

1 **Assessing the Internal Validity of a Household Survey-Based**
2 **Food Security Measure Adapted for Use in Iran**

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1 **Assessing the Internal Validity of a Household Survey-Based**
2 **Food Security Measure Adapted for Use in Iran**

3
4 **Abstract**

5 **Background:** To assess the internal validity of the adapted US Food Security Module to measure
6 adult and child food insecurity in Isfahan ,Iran.

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8 **Methods:** The U.S. Household Food Security Survey Module was translated into Farsi and after
9 adaptation, administered to a representative sample of households in Isfahan, Iran. Data were
10 provided by 2,004 households from clusters of all districts in Isfahan randomly during 2005.

11 We assessed the internal validity of measures of adult and child food insecurity constructed from
12 the response data using statistical methods based on the Rasch measurement model.

13
14 **Results:** 53.1 percent reported that their food had run out at some time during the previous 12
15 months and they did not have money to buy more, while 26.7 percent reported that an adult had cut
16 the size of a meal or skipped a meal because there was not enough money for food, and 7.2 percent
17 reported that an adult did not eat for a whole day because there was not enough money for food.
18 Item calibrations estimated under Rasch-model assumptions ranged from 2.86 to 9.51. Most Item-
19 infit statistics were near unity, and none exceeded 1.20. Total range of 7.19 and 7.3 units were
20 measured for Isfahan adult and child scale respectively.

21
22 **Conclusion:** Both scales demonstrated acceptable levels of internal validity, although several items
23 should be improved. The similarity of the response patterns in the Isfahan and the US suggests that
24 food insecurity is experienced, managed, and described similarly in the two countries.

1 **Background**

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Food security—consistent access to adequate food for active, healthy living [1]—is an important foundation for good nutrition and health. During the 1990s, household survey-based methods for assessing food security were developed in the United States [2,3]. These methods have since used for annual monitoring of household food security in the United States since 1995 [4]. They have also been adapted for use in a wide variety of cultural and linguistic contexts around the world, and have generally demonstrated both internal and external validity [5-9]. In 2006, we- at the Isfanhan University of Medical Sciences- decided to adapt the U.S. module for Iranian population, translated it into Farsi, and administered it to a representative sample of households in Isfahan, Iran.

In this article, we assessed the internal validity of measures of household-level adult and child food insecurity based on the Isfahan Food Security Survey data. We determined the performance of each item and of the adult and child measures of food insecurity using statistical methods based on the Rasch measurement model [10-14]. Finally, we examined the extent to which the Isfahan food security scales appear to measure the same phenomenon as is measured in the U.S. using similar methods. This comparison explores the extent to which the phenomenon of food insecurity is similar in these two distinct cultural and linguistic groups.

1 **Methods**

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3 **The U.S. Household Food Security Survey Module (US-HFSSM) and Food Security Scale**

4 The US-HFSSM is a measure of the severity of household food access problems. It is based on self-
5 reported behaviors, experiences, and conditions collected by interviewing one member of each
6 household using a standardized survey instrument—the US-HFSSM [15]. The food security status of
7 each household is assessed by their responses to 18 questions (10 in households with no children)
8 about food-related behaviors, experiences, and conditions that are known to characterize households
9 having difficulty meeting their food needs. The questions cover a wide range of severity of food
10 access problems ranging from worrying about running out of food to children not eating for a whole
11 day. The questions have been developed from anthropological and case-study research among low-
12 income U.S. families regarding their experiences of food deprivation and how they described and
13 coped with them [16-18]. The questions reflect familiar conditions, experiences, and behaviors, and
14 use natural language derived from the qualitative research to describe them. Each question specifies a
15 lack of money or other resources to obtain food as the reason for the condition or behavior, so the
16 scale is not affected by hunger due to voluntary dieting or fasting. In the standard module, all
17 questions are referenced to the previous 12 months, although shorter time references (e.g., 30 days)
18 are also practical.

19 Responses to the questions in the food security survey module are combined into a scale using non-
20 linear statistical methods based on the Rasch measurement model. The scale provides a continuous,
21 graduated measure of the severity of food deprivation across the range of severity represented by the
22 items. Based on their food security scale scores, households are also classified into food security
23 status categories for monitoring and statistical analysis of the food security status of the population.

24 **Adaptation the US-HFSSM for the Isfahan Food Security Survey**

25 To adapt original module according to Iranian culture, a focus group including a number of
26 nutritionists and sociologists was formed.

27 The focus group was to consider Iranian eating habits and culture and to find close - to –Iranian –
28 culture equivalent terms in order to translate the original questionnaire to Farsi, so the survey module
29 was translated into Farsi and a back-translated into English and then it was examined for consistency
30 with the original. The questions were re-ordered so that the child-referenced questions were all
31 grouped together following the adult-referenced questions (a change that will also be implemented in
32 the U.S. module in future national surveys).

33 The original English version of the questions is included in table 1.

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1 **Data and Methods**

2 Data were provided by 2,004 households from clusters of Isfahan population randomly during 2005,
3 using questionnaire included a set of question adapted from the U. S module.

4 One household provided no responses to any of the food security questions and was omitted from the
5 analysis. For the remaining 2,003 households, item-specific missing data were rare. Only 34
6 households (1.6 percent) had any missing responses to the adult questions, and 28 of those missed
7 only a single question. Of the 990 households with valid responses to the child-referenced questions,
8 only 11 missed any questions and 8 of those missed only a single question. The most frequently
9 missed questions were the three “how often?” follow up questions (AD4b, AD8b, and CH5b).

10 We constructed and assessed separate scales for adult food security and child food security rather than
11 a single scale combining adult and child items. The combined scale has proved problematic for some
12 research and monitoring purposes in the United States because the relationship between children’s
13 and adults’ food insecurity in the same household depends to a great extent on the ages of children [5-
14 [19].Preliminary analysis confirmed that adult and child food insecurity also represented distinct
15 dimensions in the Isfahan Food Security Survey data.

16 Responses were coded into 10 adult items and 8 child items following standard methods. For the
17 often/sometimes/never responses, “often” or “sometimes” were coded as affirmative (value=1), and
18 “never” was coded as negative (value=0). For yes/no responses, “yes” was coded as 1 and “no” as 0.
19 For “how often?” responses, “almost every month” and “some months” were coded as 1 and “only 1
20 or 2 months” was coded as 0. The “how often?” follow up items were coded 0 if the base item (i.e.,
21 response to the preceding question) was 0, and missing if the base item was missing.

22 Based on an initial examination of response patterns, we omitted the three “how often” follow up
23 questions, questions, A4b, A8b, and C5b, from further analysis and from the proposed adult and child
24 scales. These questions added little information to differentiate levels of severity of food insecurity
25 because they were practically redundant with their base questions. For example, of those reporting
26 that adults had ever cut the size of meals or skipped meals in the previous 12 months, only 4 percent
27 reported that this had occurred in only 1 or 2 months. The corresponding proportion for adults not
28 eating for a whole day was 13 percent and for children skipping meals, 7 percent.

29 We then fitted the remaining 8 adult items and, in a separate analysis, the 7 child items to the Rasch
30 model using WINSTEPS software [20]. We examined the item-infit statistics to assess whether the
31 items all measured the same underlying condition with approximately equal discrimination. Item-infit
32 is an information-weighted misfit statistic that assesses the logistic association of each item with the
33 underlying condition measured by the set of items. In effect, it compares the strength of that
34 association for each item with the average for all items. The expected value is 1, and higher values
35 indicate weaker associations (i.e., misfit). We also examined item-outfit (outlier sensitive) statistics,

1 which are similar to item-infit statistics but are based on squared errors and are, therefore, sensitive to
2 highly improbable responses. A high outfit statistic indicates one or more erratic responses which
3 may arise from misunderstanding of the item by the respondent or miscoding by the interviewer or
4 may indicate an item that has a different meaning or relates to food insecurity differently for a small
5 proportion of respondents.

6 Then, for each scale, we assessed conditional independence of items by extracting principal
7 components from the correlation matrix of the standardized residuals. The residual is calculated for
8 each item-respondent pair as the difference between the response (0 or 1) and the probability of an
9 affirmative response given the calibration (i.e., the severity) of the item and the measured severity of
10 food insecurity of the household. Each residual is standardized by dividing by the square root of its
11 variance. (The variance is calculated as pq , where p is the probability of an affirmative response and q
12 is the probability of a negative response.) Principle components factor analysis was then conducted
13 based on the correlations of the standardized residuals across households.

14 Finally, we compared the item calibrations (severity scores) with those for corresponding items in the
15 U.S. Current Population Survey Food Security Supplement data. This comparison provides
16 information on the extent to which food insecurity is experienced, managed, and described similarly
17 in the two countries. If the relative severity of items is similar in the two surveys, then household
18 severity levels and prevalence rates may be meaningfully compared between the two surveyed
19 populations.

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1 **Results**

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3 **Adult Scale**

4 The range of severity of items was evident in the proportions of households affirming each item (table
5 2). Just over half of the households (53.1 percent) reported that their food had run out at some time
6 during the previous 12 months and they did not have money to buy more, while 26.7 percent reported
7 that an adult had cut the size of a meal or skipped a meal because there was not enough money for
8 food, and 7.2 percent reported that an adult did not eat for a whole day because there was not enough
9 money for food.

10 Item calibrations estimated under Rasch-model assumptions ranged from 2.86 to 9.51. The
11 calibrations for the adult scale were estimated on a logit scale (that is, with a discrimination parameter
12 of 1). For a group of households with the same level of severity of food insecurity, the difference
13 between the calibrations of two items corresponds to the predicted log of the odds ratio of affirmative
14 responses to the two items. The zero point of a Rasch model-based scale is arbitrary. For the adult
15 scale, the zero point was set such that the mean of item scores was 6.0, a value which ensured that all
16 item scores and all household scores would be greater than zero. The sample was sufficiently large to
17 provide reasonably precise estimates of item calibrations. Standard errors of estimation for most
18 items were less than 0.1 logit, with the largest 0.134 logits.

19 Item-infit statistics indicate that all items measure the same underlying condition. Most were near
20 unity, and none exceeded 1.20, which would indicate an item too weakly associated with food
21 insecurity to be included in the measure [21]. However, high outfit statistics for several items and low
22 infit statistics for two items suggest that improvement of some items should be attempted prior to
23 policy-oriented use of the module. A high outfit statistic indicates a larger-than-expected proportion
24 of highly improbable responses. Highly improbable responses include either an affirmative response
25 to a very severe item by a respondent who denied most or all of the less severe items, or a negative
26 response to a low-severity item by a respondent who affirmed several more severe items.

27 Responses by a very small proportion of households were responsible for the high outfit statistics.
28 Cross tabulation of item responses by raw score indicated that the highest outfit (AD3) resulted from
29 responses of just 8 households out of the total scaling sample of 1,241. The next three highest outfits
30 (AD1, AD4, and AD7) each resulted from responses of about 4 households (but different households
31 for each item). Nevertheless, qualitative work is suggested to be done to improve understanding of
32 these items. The low infit statistics (below 0.8) for AD1 and AD6 indicate that these conditions are
33 more consistently and strongly related to food insecurity than the other items. Improving the other
34 items so as to reduce the proportion of erratic responses will improve the overall model fit, and
35 thereby increase the infit statistics of these items.

1 Figure 1 plots the item severity scores for the Isfahan Food Security Survey data against those from
2 the U.S. Current Population Survey Food Security Supplement (U.S. CPS-FSS). With the exception
3 item A1 (Worried food would run out), the items are in the same severity order in the two surveys.
4 The general phenomenon of food insecurity appears to be experienced and described similarly in
5 these two populations. The higher severity of item A1 in the Isfahan study indicates that, controlling
6 for responses to all other questions, this condition is less likely to be reported by Isfahani households
7 than by U.S. households—that is, that it represents a more severe condition. The opposite is true for
8 item A3 (could not afford to eat nutritious meals). These differences may result from inexact
9 translation. The questions may refer to somewhat different objective conditions in the two languages.
10 Alternatively, food insecurity may be experienced and managed somewhat differently in the Iran and
11 the United States, with the result that the conditions to which these questions refer relate to food
12 insecurity somewhat differently in the two countries. The validity of the Isfahan scale does not
13 depend on the measure being the same as that used in the U.S. However, if comparisons are made, it
14 should be kept in mind that raw scores in the less severe range on the Isfahan scale will represent only
15 approximately equivalent conditions to those represented the same raw scores on the U.S. scale.

16 The assessment of conditional independence, or dimensionality, indicated an unexpectedly high
17 correlation among residuals of items A1 and A2 (“worried food would run out” and “food did not
18 last”; analysis not shown). With that exception, there was no indication of problematic multi-
19 dimensionality. In further developing the module, attention may be given to whether these two
20 questions are really asking about the same condition. If so, could one be changed to capture a slightly
21 different condition (for example, anxiety in A1 and actual depletion of food stores in A2)? If not, it
22 may be preferable to drop one of them. Questionnaire layout issues (such as page break or word use)
23 should also be examined to be sure these two items are not inadvertently grouped in the way they are
24 administered.

25 The overall fit of the Isfahan data to the Rasch model is similar to that of the same items in the U.S.
26 CPS-FSS. The standard deviation of the 8 item calibrations (2.44) was essentially the same as the
27 standard deviation of the corresponding item calibrations in the U.S. scale [1].¹ Greater consistency of
28 responses with the relative severity of items increases the dispersion of item calibrations as estimated
29 from the response data, and the standard deviations of the calibrations of equivalent items estimated
30 from two sets of response data stand in direct proportion to the average item discriminations. It is
31 expected that a household that says “yes” to an item will say “yes” to most of the items that are less
32 severe. Similarly, a household that says “no” to an item is expected to say “no” to most items that are
33 more severe. These patterns are not expected to be absolute, but only probabilistically true. Overall

1 model fit as assessed by the standard deviation of calibrations of equivalent items, is a measure of the
2 extent to which these expected response patterns predominate. Low average discrimination might
3 indicate that the questions were not consistently understood, or that respondents did not take the
4 survey seriously, or that interviewers were careless in reading questions or recording responses. The
5 consistency of response patterns in the Isfahan data is evidence that none of these problems were
6 present at any serious level in this survey.

7 The measured range of the Isfahan 8-item adult scale is from 2.38 (raw score=1) to 9.57 (raw
8 score=7), a total range of 7.19 units (table 3).² Taking into consideration the standard error of
9 measurement (which is a function of the number of items in the scale and their discrimination), the
10 measured range is sufficient to differentiate three ranges of severity.

11 The following prevalence estimates for the Isfahan sample are based on thresholds similar to those
12 used in the United States and Canada and are for illustrative purposes only. A threshold for food
13 insecurity of either 3+ (similar to that used by the United States Department of Agriculture) or 2+
14 (similar to that used by Health Canada) may be appropriate, depending on the consensus of national
15 experts on nutrition and public policy. Depending on the threshold selected, either 45.8 percent of
16 households (those with raw scores of 3 or higher) or 55.2 percent of households (those with raw
17 scores of 2 or higher) may be classified as food insecure (i.e., included one or more food-insecure
18 adults). If severe food insecurity is conceptualized as a condition in which adults either reported that
19 they were hungry but did not eat, or lost weight, or did not eat for a whole day (those with raw scores
20 of 6 or higher), then 11.6 percent of households in the Isfahan sample had severe food insecurity
21 among adults. A less severe threshold (raw score of 5 or greater) would also include households in
22 which adults ate less than they thought they should, even if they did not report being hungry. Based
23 on that less severe threshold, 17.4 percent of households in the Isfahan sample had severe food
24 insecurity among adults.

25 **Child Scale**

26 The child-referenced items were very consistently ordered. For example, item CH3, “children were
27 not eating enough” was denied by almost all households with raw score 2 and affirmed by almost all
28 households with raw score 3 (figure 2). The very low in fit of 0.52 for this item confirms its very high
29 discrimination (table 4). For classification at the level of severity of this item, the response to this
30 single item would perform almost as well as the 7-item scale. The in fit statistic for item CH7 was

¹ This comparison was adjusted for the larger number of items in the U.S. scale. The U.S. scale in Bickel et al. (2000) was estimated with both adult and child items in the model. The dispersion of item calibrations estimated using joint maximum likelihood procedures is biased upward for scales comprised of small numbers of items.

² The tabled value of 10.51 for raw score 8 is not included in the measured range. Technically, the score for households that said “yes” to all items cannot be determined without additional assumptions about the distribution of food insecurity in the population. They are more food insecure than those with raw score 7, but the size of the interval cannot be determined based only on item calibrations. The tabled score is an approximation based on a hypothetical raw score of 7.5.

1 slightly high (1.26). It may be possible to improve this item, but the high in fit reflects just two or
2 three out-of-order responses, since the the numbers of cases with raw scores 4 and higher were small
3 in this study. The average item discrimination of the Isfahan child scale is similar to, or somewhat
4 higher than, that of the U.S. scale.

5 The high outfit statistics of items CH2, CH4, and CH6 indicate that those items that had a
6 disproportionate share of highly unexpected answers. However, even the very high outfit of item
7 CH2, “could not afford nutritious meals for children,” resulted almost entirely from responses of three
8 households out of the scaling sample of 501. Nevertheless, further cognitive testing of these questions
9 should be undertaken to improve consistency of comprehension.

10 To facilitate comparisons of the severities of adult- and child-referenced items, the calibrations of the
11 child items as presented in table 4 have been adjusted by a linear transformation to equate the mean
12 and standard deviation to those for the same items when they were scaled jointly with the adult items.
13 (The scaling analysis of the combined set of items is not shown.) Items describing food insecure
14 conditions of children are more severe (less likely to be reported) than those describing similar
15 conditions among adults. For example, item C6 (children were hungry) is 1.3 logistic units more
16 severe than the similar adult item (A6); and item C7 (child did not eat for whole day) is 1.5 logistic
17 units more severe than the similar adult item (A8). These differences represent the extent to which
18 children are generally protected from adverse consequences of the household’s food insecurity even
19 at the cost of greater hardship for the adults. These relationships represent an average across
20 households with children, but they are not consistent across households. They depend on household
21 characteristics—primarily on the ages of children. This dependency is evidenced by the lower
22 discrimination of the child items when they are scaled with the adult items. Because of this
23 dependency, we recommend use of separate scales to measure the food security of adults and
24 children.

25 Figure 3 plots the item calibrations for the Isfahan child items against those from the U.S. CPS-FSS.
26 The items are in the same order of severity in the two surveys. The calibrations of the first two items
27 differ only slightly in the Isfahan data, while they differ substantially in the U.S. data. With that
28 exception, the relative severities of the items are similar in the two surveys. Thus, for children as well
29 as adults, the character of the phenomenon of food insecurity (although not necessarily its prevalence)
30 appears to be quite similar in the Isfahan and U.S. populations.

31 The assessment of conditional independence, or dimensionality (not shown), indicated that the 7 child
32 items represent, essentially, a single dimension.

33 Using thresholds consistent with those applied in the United States and Canada, 47.8 percent of
34 households in the sample (those with raw scores 2 and higher) had food insecurity among children,

1 including 7.3 percent with severe food insecurity among children (those with raw scores 5 and higher;
2 table 5).³

3 The measured range of the Isfahan 7-item child scale is from 3.29 to 10.59, a total range of about 7.3
4 units. Considering the standard errors of measurement, this range is adequate differentiate three
5 ranges of severity.

6 To assess the food security of households with children, conditions among both adults and children
7 may be taken into account. We cross-tabulated the 990 households with children in the Isfahan Food
8 Security Survey on the adult and child scales to examine these relationships. For this analysis, we
9 used the more severe thresholds on the adult scale (3+ for food insecure and 6+ for severe food
10 insecurity). Based on these classifications both adults and children were food secure in 41.8 percent
11 of households with children. In 58.2 percent, either adults or children or both were food-insecure,
12 including 10.4 percent in which only adults were food insecure, 11.5 percent in which only children
13 were food insecure, and 36.3 percent in which both adults and children were food insecure. In 14.2
14 percent of households, either adults or children or both were severely food insecure, including 7.0
15 percent in which only adults were severely food insecure, 2.3 percent in which only children were
16 severely food insecure, and 4.9 percent in which both adults and children were severely food insecure.

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³The more severe range of food insecurity among children is described as “severe food insecurity” by Health Canada and as “very low food security among children” by the United States Department of Agriculture. Prior to 2006, the category was described by the U.S. Department of Agriculture as “food insecure with hunger among children.”

1 **Discussion**

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3 The U.S. Household Food Security Survey Module as translated and implemented in the Isfahan Food
4 Security Survey provides internally valid household-level measures of food insecurity among adults
5 and children. Food insecurity, as measured by the adapted module, appears to be essentially the same
6 phenomenon as that measured by the corresponding module in the United States. That is, with minor
7 exceptions, food insecurity is experienced, managed, and described in terms of the same experiences
8 and behaviors, and in the same order or severity, in the two countries.

9 Three follow up questions in the U.S. module that ask how often specific reported conditions
10 occurred during the previous 12 months added very little information and were omitted from the
11 measures.

12 Although overall performance of the module was adequate, several questions should be examined
13 further using qualitative methods prior to applying the module on a larger scale or for policy-oriented
14 research. Specifically, adult items AD1, AD3, AD4, and AD7 and child items CH1, CH2, CH4, and
15 CH6 may benefit from further development. It should be kept in mind, however, that only a small
16 number of erratic responses account for the problematic fit statistics of these items. In a different
17 survey context or a somewhat different, or larger, sample, some of these problems may disappear.
18 Nevertheless, further examination of these items is warranted.

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- 1 **Abbreviations:**
2 - AD: Adult
3 - CH: Child
4 - US-HFSSM: U.S Household Food Security Survey Module
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12 Also contribution of each author is determined below:

13 First author as Main Researcher participated in all parts from designing proposal and data collection
14 to writing article and submission.

15 Second Author contributed in data analysis, conclusion of the results and article writing.

16 Third Author had contribution in manuscript edition and submission.

17 Forth Author had a consult for designing proposal.

18 Finally, the manuscript has been read and approved by all the authors.
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1 **Table 1: The Original English Version of the Questions**

Adult Questions:

- AD1. 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?
- AD2. “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?
- AD3. “(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?
- AD4. 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)
- AD4b. [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?
- AD5. 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)
- AD6. In the last 12 months, were you every hungry but didn't eat because there wasn't enough money for food? (Yes/No)
- AD7. In the last 12 months, did you lose weight because there wasn't enough money for food? (Yes/No)
- AD8. 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)

AD8b. [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?

Child Questions:

CH1. “(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?

CH2. “(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?

CH3. “(My/Our child was/The children were) not eating enough because (I/we) just couldn't afford enough food.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

CH4. 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)

CH5. In the last 12 months, did (CHILD’S NAME/any of the children) ever skip meals because there wasn't enough money for food? (Yes/No)

CH5b. [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?

CH6. In the last 12 months, (was your child/were the children) ever hungry but you just couldn't afford more food? (Yes/No)

CH7. 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)

1 **Table 2. Response characteristics, item calibrations, and item-fit statistics of items in the**
 2 **Isfahan Adult Food Security Scale**

Item *	Affirmative responses (%)**	Item calibration***	SE****	Item infit	Item outfit
AD1 Worried food would run out	48.7	3.45	0.078	0.76	1.85
AD2 Food ran out; did not have money for more	53.1	2.86	0.085	0.95	1.47
AD3 Could not afford to eat nutritious meal	50.9	3.17	0.081	0.97	4.20
AD4 Cut size of meal or skipped meal	26.7	5.90	0.077	1.03	1.80
AD5 Ate less than thought he/she should	21.3	6.58	0.084	0.90	1.62
AD6 Hungry but did not eat	13.2	7.93	0.101	0.76	0.81
AD7 Lost weight	10.3	8.60	0.113	1.09	2.03
AD8 Did not eat for whole day	7.2	9.51	0.134	1.05	1.14
Mean		6.00			
Standard deviation		2.44			
Discrimination parameter		1.00			
Number of cases	2,003	1,241	1,241	1,241	1,241

4 *The full wording of each question specified the time reference (previous 12 months) and specified
 5 that the condition occurred because of a lack of money for food.

6 **Percent affirmative responses(%) of all households with children

7 ***Mean of item calibration: The scaling sample omits households that affirmed no items or that
 8 affirmed all items, since those responses do not provide information about the severity of the items
 9 relative to one another.

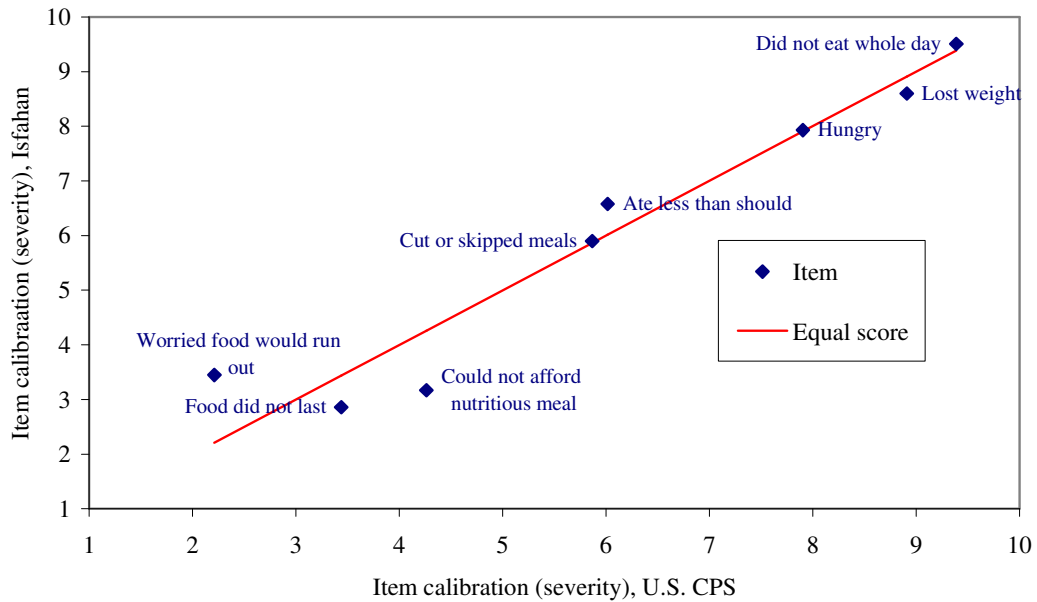
10 *** Item calibration indicates the severity of the item. The calibrations for the adult scale were
 11 estimated on a logistic scale (that is, with discrimination equal to 1). The zero point of the adult
 12 scale (which is arbitrary) was set such that the mean of item scores was 6.0, a value which ensures
 13 that all item scores and all household scores are greater than zero.

14 ****Standard error of estimation of item calibration

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4 **Figure 1. Comparison of calibrations (severity scores) of adult items**
5 **in the Isfahan Food Security Survey versus the U.S. Current**
6 **Population Survey Food Security Supplement**



Note: For this comparison, the calibrations of the items estimated from the U.S. CPS-FSS data were adjusted by a linear transformation to equate the mean and standard deviation of the the item calibrations to those estimated from the Isfahan data.

1 **Table 3. Measured values of severity of adult food insecurity by raw score on Isfahan adult**
 2 **food security scale, and prevalence of adult food insecurity among households in the Isfahan**
 3 **food security pilot survey**

Raw score	Household score*	Measurement error	Percent of households	Cumulative percent of households
0	Unknown**	NA	34.95	34.95
1	2.38	1.20	9.84	44.78
2	3.62	1.08	9.39	54.17
3	4.84	1.12	19.92	74.09
4	6.07	1.09	8.49	82.58
5	7.20	1.05	5.79	88.37
6	8.31	1.06	4.49	92.86
7	9.57	1.23	4.04	96.90
8	10.51 ²	1.57	3.10	100.00

5
 6 * Maximum likelihood estimates based on item calibrations in table 1.

7 ** The severity of food insecurity in households that affirmed no items (raw score=0) cannot be
 8 estimated based only on item calibrations. These households are more food secure than those that
 9 affirmed one item, but the size of the interval is unknown. Technically, the severity of food
 10 insecurity in households that affirmed all 8 items is also unknown, but given that this comprises
 11 only a small proportion of households, it is conventional to estimate their severity at a raw score of
 12 7.5, as was done in this case.

13

1 **Table 4. Response characteristics, item calibrations, and item-fit statistics of items in the**
 2 **Isfahan Children’s Food Security Scale**

Item *	Affirmative responses(%)**	Item calibration***	SE*****	Item infit	Item outfit
CH1 Few kinds of low-cost food	49.0	3.24	0.134	1.06	16.46
CH2 Could not afford nutritious meals	48.4	3.40	0.128	0.83	109.28
CH3 Not eating enough	32.0	5.86	0.094	0.52	0.98
CH4 Reduced size of meals	10.3	8.64	0.118	0.70	12.46
CH5 Skipped meals	6.8	9.53	0.145	0.85	4.97
CH6 Hungry	7.8	9.26	0.137	1.03	34.62
CH7 Did not eat whole day	3.3	11.03	0.222	1.26	1.16
Mean (item calibrations)		7.28			
Standard deviation (item calibrations)		2.88			
Discrimination parameter		1.50			
Number of cases in estimation sample	990	501	501	501	501

3
 4 *The full wording of each question specified the time reference (previous 12 months) and specified
 5 that the condition occurred because of a lack of money for food.

6 **Percent affirmative responses(%) of all households with children

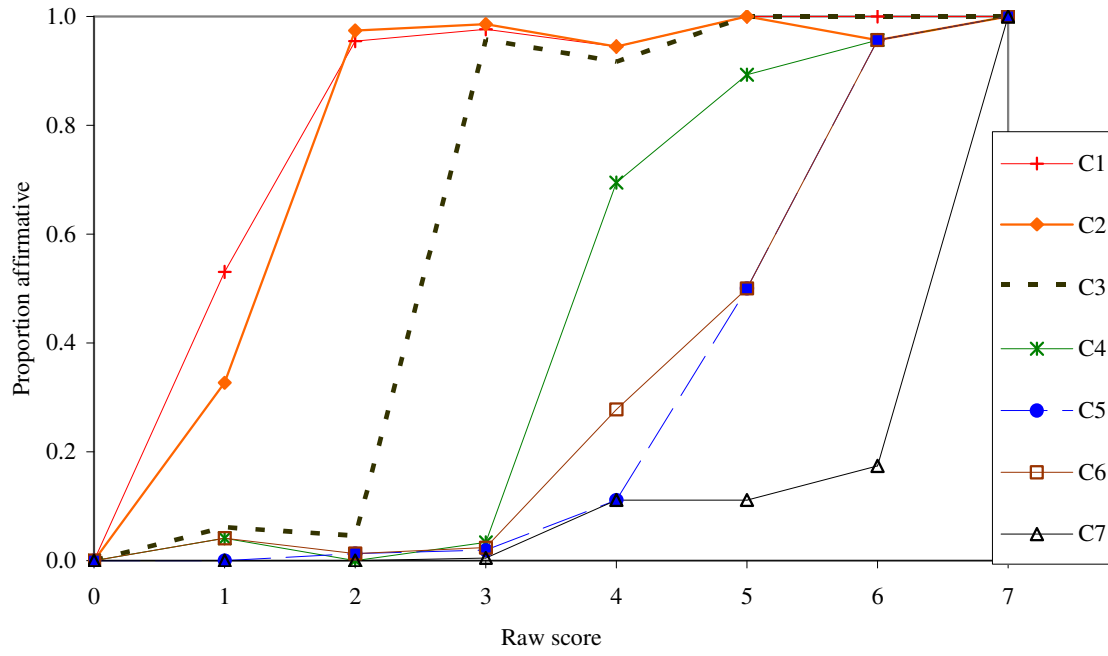
7 ***Mean of item calibration: The scaling sample omits households that affirmed no items or that
 8 affirmed all items, since those responses do not provide information about the severity of the items
 9 relative to one another.

10 Item calibration indicates the severity of the item. The calibrations for the child scale were
 11 estimated with the mean and standard deviation constrained equal to the mean and standard
 12 deviation of the same items when scaled jointly with the adult items. This provides the most
 13 meaningful comparison of the severity of child items relative to adult items. The discrimination
 14 parameter of 1.5 for the child scale required to effect this transformation indicates that the
 15 discrimination of the child items is considerably higher when scaled alone than when scaled jointly

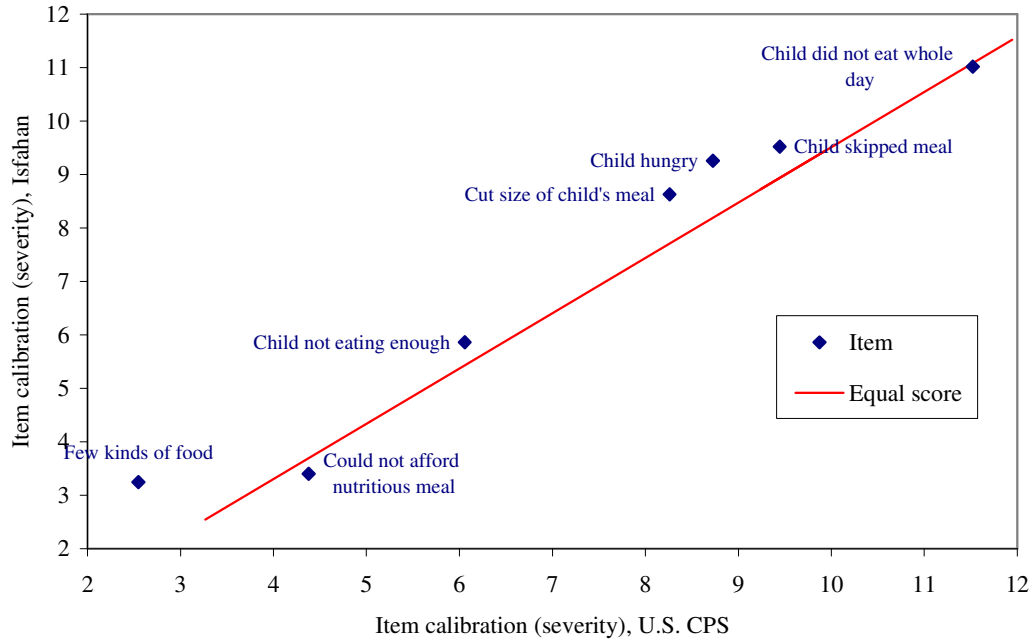
- 1 with the adult items—primarily a result of the differing relationships between adult and child
- 2 responses across households with children of different ages.
- 3 ****Standard error of estimation of item calibration
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Figure 2. Item responses by raw score, child items in Isfahan Food Security Pilot Survey



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3 **Figure 3. Comparison of calibrations (severity scores) of child items**
4 **in the Isfahan Food Security Survey versus the U.S. Current**
5 **Population Survey Food Security Supplement**



19 Note: For this comparison, the calibrations of the items estimated from the U.S. CPS-FSS data were
20 adjusted by a linear transformation to equate the mean and standard deviation of the the item
21 calibrations to those estimated from the Isfahan data.

1 **Table 5. Measured values of severity of food insecurity among children by raw score on**
 2 **Isfahan children’s food security scale, and percentage of households with each raw score**
 3

Raw score	Household score*	Measurement error	Percent of households**	Cumulative percent of households***
0	Unknown ²	NA	47.27	47.27
1	3.29	0.93	4.95	52.22
2	4.85	1.18	15.56	67.78
3	7.07	1.29	21.31	89.09
4	8.64	0.82	3.64	92.73
5	9.55	0.77	2.83	95.56
6	10.59	0.92	2.32	97.88
7	11.36 ²	1.13	2.12	100.00

4
 5 * Maximum likelihood estimates based on item calibrations in table 1.

6 ** The severity of children’s food insecurity in households that affirmed no items (raw score=0)
 7 cannot be estimated based only on item calibrations. The children in these households are more
 8 food secure than those in households that affirmed one item, but the size of the interval is unknown.
 9 Technically, the severity of children’s food insecurity in households that affirmed all 7 items is also
 10 unknown, but given that this comprises only a small proportion of households with children, it is
 11 conventional to estimate their severity at a raw score of 6.5, as was done in this case.

12 *** Households with no children present were omitted from these calculations.

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