Recent Advances Provide Improved Tools for Measuring Children’s Food Security\textsuperscript{1,2}

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\section*{Abstract}
Food security, or consistent access to adequate food, is important for children’s health and development. The first U.S. assessment of children’s food security was conducted in 1995 using the U.S. Household Food Security Scale, a measure based on 18 survey questions developed by the USDA and the U.S. Department of Health and Human Services. Three recent developments have improved on that early measurement method and expanded the scope for assessing children’s food security. 1) Development of the Children’s Food Security Scale, based only on the 8 child-referenced questions in the U.S. Household Food Security Survey Module, improved the measurement of children’s food security and was found to have excellent internal validity. 2) Questions indicating severe ranges of food insecurity and referenced to an individual child (answered by an adult proxy) were tested in a national health survey and found to have acceptable internal validity. 3) A food security measure based on a self-administered module was validated (internal validation only) for children \textgreek{prime}12 y of age. Children’s food security is correlated with that of adults in the same household, but the relation depends on the ages of children, such that separate measures of children’s and adults’ food security appear to provide better assessment than a single measure that attempts to represent both. Further research is needed to assess the relation between food security and children’s diet quality/variety and the effects of children’s food security on their health and development.

\section*{Initial development of food security measurement methods}
Food security, access by all people at all times to enough food for an active, healthy life, is one of several conditions necessary for a population to be healthy and well nourished. Access to adequate food is especially important for children because it has potential consequences for their development as well as for their current health status.

Children’s food security was an important component of 2 series of studies that developed key concepts and many of the survey questions that were later incorporated in the U.S. Household Food Security Scale and then in the Children’s Food Security Scale. Beginning in the mid 1980s, the Community Childhood Hunger Identification Project (CCHIP) developed a series of 4 questions about children’s food conditions as part of a survey module to assess hunger conditions in households\textsuperscript{(1,2)}. Analysis of survey response data confirmed that the child-referenced questions measured a common underlying condition, that the condition was related to but not unidimensional with a similar condition measured by household- and adult-referenced items, and that children were generally shielded from direct effects of household food shortages except when the effects on adults were quite severe. The most severe level of food insecurity identified by the CCHIP methodology was found to be associated with several adverse physical and mental health outcomes among low-income children\textsuperscript{(3)}.

During the same period, Radimer et al.\textsuperscript{(4–6)} developed a methodology for measuring food insecurity that included assessments of the adequacy of food quality and quantity at household, adult, and child levels, and of food anxiety at the household level. An internal (construct) validity assessment of the entire set of Radimer-Cornell items found that they measured 4 factors of food insecurity, identified as child, household, adult, and quality factors. The factors were substantially interrelated, although separately identifiable. Associations of the child factor with expected economic causes of food insecurity and dietary outcomes of food insecurity provided criterion validation of the measure.

\section*{Measuring children’s food security in combination with household food security}
In the early 1990s, the U.S. Food Security Measurement project was initiated with leadership from the USDA and the U.S. Department of Health and Human Services. The U.S. Household Food Security Survey Module, developed by the project, included child-referenced questions as well as household- and adult-referenced questions adapted from the Wehler-CCHIP and the Radimer-Cornell research. Analysis of initial survey data, collected in the April 1995 Current Population Survey Food Security Supplement (CPS-FSS) identified a set of 18 household-, adult-, and child-referenced items that measured primarily a single main dimension, conceptualized as economic access to adequate food—the principal component of household food security\textsuperscript{(7)}.

The U.S. Household Food Security Scale developed for the project by Hamilton et al.\textsuperscript{(7,8)} identified 4 ranges on the food security continuum: food secure, food insecure without hunger, food insecure with moderate hunger, and food insecure with severe hunger. The latter, most severe range was intended specifically to identify households in which children, if any were present, were likely to have been hungry at times during the year because of the household’s food insecurity. However, further research found that the category did not perform well at identifying...
such households. The number of households with children classified as food insecure with severe hunger was about half the number who responded yes to the question, “In the last 12 mo (was your child/were the children) ever hungry but you just couldn’t afford more food?” Although classification based on a multiple-indicator measure bears only a probabilistic relation to any specific question, the size of the discrepancy in this case called into question the validity of the “food insecure with severe hunger” category as a proxy for households with hunger among children, and USDA stopped reporting statistics based on this category after the initial 1995 report.

**Development of children’s food security scale**

The central problem with using the Household Food Security Scale, which includes both adult-referenced and child-referenced items, to assess children’s food insecurity is that the relation between the food security of adults and children in the same household depends critically upon the ages of the children. Young children are generally protected from disrupted eating patterns and reduced food intakes at much greater levels of adult food insecurity than are older teenaged children. The “severe hunger range” of the household scale was found to overestimate, by 48%, the prevalence of children’s hunger in households with no child >5 y of age, and to underestimate, by 33 and 20%, the prevalence of children’s hunger in the 2 older age groups (6–14 y and 15–17 y, respectively) (9). The 18 items in the Household Food Security Scale do not, in fact, measure a single dimension of food insecurity, but rather 2 dimensions, adult food insecurity and children’s food insecurity, which are correlated, but not collinear (9,10). (The bi-dimensionality of the adult and child items in the Household Food Security Scale also generally causes it to underestimate the food insecurity of adults in households with only very young children compared with adults in households without children.)

To overcome this problem, Nord and Bickel (9) proposed the Children’s Food Security Scale, which comprises just the 8 child-referenced items in the standard module. The Children’s Food Security Scale has excellent internal validity (9). The 8 items in the Children’s Food Security Scale are about evenly spaced with respect to their severity, and responses are strongly ordered.

That is, a household that affirms a specific item is likely to affirm all items that are less severe, and a household that denies a specific item is likely to deny all items that are more severe. A rough indication of the difference in severity of the items is seen in the item-response frequencies (Table 1). In 2005, 14.7% of households with children in the CPS-FSS responded affirmatively to question 1, whereas only 0.1% responded affirmatively to question 8.

The USDA provided prevalence statistics for food insecurity with hunger among children, beginning with the report *Household Food Security in the United States, 2000* (12). National-level statistics for 1995–1999 were provided by Nord and Bickel (9).

The raw score on the Children’s Food Security Scale is an ordinal, but not linear, measure of children’s food security. Of most importance, the interval between the raw scores 0 and 1 cannot be calculated statistically (unless additional assumptions are made about the form of the population distribution for food insecurity) and is usually much larger than any other single-unit difference. It is not appropriate, therefore, to summarize Children’s Food Security Scale raw scores using statistics such as mean or standard deviation, nor is it appropriate to use the raw scores in correlation or regression analyses, all of which assume linearity. Scale scores based on the Rasch measurement model can be used for these analyses, although households with extreme scores (0 and 8) may have to be omitted.

An issue left unresolved in the original development of the Children’s Food Security Scale was the specification of a lower threshold corresponding to the food secure or food insecure threshold on the household scale. Nord and Bickel (10) suggested, based on the cognitive content of the items in the scale, that a raw score of ≥2 indicated reduced quality and variety of children’s diets. USDA has not reported statistics based on a lower threshold because there has been no clear expert consensus on language to describe it. However, the NHANES, in documentation for the 1999–2000 and 2001–02 public-use data, identifies the following ranges based on the Children’s Food Security Scale:

**TABLE 1** Responses to items in the Children’s Food Security Scale by U.S. Households, 2005

<table>
<thead>
<tr>
<th>Question</th>
<th>Households responding affirmatively, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. “We relied on 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 your household in the last 12 months? (Often or sometimes are coded as affirmative.)</td>
<td>14.7</td>
</tr>
<tr>
<td>Q2. “We couldn’t feed our children a balanced meal, because we couldn’t afford that.” Was that often, sometimes, or never true for your household in the last 12 months? (Often or sometimes are coded as affirmative.)</td>
<td>8.5</td>
</tr>
<tr>
<td>Q3. “The children were not eating enough because we just couldn’t afford enough food.” Was that often, sometimes, or never true for your household in the last 12 months? (Often or sometimes are coded as affirmative.)</td>
<td>3.7</td>
</tr>
<tr>
<td>Q4. In the last 12 months, did you ever cut the size of any of the children’s meals because there wasn’t enough money for food? (“Yes” is coded as affirmative.)</td>
<td>1.3</td>
</tr>
<tr>
<td>Q5. In the last 12 months, were the children ever hungry but you just couldn’t afford more food? (“Yes” is coded as affirmative.)</td>
<td>0.8</td>
</tr>
<tr>
<td>Q6. In the last 12 months, did any of the children ever skip a meal because there wasn’t enough money for food? (“Yes” is coded as affirmative.)</td>
<td>0.6</td>
</tr>
<tr>
<td>Q7. (Asked if response to Q6 is affirmative): How often did this happen-almost every month, some months but not every month, or in only 1 or 2 months? (Almost every month or some months but not every month are coded as affirmative.)</td>
<td>0.4</td>
</tr>
<tr>
<td>Q8. In the last 12 months, did any of the children not eat for whole day because there wasn’t enough money for food? (“Yes” is coded as affirmative.)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

1. Survey responses weighted to population totals. Unweighted, n = 16,149.

2. Adapted from Nord et al. (11).
Measuring the food security of individual children

Since 1999, NHANES has included the U.S. Household Food Security Survey Module in its household-level questionnaire. Beginning in 2001, NHANES also collected information about the food security of sampled individuals (except for children aged 12–15 y). Adults and children aged 16 y of age were asked the 7 most severe adult-referenced questions in the Household Food Security Survey Module, adapted to refer specifically to conditions experienced by the respondent. Adult proxies for children 0–11 y of age were asked the 6 most severe child-referenced questions in the module, adapted to refer specifically to the sampled child. The individually referenced questions were not administered if the household food security status was fully food secure (no reported food insecure conditions) based on the household survey.

Preliminary statistical assessment by the authors of responses to the individually referenced questions (analysis not shown) indicates an adequate internal validity of the item sets to justify using them as multiple-indicator measures of individual-level food insecurity within the more severe range of food insecurity. Standards have not yet been specified for the classification of individual’s food security status based on the NHANES items.

Surveying older children directly

The food security status of older children (≥12 y of age) can be assessed using a self-administered survey tool (13). The Child Food Security Survey Module was developed by adapting questions from the Household Food Security Survey Module for direct administration to children. Cognitive testing was conducted to identify comprehension and response problems. Following pilot testing and further refinement, the module was administered to a larger sample of youth in a Mississippi school. The internal validity of the scale was assessed, and the measure was deemed to be sufficiently reliable for routine survey research. Further validation in other regions of the U.S. remains to be carried out.

In 2005, NHANES began using 5 of the questions from the Child Food Security Survey Module (adapted slightly) to provide individually referenced food security information for children 12–15 y of age. This was the age range for which individually referenced food security information was not collected in earlier years.

New USDA labels for ranges of food security

In 2006, USDA introduced new labels for ranges of children’s food security. The changes are consistent with new labels introduced at the same time to describe ranges of household food security. The labels for categories identified by the Children’s Food Security Scale are: High or marginal food security among children (raw score 0–1); Low food security among children (raw score 2–4); and Very low food security among children (raw score 5–8).

The label “Very low food security among children” replaced “Food insecure with hunger among children” and refers to the same range of severity.

USDA made these changes in response to recommendations by an expert panel convened at the USDA’s request by the Committee on National Statistics (CNSTAT) of the National Academies. The USDA requested the review to ensure that the methods used to assess household access to adequate food, and the language used to describe those methods, were conceptually and operationally sound and that they conveyed useful and relevant information to policy officials and the public. The CNSTAT panel affirmed the appropriateness of the general methodology currently used to measure food insecurity, but recommended that the USDA consider alternate labels to convey the severity of food insecurity without using the word “hunger.”

The word “hunger,” the panel stated in its final report, “should refer to a potential consequence of food insecurity that, because of prolonged, involuntary lack of food, results in discomfort, illness, weakness, or pain that goes beyond the usual uneasy sensation” (14). To measure hunger in this sense would require collection of more detailed and extensive information on physiological experiences of individual household members than could be accomplished effectively in the CPS-FSS.

Communicating the extent and severity of children’s food hardship to policy officials and the public will continue to be a challenge for researchers. Following the publication of the annual USDA food security report in November 2006 (11), the new descriptive “very low food security” was strongly criticized by several prominent newspapers and by anti-hunger advocates for diminishing public awareness of hunger problems in the country (15–17). At the same time, reporters criticizing the change used the word “hunger” variously to refer to conditions across a wide range of severity, suggesting that the older label, “food insecurity with hunger,” also miscommunicated to many readers (18,19). Whichever labels researchers use, they will need to provide, along with the labels, a description of the conditions that characterize households in each category.

Based on data collected in the December 2005 CPS-FSS, children’s food security was high or marginal in ~92% of U.S. households with children present (Table 2). About 7.5% had low food security among children, and 0.7% had very low food security among children.

Consequences of children’s food insecurity

To date, little research use has been made of the Children’s Food Security Scale, but many studies have demonstrated associations of children’s health, development, and well-being with household-level measures of food insecurity (including adult and child items) or with an older measure of food insufficiency at the household level. The household-level conditions represented by these measures have been found to be associated with behavioral

<table>
<thead>
<tr>
<th>Children’s food security status</th>
<th>Raw score</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>High or marginal (91.81%)</td>
<td>0</td>
<td>84.21</td>
<td>84.21</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>7.60</td>
<td>91.81</td>
</tr>
<tr>
<td>Low (7.51%)</td>
<td>2</td>
<td>4.51</td>
<td>96.31</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2.35</td>
<td>98.66</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>0.66</td>
<td>99.32</td>
</tr>
<tr>
<td>Very low (0.68%)</td>
<td>5</td>
<td>0.32</td>
<td>99.63</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>0.17</td>
<td>99.80</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>0.18</td>
<td>99.98</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>0.02</td>
<td>100.00</td>
</tr>
</tbody>
</table>

1 Survey responses weighted to population totals.
2 Calculated by the authors using data from the Bureau of the Census (20).
problems in preschool-aged children (21); poorer physical and psychosocial function in children in some age groups (22); several adverse health outcomes for infants and toddlers (23); lower educational achievement in kindergarteners (24); depressive disorder and suicidal symptoms in adolescents (25); poorer cognitive, academic, and psychosocial development of children (26); and poorer health status and higher incidence of stomachaches and headaches in children (27). All of these studies controlled for income, employment, and other household characteristics likely to confound the relations of interest.

To our knowledge, only one study to date has used the children’s food security scale to examine health outcomes of children’s food insecurity. Iron deficiency anemia was found to be substantially more likely in food-insecure than in food-secure infants and toddlers in low-income households (28).

The children’s food security scale, or the child-referenced items needed to calculate it, is available in several surveys that include measures of children’s development, health, and well-being, including: NHANES (beginning with the 1999–2000 data); the Early Childhood Longitudinal Study, Kindergarten, and Birth Cohorts; the Survey of Program Dynamics (especially the 1999 survey, which included an extensive child well-being module); and the Panel Study of Income Dynamics (especially the Child Development Supplements initiated in 1997).

Analyses of these data may shed further light on the effects of both household-level and child-level food insecurity on children’s health and development and the causal pathways through which these effects are mediated.

**Literature Cited**


