat [Ask 1a; SKIP 1b]

   [4] Often not enough [Ask 1a; SKIP 1b]

   [ ] DK or Refused (SKIP 1a and 1b)

1a. [IF OPTION 3 OR 4 SELECTED, ASK] Here are some reasons why people don't always have enough to eat. For each one, please tell me if that is a reason why YOU don't always have enough to eat. [READ LIST. MARK ALL THAT APPLY.]

YES	NO	DK	
[ ]	[ ]	[ ]	Not enough money for food
[ ]	[ ]	[ ]	Not enough time for shopping or cooking
[ ]	[ ]	[ ]	Too hard to get to the store
[ ]	[ ]	[ ]	On a diet
[ ]	[ ]	[ ]	No working stove available
[ ]	[ ]	[ ]	Not able to cook or eat because of health problems

1b. [IF OPTION 2 SELECTED, ASK] Here are some reasons why people don't always have the quality or variety of food they want. For each one, please tell me if that is a reason why YOU don't always have the kinds of food you want to eat. [READ LIST. MARK ALL THAT APPLY.]

YES	NO	DK	
[ ]	[ ]	[ ]	Not enough money for food
[ ]	[ ]	[ ]	Kinds of food (I/we) want not available
[ ]	[ ]	[ ]	Not enough time for shopping or cooking
[ ]	[ ]	[ ]	Too hard to get to the store
[ ]	[ ]	[ ]	On a special diet

BEGIN FOOD SECURITY/HUNGER CORE MODULE (i.e., SCALE ITEMS)

NOTE: The children's food security scale is based on the child-referenced items: 5-7 and 13-16.

Stage 1: Questions 2-6—ask all households:

[IF SINGLE ADULT IN HOUSEHOLD, USE "I," "MY," AND "YOU" IN PARENTHESES; OTHERWISE, USE "WE," "OUR," AND "YOUR HOUSEHOLD;" IF UNKNOWN OR AMBIGUOUS, USE PLURAL FORMS.]

2. Now I'm going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months, that is, since last (name of current month).

   The first statement is "(I/We) worried whether (my/our) food would run out before (I/we) got money to buy more." Was that often true, sometimes true, or never true for (you/your household) in the last 12 months?

   [ ] Often true

   [ ] Sometimes true

   [ ] Never true

   [ ] DK or Refused

3. "The food that (I/we) bought just didn't last, and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

   [ ] Often true

   [ ] Sometimes true

   [ ] Never true

   [ ] DK or Refused

4. "(I/we) couldn't afford to eat balanced meals." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

   [ ] Often true

   [ ] Sometimes true

   [ ] Never true

   [ ] DK or Refused

[IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q5-6; OTHERWISE SKIP TO 1st Level Screen.]

5. "(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." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

   [ ] Often true

   [ ] Sometimes true

   [ ] Never true

   [ ] DK or Refused

6. "(I/We) couldn't feed (my/our) child/the children) a balanced meal, because (I/we) couldn't afford that." Was that often, sometimes, or never true for (you/your household) in the last 12 months?

   [ ] Often true

   [ ] Sometimes true

   [ ] Never true

   [ ] DK or Refused

1st level Screen (screener for Stage 2): If AFFIRMATIVE RESPONSE to ANY ONE of Questions 2-6 (i.e., "often true" or "sometimes true") OR response [3] or [4] to Question 1 (if administered), then continue to Stage 2; otherwise, skip to end.

Stage 2: Questions 7-11—ask households passing the 1st level Screen: (estimated 40% of households < 185% Poverty; 5.5% of households > 185% Poverty; 19% of all households).

[IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK Q7; OTHERWISE SKIP TO Q8]

7. "(My/Our child was/The children were) not eating enough because (I/we) just couldn't afford enough food." Was that <u>often</u>, <u>sometimes</u>, or <u>never</u> true for (you/your household) in the last 12 months?

   [ ] Often true

   [ ] Sometimes true

   [ ] Never true

   [ ] DK or Refused

8. In the last 12 months, since last (name of current month), 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?

   [ ] Yes

   [ ] No (SKIP 8a)

   [ ] DK or R (SKIP 8a)

8a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

   [ ] Almost every month

   [ ] Some months but not every month

   [ ] Only 1 or 2 months

   [ ] DK or R

9. In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money to buy food?

   [ ] Yes

   [ ] No

   [ ] DK or R

10. In the last 12 months, were you ever hungry but didn't eat because you couldn't afford enough food?

   [ ] Yes

   [ ] No

   [ ] DK or R

11. In the last 12 months, did you lose weight because you didn't have enough money for food?

   [ ] Yes

   [ ] No

   [ ] DK or R

<u>2nd level Screen</u> (screener for Stage 3): If AFFIRMATIVE RESPONSE to ANY ONE of Questions 7 through 11, then continue to Stage 3; otherwise, skip to end.

<u>Stage 3: Questions 12-16</u>—ask households passing the 2nd level Screen: (estimated 7-8% of households < 185% Poverty; 1-1.5% of households > 185% Poverty; 3-4% of all households).

12. 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?

   [ ] Yes

   [ ] No (SKIP 12a)

   [ ] DK or R (SKIP 12a)

12a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

   [ ] Almost every month

   [ ] Some months but not every month

   [ ] Only 1 or 2 months

   [ ] DK or R

[IF CHILDREN UNDER 18 IN HOUSEHOLD, ASK 13-16; OTHERWISE SKIP TO END.]

13. The next questions are about children living in the household who are under 18 years old. In the last 12 months, since (current month) of last

year, did you ever cut the size of (your child's/any of the children's) meals because there wasn't enough money for food?

[ ] Yes

[ ] No

[ ] DK or R

14. In the last 12 months, did (your child/any of the children) ever skip meals because there wasn't enough money for food?

[ ] Yes

[ ] No (SKIP 14a)

[ ] DK or R (SKIP 14a)

14a. [IF YES ABOVE ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

[ ] Almost every month

[ ] Some months but not every month

[ ] Only 1 or 2 months

[ ] DK or R

15. In the last 12 months, (was your child/were the children) ever hungry but you just couldn't afford more food?

[ ] Yes

[ ] No

[ ] DK or R

16. 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?

[ ] Yes

[ ] No

[ ] DK or R

END OF FOOD SECURITY/HUNGER CORE MODULE

Appendix B

Implementing the Children's Food Security Scale

This appendix describes procedures that researchers can use to calculate the children's food security scale from CPS Food Security Survey data. This includes the operational steps required to:

- Code the survey responses collected using the core CPS Food Security Survey module into the format needed to calculate the children's food security scale
- Calculate the children's food security scale, which is an interval-level measure of the severity of food deprivation among children in the household
- Classify households as to whether children have been hungry due to lack of household resources for food.

It is assumed that the child-referenced items are collected in the context of the entire 18-item module.[24] (The food security core module questionnaire is included in appendix A.) Detailed instructions for calculating the household-level food security measures are available in *Guide to Measuring Household Food Security, Revised 2000* (Bickel et al., 2000). We summarize here some of the material from the Guide that is needed to calculate the children's food security scale and provide additional detail that is specific to this scale. Readers should consult the *Guide* for additional information.

Coding Survey Responses for the Food Security Scale

NOTE: If the child-referenced items have already been recoded in order to calculate the household food security scale, there is no need for further recoding, and this subsection may be skipped.

In order to determine a household's score on the children's food security scale, it is first necessary to code their response to each of the child-referenced items as either "affirmative" or "negative." Some of this coding is obvious because the only response choices are "yes" or "no." Two groups of questions, however, have less obvious response categories, and responses missing because of screening may need to be dealt with. The procedure for coding these questions is described below and summarized in table B-1.

Questions Q5, Q6, and Q7 have three response categories: "often true," "sometimes true," and "never true." For these questions, "often true" and "sometimes true" are considered affirmative responses because they indicate that the condition occurred at some time during the year. The distinction between the "often" and "sometimes" responses is not used in the scale.

Question Q14a is a followup question whose response categories are "almost every month," "some months but not every month," and "only 1 or 2 months." For purposes of the scale, the first two responses are considered affirmative and the third is considered negative.[25] Thus, the negative condition on these indicators is "only 1 or 2 months" while the positive, or affirmative, is that the condition occurred in 3 months or more during the year. Q14a is coded negative for households that are skipped over this question because they responded "no" to Q14. Q14a is coded missing for households that are skipped over it because they responded "don't know" or refused to answer Q14.

Questions that a household does not answer because it has been screened out are coded as negative responses. The household was screened out precisely because it was deemed, on the basis of earlier information, not to have experienced the conditions represented in those questions.

[24] It is probably practical to collect just the child-referenced items, but to date there is no research evidence as to whether response to these items is affected substantially if they are asked outside of the context of the full module.

[25] Thus, households that report that children skipped meals in only 1 or 2 months register a single affirmative response (for Q14), while those reporting that children skipped meals in 3 or more months register two affirmative responses, one for Q14 and one for Q14a.

Table B-1—Coding survey responses for items in the children's food security scale

Question Number	Question	Negative responses (Code = 0)	Affirmative responses (Code = 1)	Missing data (Code = .)
Q5	Relied on a few kinds of low-cost food for children	Never true (*or screened out at preliminary screen*)	Often true; Sometimes true	Refused; Don't know
Q6	Couldn't feed the children a balanced meal	Never true (*or screened out at preliminary screen*)	Often true; Sometimes true	Refused; Don't know
Q7	Children were not Eating enough	Never true (*or screened out at preliminary or 1st- level*	Often true; Sometimes true	Refused; Don't know
Q13	Cut size of child's Meals	No (*or screened out at preliminary, 1st, or 2nd level screen*)	Yes	Refused; Don't know
Q14	Children ever skipped meal	No (*or screened out at preliminary, 1st, or 2nd level screen*)	Yes	Refused; Don't know
Q14a	Children skip meals, 3 or more months	Only 1 or 2 months; Skipped because of "no" on Q14; (*or screened out at preliminary, 1st, or 2nd level screen*)	Almost every month; Some months but not every month	Refused; Don't know
Q15	Children hungry but Couldn't afford more Food	No (*or screened out at preliminary, 1st, or 2nd level screen*)	Yes	Refused; Don't know
Q16	Children did not eat for whole day	No (*or screened out at preliminary, 1st, or 2nd level screen*)	Yes	Refused; Don't know

Note: Include options in italics in coding criteria when screens are used; if screens are not used, disregard.

Any other question that a household fails to answer, for any reason other than being screened out or skipped over, is coded as "missing" (i.e., item nonresponse). This includes all responses with codes such as "don't know" or "refused to answer."

Assigning Children's Food Security Scale Scores to Households and Classifying Households as to Children's Hunger Status

Both the children's food security scale (the continuous, interval-level measure of food deprivation among children) and the categorical measure identifying households with hunger among children can be computed from the eight child-referenced items. The two measures and their applications are described in detail in chapter 2. This section specifies how to calculate each measure from the child-referenced items, recoded as described above.

For households with valid responses to all the child-referenced items, that is, with no responses coded as "missing" after the recoding described above, both scale score and categorical assignment can be read directly from table 7. More severe food deprivation, represented by a higher number of affirmative responses, is represented by a higher scale score. Two metrics are in common use, and both are presented in table 7. One is a linear transformation of the other, so the choice is a matter of preference.[26] The score of zero for households with no affirmative responses is arbitrary. The appropriate score for these households cannot be determined by the measurement model,

[26] Researchers working on scaling issues will generally prefer the "computational metric," because it is a logit-unit metric. See *Guide to Measuring Household Food Security, Revised 2000* (Bickel et al., 2000), Appendix C, for further information on alternative units of measure used in U.S. food security reports and data products and the relationships among them.

except that it is known to be lower than the score of households that affirmed one item, and may vary from household to household. Researchers should take this into consideration when carrying out analyses that include households with raw scores of zero.

If any households have missing responses to the items in the children's food security scale after recoding as described above, the choice must be made either to utilize one of several direct imputation methods to replace missing values with imputed affirmative or negative responses, or to employ Rasch model software to calculate household scale values. The direct imputation method described below is simple, and in most cases is quite adequate for the small proportion of missing values typically found in CPS Food Security Survey data. Using Rasch methods has the advantage of applying a sophisticated statistical imputation formula for the missing data, but requires special software as well as considerable statistical background and programming experience. Rasch methods may be needed if large proportions of responses are missing, or if the same item is missing for a large proportion of households, as may result from survey administration problems. For detailed information on imputation and an overview of Rasch-model capabilities, see *Guide to Measuring Household Food Security, Revised 2000* (Bickel et al., 2000).

If missing values for the child-referenced items have already been imputed in the context of the entire 18 items, those imputed responses may be retained for the children's food security scale. Alternately, the following procedure can be used to impute missing responses based just on the child-referenced items.

1. Preparatory to imputation, order the eight items by severity:

   1st (Q5) Relied on a few kinds of low-cost food for children

   2nd Q6) Couldn't feed the children a balanced meal

   3rd (Q7) Children were not eating enough

   4th (Q13) Cut size of children's meals

   5th (Q15) Children were hungry but couldn't afford more food

   6th (Q14) Children skipped meals

   7th (Q14a) Children skipped meals in 3 or more months

   8th (Q16) Children did not eat for whole day

2. Impute "yes" to a missing item if, for that household, there is a valid affirmative response to at least one item more severe than the missing item and no negative response to any item less severe than the missing item.

3. Impute all other missing items as "no." (Note that this procedure is methodologically conservative, tending to minimize false positives.)

4. Determine if cases with very few valid responses have enough information to be imputable, or if the entire case should be declared missing (i.e., unscalable—children's hunger status unknown). There are no hard and fast rules for this. It depends somewhat on how good you believe the partial data that you have are. If a household gave no valid responses to any of the child-referenced items, then it should almost certainly be declared unscalable. Note that a household could refuse all of the first stage questions and then be skipped out of the rest of the questionnaire at the 1st level screener. For such a household, it is probably not appropriate to score the skipped questions as "no" responses. Rather, those responses also should be assigned as missing and the household classified as unscalable—children's hunger status unknown.

Following imputation of any missing responses, children's food security scale score and categorical assignment for these households can be read directly from table 7 based on the number of items affirmed by the household. Any items imputed as affirmative are included in the count of affirmative responses.