

GOING BEYOND CALORIES – LOOKING AT EXPERIENTIAL FOOD INSECURITY IN URBAN SLUM HOUSEHOLDS IN KOLKATA

Chandana Maitra

School of Economics

University of Queensland

Abstract. This paper primarily addresses the issue of food access in urban India by investigating into the possibility of constructing an experience-based measure of food access following the U.S. Household Food Security Survey Module (US HFSSM), on the basis of a survey conducted in 500 households in the slums of Kolkata, India, in 2010-11. In past, National Sample Survey Organisation (NSSO) attempted to measure food insecurity, subjectively, by asking a single question based on whether or not a household gets two square meals a day but the survey apparently produced estimates too low to be believed. In the absence of reliable official data on self-reported hunger, it may be worthwhile to explore other methods of constructing such experiential measure of food access such as the US HFSSM. The questionnaire was administered in Bengali, based on which a nine-item food security scale was constructed according to which, 15.4% of the Kolkata slum households were food insecure including 2.6% severely food insecure. The finding has important implications for food security measurement and targeting in view of the fact that the experiential measure provides an alternative indicator of food access which can be used in conjunction with the existing indicators like calorie intake and nutritional status, for better identification of the food insecure households which makes targeting more cost-effective.

Key Words: calorie intake, food access, experiential, food security scale.

1. INTRODUCTION

The Indian economy has recently grown at historically unprecedented rates with per capita real GDP growth reaching 8.4% in 2010-11. But despite strong economic growth food insecurity remains a major issue in the country. Although food availability is not a major concern anymore (MSSRF 2002; 2010) access to food remains an issue of serious concern as reflected in the two outcome indicators of food access – hunger and malnutrition. The country's hunger situation is described as “alarming” in the Global Hunger Index (Menon et al., 2008). Child malnutrition rates in India are extraordinarily high, among the highest in the world, with nearly one-half of all children under three years of age being either stunted or underweight (Deolalikar, 2012). Indian adults today (like Indian children) have some of the highest levels of undernutrition in the world, with 36% of adult women suffering from low Body Mass Index (Deaton and Dreze, 2009). Maternal mortality rate, though declining sharply between 1990 and 2010, is still high in the country with 200 deaths per 100,000 live births in 2010 (WHO, 2012). The issue of access to food has assumed greater importance, in recent years, in view of the worldwide food price inflation of 2008 which is supposed to have eroded the purchasing power of the consumers to a great extent, leading to considerable worsening of an already grim food security scenario in the country.

Given this dichotomy of rapid economic growth and worsening food access condition, it is extremely important that the households with difficulty in food access are accurately identified so that they are able to reap the benefits of several government and non-government assistance programs. This in turn requires development of appropriate indicators of food access which would capture the real extent of household food insecurity and this is where the present study contributes. The present paper focuses on the development of an experiential measure of food access following the United States Household Food Security Survey Module (US HFSSM), as an alternative to the traditional quantitative indicator of food access which is calorie intake. It aims to investigate into the possibilities of adapting the US HFSSM in the context of low income urban slum households in the city of Kolkata, India. The reason it focuses on urban households is that urban poverty is on the rise and being “net buyers” of food, the urban poor are likely to be the hardest hit if there is a sudden hike in food prices (FAO, 2010) as the most recent one in 2008.

a) Background

In any analysis on the issue of “access” to food, the most difficult task is how to measure “food access.” Frankenberger (1992) identified four outcome indicators of food access – calorie intake calculated from Household Income and Expenditure Surveys (HIES), Food Frequency Assessment and peoples’ own perception of food needs, as the “direct” indicators and, households’ nutritional status (measured by anthropometric evidences) as the “indirect” outcome indicator. In the present paper we deal with “direct” outcome indicators only since poor nutritional status is not just an outcome of food insecurity but is a manifestation of a complex array of factors including availability of good sanitation and drinking water, mother’s nutritional status and level of education, quality of care and so forth.

As for Food Frequency Assessments, they aim to estimate food intakes by interview through standardized descriptions of portion sizes as well as amounts cooked and served, as part of food intake surveys. Some characteristics of Food Frequency Questionnaires (FFQs) such as their length and complexity, which is mainly due to asking for detailed questions on a long list of food items, portion sizes and food preparation methods, could affect the accuracy of collected information. On the other hand, poorly designed FFQs without comprehensive food lists may lead to misclassification and, to obtain relevant data, the surveys must be fine-tuned to the relevant cultural setting. Moreover, the main application of FFQs has been in estimating diet-disease relationship.

Increasing availability of household food consumption and expenditure surveys and improved computational capabilities have made calorie data collected from HIES feasible and attractive, making it the most widely used indicator of food access. “Analysts operate on the principle that other needs are usually satisfied when calorie intake is sufficient” (Maxwell and Smith, 1992). However, there are some inherent problems in using calorie intake as an indicator of access to food. It is expensive and cumbersome to collect data on calorie intake and it is subject to systematic measurement error (Srinivasan 1981; Bouis 1994; Strauss and Thomas 1995; 1998). Besides, inter- and intra-individual variations in nutrient requirements – based on genetics, activity levels, health status etc. complicates definition of appropriate intake threshold and thus, estimation of the incidence of hunger and undernutrition. Finally,

calorie won't capture the inherent “risk” factor associated with food insecurity (Barrette, 2002).

Apart from these conceptual issues, certain developments in the context of the Indian economy, in recent years, pose question on the appropriateness of using calorie intake as an indicator of food access. In India, demand for calories has been declining over the past few decades, across all expenditure classes, in both rural and urban sectors, despite a rising trend in per capita real income (Vaidyanathan 1994; Mehta and Venkatraman, 2000; Rao, 2000; Palmer-Jones and Sen, 2001; Patnaik, 2004; Meenakshi and Viswanathan, 2005; Radhakrishna, 2005; Ray and Lancaster, 2005; Sen, 2005; Deaton and Dreze, 2009, Li and Eli, 2010; Gaiha et al., 2010; Marjit, 2012). It seems, a shift in consumption pattern away from calories has occurred and even the poor have ceased to exhibit the lexicographic preference pattern they once had for calories (Sen, 2005). Whether the poor households are going for nutritionally superior food basket is a question which has to be answered by a nutritionist but the fact that a shift has occurred appears incontestable (Sen, 2005). A decline in calorie intake per se is not a problem as long as it is not accompanied by declining nutritional status. But the Indian nutrition scenario is equally grim as far as the latter is concerned, despite showing some improvement between 1998-99 and 2005-06, as indicated by the anthropometric indicators in the second and third rounds of National Family Health Survey (NFHS), respectively (NFHS, 2007). Additionally, India is also facing the double burden of malnutrition – undernutrition accompanied by overnutrition and obesity, partly initiated by the increasing tendency to consume processed food in recent years. In general, the above observation raises doubt on the relevance of calorie as an indicator of food access.

This leads us to focus on indicators which are based on households’ perception of food insecurity. In past, National Sample Survey Organisation (NSSO) attempted to estimate self-reported hunger (NSSO 1983; NSSO 1993-94; NSSO 2001; NSSO 2007) but apparently produced estimates too low to be believed.¹ Moreover, trend in self-reported hunger seems to be uncorrelated with calorie shortfall (Deaton and Dreze, 2009). Following Deaton and Dreze (2009), this lack of correlation might be taken as “casting further doubt on the validity of the hunger questions, or on the relevance of the calorie norms, or even both” (Deaton and Dreze, 2009, page 12).

In the absence of reliable official data on self-reported measure of hunger, we come upon the US HFSSM which is scientifically constructed, being based on a wider range of questions (18 items) that try to capture food insecurity at different levels of severity (Hamilton et al. 1995). The U.S. method of food security measurement has been applied in several developed and developing countries including India. There have been applications of US HFSSM in Canada (Health Canada), Russian Federation (Welch et al., 1998), Bangladesh (Webb *et al.*, 2001), Burkina Faso (Frongillo and Nanama, 2003), Hawai (Derrickson *et al.*, 2001), Iran (Morteza *et al.*, 2009) and so on. The two previous applications in India were at rural Orissa (Raj and Satpathy, 2002) and slums of New Delhi (Agarwal *et al.*, 2009).

The present study improves over the existing studies in the following areas. First, the present study administers the full 18-item questionnaire which is intended to capture a wider range of food insecurity conditions in the studied population, as opposed to a shorter version of HFSSM which several other studies have done in past (Agarwal *et al.* 2009). Second, the experiment was conducted in Bengali, one of the top ten widely spoken languages in the world today. Third, food security classification was based on locally meaningful standards rather than the U.S. measure which most of the other studies have done, except the large scale projects such as the one conducted in Bangladesh (Webb *et al.* 2001) or Burkina Faso (Frongillo and Nanama, 2003). Finally, it was possible to conduct external validation of the Kolkata food security scale with respect to household socio-demographic characteristics and nutrient intake which enhances the prospects for wider practical application of the scale.

The paper is organized in the following way. Section 2 outlines the study with respect to the survey location and survey methodology; Section 3 discusses the methodology of adapting the US HFSSM with respect to the development of the questionnaire and coding of survey responses. Section 4 discusses results and section 5 concludes with some policy recommendations.

2. THE STUDY

The construction of the food security scale was carried out on the basis of a survey conducted in the slums of Kolkata, India in 2010-11. Responses were collected from 500 randomly selected households from 15 slums in Kolkata Metropolitan City (KMC) area.² The survey

questionnaire has two main sections – section one collected information on socio-economic, demographic and environmental characteristics of the slums and also on details of consumption expenditure pattern of the surveyed households, which allowed us to calculate intakes of calorie, protein and fat following NSSO (2012). Section two presents the items on the food security scale. Altogether there are 22 items in this section but only 19 of them are scale items. All questions were asked with reference to “last 30 days”. The survey design and the sampling technique was so formulated as to capture the inherent diversity of the slums in terms of social, cultural and economic behaviour.

a) Survey Location

Kolkata is an interesting case study because of its importance as the major economic centre of Eastern India which is due to the concentration of industry, financial services and commercial activities within the city that began with the advent of East India Company in the mid-19th century. One of Kolkata’s most striking characteristics is prevalence of slums and squatter settlements characterised by pollution, inadequate sanitation and overcrowding – typical of slums in modern day mega cities in the developing economies where urbanization has been driven mostly by poverty induced migration of rural poor to urban informal sectors rather than due to growth induced expansion of the urban economy (Mukherji, 1993). These slums are often the centres of misery and food insecurity. Figure 1 shows the distribution of slum areas in Kolkata district (under Kolkata Municipal Corporation). Slums are spread all over the city with certain areas in the west and north-east showing very high concentration - 60 percent to 80 percent. Some areas in the south-west too have high concentration of slum areas – 40-60 percent.

[Figure 1 here]

b) Survey Methodology

The survey follows the sampling frame outlined in Urban Frame Survey (NSSO, 2008) conducted by Field Operations Division (FOD) of National Sample Survey Organization (NSSO), India. The survey design is “multistage sampling” where the selection has been done in three stages.

In the first stage, fifteen Investigator Units (IV)³ were selected randomly, by the method of “systematic random sampling”⁴, out of the three hundred and thirty IV Units listed under Kolkata Metropolitan Corporation (KMC) in UFS 2002-07. In stage two, fifteen blocks⁵ with “slum areas”⁶ were selected randomly from the IV Units selected above.⁷ Within each IV Unit there may be one or more blocks with “slum areas” or blocks with “no slum area” at all. In the IV Units having more than one block with “slum area”, systematic random sampling was applied again to select a block with a “slum area” in it.⁸ In the final analysis, there would be thirteen IV Units and fifteen blocks with “slum areas” in them.

Once the slum areas are selected, random samples of households were to be drawn from each selected slum. Since, the slums were found to be of unequal sizes, the next step was to decide on; i) the number of households to be drawn from each slum and; ii) the sample size. While drawing the final sample of households from each slum, two considerations were taken into account. First, the sample was to be stratified by male headed and female headed households - the reason being female headed households might behave differently as far as household food security is concerned.⁹ Second, stratification, if done correctly, is expected to give more precise (having lower variance) estimates for the whole population (Lohr, 1999).¹⁰ A higher percentage of households were selected from the bigger slums using a special case of optimal allocation - Neyman allocation. While sampling units of different sizes, the larger units are likely to be more variable than the smaller units. Optimal allocation is usually the best sampling method in such cases which samples the larger units at a higher rate and thus results in smaller costs and better precision. Neyman allocation is applied when the costs in the stata (but not the variances) are approximately equal (Lohr, 1999). We used this technique to calculate the sample size and allocate observations to each slum block. Based on above, a sample size of 500 was drawn out of the 15 slum blocks, with 426 male headed and 74 female headed households.¹¹

3. ADAPTING THE US HFSSM IN KOLKATA SLUM HOUSEHOLDS

a) Developing the Food Security Scale Questionnaire

The food security scale questionnaire administered in the Kolkata survey is an adapted version of the Food Security Core Module included in the food security supplement of U.S. Current Population Survey (CPS). The questions in the Kolkata survey were developed mostly by translating the questions in the US HFSSM. Some additional questions that have been developed and tested by researchers in Bangladesh were also included. A modest amount of cognitive testing was done to assure that the questions were understandable. The CPS questions had to be translated in Bengali, to facilitate communication with the local population. It was also necessary to rephrase certain items of the questionnaire to make them consistent with local culture and food habits. Before finalizing the questionnaire a pilot survey of the translated version was undertaken in 30 households to test comprehension of the questions and to assess the effects of several modifications that were made to adapt the U.S. module to local culture and conditions.

The food security scale is based on questions Q1 to Q21 in Part B of the questionnaire, excluding questions 2 and 9, which are not scale items. Table 1 lists the candidate items with corresponding abbreviations and the related domain to which the question belongs to. All of these items related to 1 of the 4 domains (uncertainty and worry, insufficient quality, inadequate quantity and reported consequences of reduced intake) described in (Bickel, 2000).¹² All of the scale questions were referenced to the previous 30 days rather than the previous 12 months to improve recall accuracy. All questions were asked with “yes” or “no” response options.

With the exception of three questions – Q5, Q12 and Q21, for all other questions “yes” responses were followed up with “How often?” asking about the frequency of occurrence of the event. The response options for “How often” were “often”, “sometimes” and “rarely.” “Often” was meant to correspond to a period of “a few times most week”, “sometimes” referring to “one or two weeks but not every week” of the month and “rarely” referring to “only a few days in a month” (more specifically, one or two days in the month). These cut-offs were decided on the basis of the pilot survey. The question about “rich food” requires special attention in coding. For all the other yes/no questions, a response of “yes” indicates a food-access problem or difficulty. For the “rich food” question, the opposite is true - a response of “no” indicates a possible food-access problem.

As shown in Table 1, 19 items were identified as candidates for assessment -11 of them related to conditions at the household level and among adult members of the household, and 8 about food conditions of children below 15 years of age.¹³ In developing the food security scale, the responses to only the adult-relevant items were combined into a scaled measure of the severity of food insecurity experienced by adults in the household, and responses to the child-referenced questions were combined into a scaled measure of the severity of food insecurity experienced by children in the household.

[Table 1 here]

b) Coding Survey Responses for the Food Security Scale

The responses were coded into scale items in three different formats to capture the time dimension in the phenomenon of food insecurity by referring to its frequency of occurrence:

- Ever during the reference period: Responses were coded 1 for “yes” (reverse for the question on “rich food”), ignoring the “how often” follow-up.
- More than rarely during the reference period: Responses were coded “1” for “yes” only if the response to the follow-up was “often” or “sometimes.”
- Frequent or chronic: Responses were coded “1” for “yes” only if the response to the follow-up was “often”.

c) Missing responses

Missing responses were rare. Only 1 response to a question about “adult skipping meals” was missed for 11 adult yes/no questions. Three of the follow-up “how often” questions to the adult question had one missing response each, each by a different household. As for the child items, 235 items had missing responses to all the child items for the simple reason that these households had no child present. Of the remaining 265 households, 260 (98.1 percent) had valid responses to all child items. The five missing responses were scattered across 4 items. Only the question about a child losing weight was missed by two households. The households with missing responses were omitted from the psychometric analysis, but were included in the prevalence tabulation, imputing responses of zero to the missing items.

Rasch model was estimated by conditional maximum likelihood (CML) implemented in Stata's "Raschtest".¹⁴

4. RESULTS

Results of psychometric analysis are presented for the adult "ever" coded scale only. The "more than rarely" scale turned out to have very low reliability and the psychometric properties of the chronic scale could not be assessed, in detail, due to lack of enough observations for higher frequency of occurrence. For the child scale even for the "ever" coding the three most severe child items had insufficient number of affirmative responses for analysis. Besides, external validation of the child scale could not be implemented because of lack of separate information on nutrient intake of children and on anthropometry which could not be collected, in the survey, due to time and resource-constraint. It is believed, experimenting with a larger data set in future, will bring out the psychometric properties of the various scales more clearly.

a) Fitting The Rasch Model

i) Item Fit Statistics

The item infit statistic is an information-weighted chi-square-like measure of the extent to which an item discriminates more or less sharply than the average item in the module. Items with average discrimination have an infit of 1, and higher infit statistics indicate less strongly discriminating items. Item outfit statistics are similar to infit statistics except that they are not information-weighted, and are therefore particularly sensitive to erratic or improbable responses. Items were assessed mostly based on infit statistics and to a lesser extent on item outfit statistics because outfit statistic is very sensitive to even one or two unexpected response in a sample of several hundreds.

Examination of the item fit statistics in scale #1 comprising all eleven items¹⁵ revealed that the infit of "same food" was unacceptably high (1.80) and the infit of "borrowed food" was marginally high (1.37). High infit indicates that an item is not strongly or consistently associated with the underlying latent trait (food insecurity) measured by the other items. Including such weakly associated items in a scale distorts the measurement of food insecurity

in some households, introducing measurement error into the data. Therefore, “same food” was removed from the model and fit statistics were checked for scale #2, comprising the remaining 10 items.¹⁶ The reason why “same food” performed poorly could be because in the surveyed households, dietary variety is quite low to begin with so that eating a diet with low variety is not a good marker for food insecurity.

With “Had to eat the same kind of food every day” removed from the model, the infit of “borrowed food” increased to 1.66 and was deemed to be unacceptably high and therefore was to be removed from the model too. Borrowing food from friends and relatives is a kind of coping strategy and perhaps that is the reason this item performed poorly as an indicator of food access. Such resource augmentation items were found to have performed poorly in the initially proposed U.S. items as well (Hamilton *et al.* 1997). Conceptually this is understandable. To some extent, these measures indicate access to outside resources, not just food insecurity. And ability to draw on outside resources may make it unnecessary to engage in stinting behaviour (as measured by the other items), thereby introducing a negative conditional correlation.

[Table 2 here]

The next step was to assess item fits for scale #3, comprising the remaining nine adult items, excluding “same food” and “borrowed food.” Table 2 shows item severity, infit and outfit for scale #3, nine adult items.¹⁷ With the two poorly performing items removed, the remaining nine items comprise an adequately fitting scale of adults.

ii) Item Severity Parameters

The “severity” parameters in food security measurement vary as to the severity of food insecurity to which they are sensitive. Stata reports the “severity” parameters with the mean arbitrarily fixed at “zero” because item and household severity parameters are on the same scale, which is an interval measure (with logit units), but not a ratio measure. That is, the measures do not have a natural zero point.” In the present paper, we report the severity parameters by adding seven to the estimates obtained from Stata to make them positive and consistent with the U.S. computation method.¹⁸

Stata reports the item severity parameters as “difficulty” parameters because in IRT field they are meant to test whether test items differ in difficulty. In scale #3, comprising 9 adult items, the most severe items are found to be adults staying “hungry” (10.87) and “not eating for a whole day” (10.87) and “skipping meals” (9.74) indicating serious food access problems. This is not surprising because only 2.4%, 2.2% and 3.8% of households affirmed these three items respectively. The least severe item turns out to be “rich food” - its severity parameter (0.48) being four logistic units less severe than the next item in severity order, “worried food would run out” (at 5.53). In the entire sample, 82% of households affirmed the “rich meal” question which explains its low severity. It almost single-handedly identified raw score 1- of the 260 households with this raw score, 258 affirmed the “rich meals” question. It remains in the scale because its infit statistic is quite good but for future applications, this item might well be omitted unless it is important to identify this very light level of food insecurity.

A somewhat unexpected result is the relatively low severity of the item “lost weight”. In all other countries where it has been tested this item has been very high in severity ranking, almost equal in severity with “hungry” or “whole day”. It seems the Bengali translation of the question needs to be carefully scrutinized before further application in future.

iii) Household Severity Parameters

[Table 3 here]

Table 3 presents household severity parameter and the distribution of households by raw score (number of affirmative responses, assuming that the household responded to all items in the scale) on adult food insecurity scale #3. Household severity parameters are a continuous interval-level measure of the extent of food insecurity or hunger in the household. Stata reports them as “ability” parameters as in IRT they are meant to test whether students differ in “ability.” Household scale scores cannot be calculated precisely for households that affirm no items or for households that affirm all valid items. While Rasch modelling 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 score of zero assigned to such households in some data sets is purely nominal. For the few households that affirm all items,

the standard solution for this problem is to assign them the score corresponding to assigning 10.5 for a questionnaire such as the Kolkata 11 item adult questionnaire above.¹⁹

b) Adjusting the metric so that the scale is equivalent in meaning to the U.S. scale

The severity parameters of the items in the Kolkata adult food security scale were compared with those of corresponding items in the U.S. scale. The comparison was intended primarily to assess the comparability of measured severity levels and prevalence statistics between the two countries. The reliability of the Kolkata scale does not depend on the items having similar relative item severities to their counterparts in the U.S. scale.

In comparing the relative severities of estimated Rasch model parameters from the two different survey populations in U.S and Kolkata, the first step was to equate the metrics of the two scales. This was done by adjusting the U.S parameter values by a linear transform so as to equate the mean and standard deviation of the six adult items which were found to be approximately equivalent in the two surveys – worried, ran out, eat less, hungry, lost weight and whole day.

Initial comparison shows that the severity of “lost weight” and “ate less” differed substantially in the two surveys. The item about losing weight is very much less severe (i.e., more likely to be affirmed given responses to other items) in the Kolkata survey (6.03) where it is reported at about the same frequency as running out of food stores (6.44) and not much less frequently than worrying food would run out (5.53), while in the U.S. (and most other countries where it has been tested), it is reported at about the frequency of having been hungry but not eating. It seems highly probable that this question is understood to refer to a different objective condition in Kolkata. It may be worthwhile to examine the translation of this question and to explore its meaning in focus group or cognitive interview methods. The item fits the Rasch model well. The surprise is its low level of severity.²⁰ Therefore, this item was excluded from the metric adjustment set and item calibrations were readjusted using mean and SD of the remaining 5 items.

After omitting “lost weight” from the metric adjustment set, the relative severities changed markedly and now the item “ate less” was found to be substantially less severe in the Kolkata survey (only 6.15 as against item calibration of 8.17 in the U.S adjusted scale metric). The question on “eating less” was adapted directly from the Bangladesh Module (Webb *et al.* 2001) and was found to have low severity in Bangladesh too. The reason could be a different social condition in typical Indian households where some family member (typically women) would eat less just to keep more for husband, kids or major earning member in the family merely as part of a cultural practice (Harris, 1990; Wheeler, 1984). Thus, this behaviour may not always be the reflection of the most severe food insecurity condition in the family. In the Kolkata survey module, the question on eating less was followed by a question on “if you ate less, who did you sacrifice for?” Of those who responded to this question, 22% of the respondents replied that that they sacrificed food for their spouse (husband), 20% replied, for the children and 16% said that they ate less to keep more food both for the main working adult in the family and the children. Therefore, “ate less” was also removed from the metric adjustment set and the remaining four items tested.

After removing from the adjustment set the two items that differed substantially in severity in the two surveys, the remaining four similarly worded items now showed similar severity parameters. Figure 2 compares the relative severities of selected items in the Kolkata food security scale with corresponding (or roughly corresponding) items in the U.S. food security scale.

[Figure 2 here]

For the four items considered to be equivalent, “worried,” “ran out,” “hungry” and “whole day,” the relationship is almost linear, providing inferential evidence that these four items reference similar objective conditions in the two populations. This, in turn, indicates that household severity measures based on all of the items in each of the scales (after adjustment of the U.S. scale) will indicate approximately equal levels of severity of food insecurity in the two diverse population groups of Kolkata and U.S. The comparison of item severity parameters between U.S. and Kolkata are presented in Table 4 and the household severity parameters for each raw score in the Kolkata scale (as well as the adjusted U.S. parameters) are shown in Table 5.

[Table 4 here]

[Table 5 here]

c) Setting Thresholds on the Food Security Scale

Once a scale has been specified, that is candidate items selected and the metric adjustment set determined, the next important step is setting threshold on the scale for classifying the households into various food security categories. In the context of the Kolkata Survey, four categories were identified – highly food secure, marginally food secure, moderately food insecure and severely food insecure, in order of increasing severity.

[Figure 3 here]

The first step in deciding on a suitable cut-off was selecting an item which would most appropriately describe the experience of food insecurity in a typically low income Bengali household. The next step was to plot the severity parameters of items and raw scores in the 9-item adult scale (#3) on the same severity scale. Figure 3 presents this item-raw score map which is based on the estimated item and household severity parameters for the 9-item adult scale presented in Table 2 and 3. On the basis of the item-raw score map, a scale developer can give meaningful content to a given raw score based on the item that most nearly matches it in severity. It also displays how well the difficulty of the items is matched by severity of food insecurity. Thus, this presentation is useful in determining appropriate threshold for categories of food insecurity. Figure 3 also presents a comparison of the items and raw score for the adjusted U.S. items (based on Tables 4 and 5) to allow a meaningful comparison of items and raw scores across the diverse population groups of Kolkata and the U.S.

i) Cut-off Selection for the Category “Food Secure”

In Bengali, “getting two square meals a day” has always been the typical expression for indicating food insecurity. In that sense, the item on “two square meal” seems, subjectively, to be the most appropriate candidate for demarcating the food secure and food insecure households in Kolkata. In fact, not only in the Bengali speaking State of West Bengal, “two square meals a day” is actually a standard of food adequacy across all States of India. That is why, NSSO (1983; 1993-94) actually published the report on food adequacy in India on the

basis of the question “whether all members of the household get two square meals a day.” Thus, it is an expression which is sufficiently “robust” with respect to time and region.

With the item “two square meals” (“< 2 meal” in the graph in Figure 3) as the marker of food insecurity, the corresponding raw score, for placing threshold, can be determined from the item-raw score map in Figure 3. It suggests that a threshold of 5+ might be appropriate if it is thought that adults not eating at least two square meals are the right indicator of food insecurity.²¹ On the other hand if it is thought that the category should almost require an affirmative response to that item, then the 6+ threshold would be appropriate.

It is of interest to know how the threshold of 5+ for food insecurity on the Kolkata scale compares with the standard used in the US. These would not necessarily be identical, given the differences in culture and income, but, in fact, they turn out to be quite similar. The severity levels corresponding to the food-insecure thresholds on the two scales were compared based on the adjustment of the U.S. scale described above (Figure 3). In the U.S. case, the cut-off for food insecurity is at raw score 3, which is very close to the same severity level as raw score 5 on the Kolkata scale. Thus, the threshold of 5+ on the Kolkata scale not only identifies food insecurity at a severity level consistent with cultural norms, but is also approximately equivalent to the threshold for food insecurity in the U.S. Based on the above, the final decision to set the cut-off for demarcating the food secure and food insecure households in the Kolkata sample, was on raw score 5. Going by this criterion all households in the sample with raw score 5 and above would be considered food insecure.

ii) Cut-off Selection for the Category “Marginally Food Secure”

Within the category of “food secure”, there would be variations in the degree of food security in the sense that some households will be more food secure than others. A household with scale score 0 and scale score 4 are both food secure but there might be difference in degree of severity of food insecurity. It is important to capture the effect of such variations in the data. Thus, for analytical purposes it might be useful to disaggregate the category “food secure” into two other categories - “highly” food secure and “marginally” food secure. The threshold for identifying the marginally food secure households can be placed near the severity level of the item “worried food would run out” (“worried” in Figure 3) because one would expect some difference in food security status for those households which express anxiety on the

possibility of running out of food store and those who do not. The category “marginally food secure” households will thus comprise all households which have given at least some indication of food-access problems beyond not preparing “rich food”. The corresponding raw score from the item-raw score map in Figure 3 is 3. Thus, all households with raw score 3-4 can be categorized as “marginally” food secure, being on the verge of food insecurity. A comparison of the score with the U.S. adjusted parameters (Figure 3) shows that raw score 3 in Kolkata scale corresponds to a raw score of 1 in the US scale, the cut-off for marginal food security in the U.S.

iii) Cut-off Selection for the Category “Severely Food Insecure”

Again, within the category of “food insecure” households, some would be more severely food insecure than others. For some descriptive and research purposes, it may be useful to differentiate households with moderate and severe food insecurity. Therefore, the next task was to identify a candidate item that would characterize the minimum level of severity that should be described as “severely” food insecure. The item next to “two square meal”, in order of severity, was “adult skipping meal” (“skipped meal” in Figure 3) and this seems to be the appropriate threshold as the first sign of falling into more severe food insecurity would be to skip one meal. It actually means something more than “not getting two square meals a day.” There are enough evidences, in the Bengali literature, of such typical expressions for severe food insecurity which would imply “skipping a meal” or “skipping a meal of rice,” to be more precise (Devi, 1979). Households that reach this level on the scale have at least one, and potentially more, adult members who have experienced resource-constrained hunger. Thus, households that report repeated reductions in adults’ food intake in terms of skipping a meal, in combination with affirmative responses to all less severe questions, are classified as severely food insecure. Thus, the boundary for demarcating severe food insecurity should be placed near the severity level of the item “adult skipping meal.”

The item-raw score map in Figure 3 shows the raw score corresponding to “adult skipping meal” is 7. A comparison of the scores with the U.S. adjusted parameters from the item-raw score map shows that the raw score of 6, marker of “very low food security” in US, corresponds to a raw score of 7 in the Kolkata scale. Thus, the U.S. range for very low food

security (raw score 6) is best approximated by raw score 7 on Kolkata scale. Therefore, it may be appropriate to place the threshold for identifying “severe food insecurity” on a raw score of 7. Going by this criterion, all households with raw score 7 and above would be considered severely food insecure.

d) Classifying Households by Food Security Status

Based on Table 6, the measured range of the Kolkata adult food security scale is 7.52 logistic units ranging from 3.57 to 11.09, as evident from the second column in the Table. We do not consider 12.59 because it is a kind of pseudo-value based on raw score 8.5. Raw score 5 corresponds to “true” (average) severity of 7.32 and raw score 4+ corresponds to a true (average) severity of 6.54. The scale value of the food-insecure threshold, thus, corresponds approximately to the midpoint between the scale values of raw score 4 and raw score 5, which is 6.93. Similarly, the threshold for marginal food security is 5.43, the mid-point of raw score 2 and 3 (scale scores 5.03 and 5.84 respectively) and that for severe food insecurity is 9.26, the midpoint of raw score 6 (scale score 8.54) and 7 (scale score 9.98).

[Table 6 here]

With complete information on where to set the thresholds on the food security scale to convert it to a categorical measure, four categories of food security could now be identified - highly food secure, marginally food secure, moderately food insecure and severely food insecure. The percentage at a more severe level could not be reliably estimated because too few cases would be in the category to ensure a reliable estimate. This makes it possible to set a table, similar to Table 6, assigning scale scores and food security status categories. Reading from Table 6, 84.6% of households in the Kolkata sample were food secure including 76.2% highly food secure and 8.4% marginally food secure; and 15.4% were food insecure, including 12.8% with moderate food insecurity and 2.6% with severe food insecurity.

e) Internal validity and Reliability of the Kolkata Nine-item Adult Scale

i) Inter-relationship among indicator items

The internal validity of the experiential food security measure is generally assessed based on the Rasch measurement model - by examining the interrelationships among the indicator items. “Consistency of inter-item associations with expected patterns is evidence that the item responses, when appropriately combined, are a valid measure of the unobserved latent condition” (Hamilton *et al.* 1997).

With respect to Kolkata Survey Module, there is enough evidence that the 9 items in the adult scale, adequately measure the underlying construct, food insecurity. This is evidenced, primarily, by the ordering of the responses to the nine adult items. The pattern of relative item severity should reflect the successive stages of food insecurity established by previous research - first stage reflecting concerns about food supply and adjustment related to kind and quality of food eaten and the final stage reflecting drastic reductions in adult intake. In between, should lie the conditions involving gradual reductions in adult food intake (Hamilton *et al.* 1997).

[Figure 4 here]

The item severity parameters in Kolkata 9-item adult scale, more or less correspond to this pattern, with some overlap in severity ordering in some of the questions. Figure 4 shows the pattern of relative item severity. The least severe questions are those relating to anxiety and quality of food (rich food, worried) and the most severe questions relate to drastic reduction in adult intake (hungry and whole day). In between, lies the questions on graduated reduction in intake (two square meal and ate less). A notable exception is the item “lost weight” which is concentrated in the middle range of the severity scale along with the questions on food supply (ran out) and gradual reduction in amount (two square meal and ate less), whereas it should have been placed quite high on the scale, next to being hungry.²²

ii) Cronbach’s Alpha

Sometimes researchers turn to a familiar reliability statistic, Cronbach’s alpha (Cronbach, 1951), to assess the reliability of a set of questions, as a measure of household food security. Cronbach’s alpha for the 9-item adult food security scale was computed and it turned out to be exactly 0.85 which indicates the scale is reliable (Frongillo, 1999). Cronbach’s alpha will

generally increase as the intercorrelations among test items increase, and is thus known as an internal consistency estimate of reliability of test scores.²³

iii) Rasch Reliability and Classification Reliability

The more appropriate tests of reliability would be Rasch reliability statistic or Classification reliability statistic which analyses sensitivity and specificity of the model. Rasch reliability is the modelled variance divided by the total variance where total variance is the sum of modelled variance and error variance. With respect to scale analysis, modelled variance is the variance that would exist if all households in each raw score had exactly the mean (household) severity and error variance is the variance within each raw score. For the Kolkata 9-item adult scale, Rasch Reliability was found to be 0.75 approximately.

The main classification reliability statistics are sensitivity and specificity. Sensitivity is the proportion of those truly insecure that are measured as insecure and specificity implies the proportion of those truly secure measured as secure. It is also helpful to calculate positive predictive value (calculated as the ratio of true positives over true positives plus false positives) which indicate the probability that a household identified as food insecure (screened positive) by the scale actually is food insecure. Assuming a zero-bias threshold (which equates false positives and false negatives), sensitivity and specificity for the Kolkata 9-item adult “ever” scale were estimated at 0.83 and 0.97 respectively. Positive predictive value for the scale was found to be 0.85.

Based on the above results, in general, it can be concluded that the adult 9-item scale is a valid instrument for evaluating the extent of food insecurity in the context of the surveyed population.²⁴ Internal validity of the scale is thus established but further work remains on external validation with respect to other proxy indicators of food insecurity, before attempting any general recommendation for future application.

f) External validation of the Kolkata Food Security Scale

i) Construct Validity of the Kolkata Adult Nine-item Adult “ever” Scale

The construct validity of a food security measure is assessed by examining its association with conditions that are known (or expected) to be either causes or consequences of food insecurity or measures of closely related conditions. If the pattern of association is in the expected direction then it can be taken as an indication of validation of the constructed measure. In order to establish construct validity three categories of food insecurity were considered: highly food secure (raw score <3), marginally food secure ($3 \leq$ raw score <5) and food insecure (raw score ≥ 5). Households with moderate and severe food insecurity were analysed as a single category because only a small number of households (only 13) were present in the latter category.

[Table 7 here]

Table 7 presents the percentage of households in each food security category based on a household's selected socio-demographic and economic and characteristics. As evident from Table 7, food insecurity was found to be declining with increase in the level of income and improvement in poverty status.²⁵ Food insecurity was also found to be more prevalent in households not owning an asset, in female headed households, in casual labor households, in households with children and in households with illiterate heads. These results indicate that the relationships are in line with a priori expectations.

ii) Criterion Validity

“Criterion validity” compares the measure with a known “gold standard.” Criterion validation is not generally feasible for food security measures, since food security is a latent trait and not, in a practical sense, directly observable. If food insecurity is consistent access to adequate food for healthy, active, living, then realized adequate food intake may be considered a criterion test.²⁶ Assuming dietary intake or food supply to be valid indicators of food security, several studies have examined the association between perceived adequacy of the household food supply and household members' dietary intakes and between household

food security status and available household food supply (Cristofar and Basiotis, 1992; Kendall et al., 1995; Rose and Oliveira, 1997) and in all cases it was revealed that individuals from food insecure households were likely to have lower dietary (calorie) intake.

With respect to the surveyed sample of Kolkata slums, we proceed to test criterion validity in terms of nutrient intake – calorie, protein and fat and some selected food items. Data were collected on the quantity and value of food items consumed by the households during a period of last 30 days preceding the date of inquiry. The quantity estimates of the food items consumed by a household were measured in units of calorie, protein and fat after application of conversion factors appropriate to the items of food, using the Nutrition Chart provided in NSSO (2012).²⁷ The estimates of total nutrient equivalent of all food consumed by the household during the reference period was derived by aggregation over different groups (components) of food. The eight major food groups that have been considered are: cereals, pulses and soybean, milk & milk products, vegetables and fruits, sugar and honey, meat-egg-fish, edible oil and miscellaneous food products.²⁸ Finally, the required figure on the level of calorie, fat and protein intake per day per person was calculated by sub-dividing this aggregate by the product of total number of members in the family and the duration of the reference period which was 30 days.²⁹

[Table 8 here]

Table 8 presents a simple description of the raw data - it shows intake of protein, fat, calorie and selected food items for two categories of food security status - food secure (raw score <5) and food insecure (raw score ≥5). It reveals the following facts: (i) average consumption of all nutrients and food items are much higher in food secure households compared to food insecure households and the differences are statistically significant; (ii) not only do the food secure households consume higher quantities of nutrients and selected food items but also their consumption of most of the items is adequate with respect to ICMR prescribed norm.³⁰ Cereals and milk are the only two items which food secure households consume inadequately while the only item that food insecure household consume adequately is vegetables.³¹

This may indicate a fair amount of association between a household's food security status and nutrient intake. It can be further tested by computing the correlation between prevalence rates of food insecurity and nutrient deficiency. If households consuming fewer than ICMR

prescribed norm of 2100 kcal of calories are termed as food insufficient, the tetrachoric correlation between binary food security status (1 if food insecure, 0 otherwise) and food insufficiency (1 if per capita per day calorie intake <2100 kcal, 0 otherwise), turns out to be 0.56 and it is statistically significant ($p < 0.000$). Similarly if ICMR prescribed norms of protein and fat intake are taken as appropriate thresholds for these nutrients, tetrachoric correlation between protein deficient households (1 if protein deficient and 0 otherwise) and food security status turns out to be 0.73 and between fat deficient households (1 if fat deficient and 0 otherwise) turns out to be 0.64. Both correlations are significant ($p < 0.000$) indicating that the association is strong enough.

5. SUMMARY AND CONCLUSION

The motivation behind the present study comes from the fact that despite strong economic growth, food insecurity continues to be a major issue in India. Calorie intake, the proxy indicator of food access, has been declining over the past few decades in both urban and rural households in India, indicating a shift in preference away from calories. There also exists an apparent lack of correlation between calorie intake and information on self-reported food security status provided by the National Sample Survey Organisation, India. Paradoxically, India is also facing the doubly burden of malnutrition experiencing undernutrition combined with overnutrition and obesity, primarily caused by the recent trend of increasing fast food consumption. The above facts raise concern on the validity of calorie as an indicator of nutritional adequacy and food access and at the same, question the reliability of self-reported hunger figures obtained from NSSO (1983; 1993-94; 2001; 2007). Given above, we attempted to explore the possibility of developing an alternative measure of food access, in terms of an experiential indicator, by adapting the US HFSSM in the context of low income urban households in Kolkata, India. The results show that the US HFSSM can be adapted successfully in the context of the studied population as far as the adult scale is concerned, and the newly constructed measure can serve as an alternative indicator of food access.

The present study is an improvement over the two existing studies carried out in India so far, because of the following reasons; i) unlike the Delhi study which was conducted in a single

slum, the Kolkata study was conducted in 500 households spread across 15 slums selected from different regions in the city of Kolkata which makes the results better representative of the Kolkata slum population in general³² ; ii) it addresses a broader dimension of the issue of hunger by administering the full 18-item questionnaire in the context of Kolkata slums and finally; iii) it included a diet-survey to establish association of the experiential indicator with nutrient intake. In the Orissa study (Raj and Satpathy, 2002) internal validity of the scale was established but it could not be validated externally. In the Delhi study (Agarwal *et al.*, 2009) there was some attempt at external validation through socio-economic indicators of household but association with nutrition could not be established.

The major limitations of the study might be the following. In the construction of the food security scale, a larger sample size would have been desirable but it could not be done due to time and resource constraint. Resource constraint also prevented us from collecting separate information on food intake of children in the survey and therefore the scale could not be tested with respect to nutritional status, another outcome indicator of food access. Also, the results based on a single city cannot be generalized to urban India, in general. But taking into account the results of the Delhi study, it may be possible to move towards a conclusion that there are possibilities of general application of the experience-based measure in the context of urban India as a whole.

Further development of this alternative measure of food security is recommended so that it can be used in conjunction with the existing food security indicators like nutrient intake and nutritional status, for better targeting. There will be a large initial cost in terms of setting up the research but once done the subsequent applications would be simple. Since the construction of the food security scale only requires administering the 18 item questionnaire on the surveyed population, the method is simple and inexpensive. Respondent burden tends to be low; this is a clear advantage when one is inserting a food security module into a longer survey. One of the major recommendations of the paper is thus, to include the food security scale questions as part of the ongoing surveys conducted by National Sample Survey Organisation or National Family Health Survey. If the 18-item questionnaire is found to be too long even the 6-item shorter version of the questionnaire can be included and administered, to start with. Future research should consider developing a more refined

questionnaire for constructing the food security scale relevant for application to the diverse cultural setting across different states of India.

References

- Agarwal, S., V. Sethi, et al. (2009). Experiential household food insecurity in an urban underserved slum of North India. *Food Security*,1: 239-250.
- Barrett, Christopher, B. (2002). Food Security and Food Assistance Programs, in: Gardner, B. L.,G. Rausser, C., (Eds.), *Handbook of Agricultural Economics*, first edition, Elsevier, volume 2, chapter 40, pages 2103-2190.
- Bickel, G., M. Nord, C. Price.,W. Hamilton., J. Cook (2000). *Guide to measuring household food security* (revised). Alexandria, Va, USA, US Department of Agriculture, Food and Nutrition Service.
- Bouis, H. E. (1994). The effect of income on demand for food in poor countries: Are our food consumption databases giving us reliable estimates? *Journal of Development Economics*, 44(1): 199-226.
- Coates, J. C., P. Webb, et al. (2010). "He said, she said": who should speak for households about experiences of food insecurity in Bangladesh?" *Food Security*, (2): 81-95.
- Cristofar, S. P. and P. P. Basiotis (1992). Dietary intakes and selected characteristics of women ages 19 -50 and their children ages 1 -5 by reported perceptions of food sufficiency. *Journal of Nutrition Education*, 24(2): 53-58.
- Deaton, A. & J. Dreze. (2009). Food and Nutrition in India: Facts and Interpretations. *Economic and Political Weekly*, 44(7), 42-64.
- Deolalikar (2012). A national shame: Hunger and malnutrition in India. Retrieved from <http://www.ideasforindia.in/article.aspx> on 13th March, 2014.
- Derrickson, J. P., A. G. Fisher., J. E. Anderson, A. C. Brown (2001). An assessment of various household food security measures in Hawaii has implications for national food security research and monitoring. *Journal of Nutrition*, 131(3): 749-757.
- Devi, M. (1979). *Sreshtho Galpo*. Kolkata, India, Karuna Prakashoni.

Dreze, J. and P. V. Srinivasan (1997). "Widowhood and Poverty in Rural India: Some Inferences from Household Survey Data." *Journal of Development Economics*. 54(2): 217-234.

FAO (2010). *State of Food Insecurity in the World*. Rome, Italy. Food and Agricultural Organization of the United Nations.

FAO (1996). Rome Declaration on World Food Security. World Food Summit. Rome: Food and Agriculture Organisation

Frongillo, E. A. and S. Nanama (2003). *Development and validation of an experiencebased tool to directly measure household food insecurity within and across seasons in northern Burkina Faso*. Ithaca: Division of Nutritional Sciences, Cornell University.

Fuwa, B. (2001). *A Note on the Analysis of Female-headed Households in Developing Countries*. Mimeo. Agricultural Economics Department, Faculty of Horticulture, Chiba University.

Gaiha, R., R. Jha., V. S. Kulkarni. (2010). Prices, Expenditure and Nutrition in India. Working Paper No.2010/15, Australia South Asia Research Centre, Australian National University.

Gangopadhyay, S. and W. Wadhwa (2004). *Are Indian female-headed households more vulnerable to poverty?* Mimeo (Delhi: Indian Development Foundation).

GOI (2001). Census of India. New Delhi, Registrar General and Census Commissioner , India.

Hamilton, W. L., Cook, J.T., Thompson W.W., Buron L.F., Frongillo E.A Jr., Olson C.M., Wehler C.A (1997). Household Food Security in the United States in 1995: Summary Report of the Food Security Measurement Project. Washington, DC, US Department of Agriculture Food and Consumer Service, Office of Analysis and Evaluation, and Abt Associates.

Kendall, A., C. M. Olson and E.A.Frongillo, Jr. (1995). Validation of the Radimer/Cornell measures of hunger and food insecurity. *The Journal of Nutrition*, 125(11): 2793.

Kennedy, E. (1991). Effects of Gender of Head of Household on Women's and Children's Nutritional Status. Washington, D.C: International Food Policy Research Institute.

King, G. and J. Wand (2006). Comparing Incomparable Survey Responses: Evaluating and Selecting Anchoring Vignettes Political Analysis Advance Access, Society for Political Methodology, Oxford University Press.

Li, N. & Eli, S. (2010). In Search of India's Missing Calories: Energy Requirements and Calorie Consumption, Available for download at: <http://emlab.berkeley.edu/webfac/emiguel/e271f10/Li.pdf>.

Lohr, L.S. (1999). *Sampling: Design and Analysis*. Duxbury Press : An Imprint of Brooks/Coles Publishing Company, A Division of An International Thomson Publishing Company.

Frankenberger, T. (1992). Indicators and data collection methods for assessing household food security. In Maxwell, S. and Frankenberger, T (Ed.) *Household Food Security: Concepts, Indicators, Measurements: A Technical Review*. New York and Rome, UNICEF and IFAD.

Marjit, S. (2012). *Conflicting Measures of Poverty and Inadequate Saving by the Poor: The Role of Status Driven Utility Function*. Working Paper, WIDER. Kolkata, Center for Studies in Social Science.

Maxwell, S. and M. Smith (1992). Household Food Security: A Conceptual Review. *Household Food Security: Concepts, Indicators, Measurements: A Technical Review*. In S. Maxwell and T. Frankenberger (Ed.). New York and Rome, UNICEF and IFAD.

Meenakshi, J. V. and B. Viswanathan. (2005). Calorie Deprivation in Rural India, 1983-1999/2000: Evidence from Unit Record Data. In Angus Deaton and Valerie Kozel (Ed.) *The Great Indian Poverty Debate*. New Delhi, Macmillan India Limited.

Mehta, J. & Venkatraman, S. (2000). Poverty Statistics: Bismillah's Feast. *Economic and Political Weekly*, 35(27), 2377-2382.

Menon, P., A. Deolalikar, et al. (2009). India State Hunger Index: Comparisons of Hunger Across States. Washington, D.C., Bonn, and Riverside, IFPRI/University of California/Welthungerhilfe.

Minhas, B. S. (1991). On Estimating The Inadequacy of Energy Intakes: Revealed Food Consumption Behavior Versus Nutritional Norms (Nutritional Status of Indian People in 1983). *Journal of Development Studies*, 28(1): 1.

Morteza, R., M. Nord, A. Sadeghizadeh and M.H. Entezari (2009). Assessing the internal validity of a household survey-based food security measure adapted for use in Iran. *Nutrition Journal*, 8(28).

MSSRF (2002). Food Insecurity Atlas of Urban India. Chennai: M.S.Swaminathan Research Foundation and the World Food Programme.

MSSRF (2010). Food Insecurity Atlas of Rural India. Chennai: M.S.Swaminathan Research Foundation and World Food Programme.

Mukherji, S. (1993). Poverty Induced Migration and Urban Involution in India: Cause and Consequences, International Institute for Population Sciences: 1-91.

NFHS (2007). National Family Health Survey (NFHS-3), 2005-06. Mumbai: International Institute for Population Sciences (IIPS) and Macro International.

NSSO (1983). Per capita and per consumer unit per diem intake of calorie, protein and fat and perception of people on adequacy of food New Delhi, India, National sample Survey, Report No. 348, 38th Round, Department of Statistics. New Delhi. .

NSSO (1993-94). *Reported Adequacy of Food Intake in India*. New Delhi, India, Report No.415, 50th Round, July 1993-June 1994, National Sample Survey Organisation, Department of Statistics, Government of India.

NSSO (2001). *Reported Adequacy of Food Intake in India 1999-2000*. New Delhi, Report No 466 (55/1.0/7), 55th Round, July 1999-June 2000, National Sample Survey Organisation, Ministry of Statistics & Programme Implementation.

NSSO (2007). *Perceived Adequacy of Food Consumption in Indian Households 2004-2005*. Report No. 512(61/1.0/5), July 2004- June 2005, National Sample Survey Organisation, Ministry of Statistics & Programme Implementation, Government of India.

NSSO (2008). *Urban Frame Survey*. Kolkata, National Sample Survey Organisation.

NSSO (2012). *Nutritional Intake in India*. New Delhi, India: Report No. 512, July 2009- June 2010, National Sample Survey Organisation, Ministry of Statistics & Programme Implementation, Government of India.

Patnaik, U. (2004). Republic of Hunger. *Social Scientist*, 32(9-10): 9-35.

Palmer-Jones, R. & K. Sen. (2001). On India's Poverty Puzzles and the Statistics of Poverty, *Economic and Political Weekly*, 26(3), 211-217.

Radhakrishna, R. (2005). Food and Nutrition Security of the Poor: Emerging Perspectives and Policy Issues. *Economic and Political Weekly*, 40(18), 1817-1823.

Raj, N. and A. K. Satpathy (2002). Household Food Insecurity and Child Labour: Some Evidences from Rural Orissa. In Nira Ramchandran and Lionel Massum (Eds.) *Coming to Grips with Rural Child Work*, New Delhi: IHD Publishers.

Rao, C. H. H. (2000). "What Affects Changes in Cereal Consumption? *Economic and Political Weekly*, 35(4(January)): 201-206.

Ray, R. & Lancaster, G. 2005. On Setting the Poverty Line Based on Estimated Nutrient Prices: Condition of Socially Disadvantaged Groups during the Reform Period. *Economic and Political Weekly*. 40(1), 46-56.

Rose, D. and V. Oliveira (1997). Nutrient Intakes of Individuals from Food-Insufficient Households in the United States. *American Journal of Public Health*, 87(12).

Rose, D. (1999). Economic Determinants and Dietary Consequences of Food Insecurity in the United States. *Journal of Nutrition*, 199 129: 2 517.

Sen, P. (2005). Of Calories and Things: Reflection on Nutritional Norms, Poverty Lines and Consumption Behaviour in India. *Economic and Political Weekly*, 40(43), 4611-4618.

- Srinivasan, T. N. (1981). Malnutrition: Some measurement and policy issues. *Journal of Development Economics*, 8: 3-19.
- Strauss, J. and D. Thomas (1995). Human Resources: Empirical modeling of household and family decisions. In J. Behrman, and Srinivasan, T.N (Ed.), *Handbook of Development Economics*, Amsterdam, Elsevier. 3A.
- Strauss, J. and D. Thomas (1998). Health, nutrition and economic development. *Journal of Economic Literature*, 36: 766-817.
- Vaidyanathan, A. (1994). Employment Situation: Some Emerging Perspectives. *Economic and Political Weekly*, 29(50): 3147-3156.
- Webb, P., J. Coates and Houser, R. (2001). Food insecurity measurement and validation study: a report on the formulation of the core food security module, and experiences in its implementation in Bangladesh. *Report to Academy for Educational Development, Food and Nutrition Technical Assistance Project*. Washington, DC, United States Agency for International Development.
- Welch, K. J., Mock., N. and O.Netrebenko (1998). Measuring hunger in the Russian Federation using the Radimer/Cornell hunger scale. *Bulletin of World Health Organization*, 76(2): 143-148.
- Wright, R. E. (1992). A feminisation of poverty in Great Britain. *Review of Income and Wealth*, 38(1): 17-25.

Notes

¹ The NSS consumption surveys have been including a question on food adequacy since 1983. In 1983 and 1993-94 the question was whether everyone in the household got “two square meals a day” and from 1999-00 the question was revised as “whether everyone in the household got enough food every day.”

² The slums in greater Kolkata, outside KMC were not included because KMC slums are registered and have formal identified boundaries shown in maps which were easier for the surveyors to identify. These maps were obtained from NSSO, FOD, Kolkata.

³ By convention, an Investigator Unit (IV) is a geographically compact and distinct area with a population of about 20,000 with exception in certain cases. A group of about 20-25 adjacent UFS blocks forms an IV.

⁴ Systematic sampling involves a random start and then proceeds with the selection of every kth element from then onwards. In this case, $k = (\text{population size} / \text{sample size})$. It is important that the starting point is not automatically the first in the list, but is instead randomly chosen from within the first to the kth element in the list. The sample size is thus, 15/330 or 1/22 of the population. Therefore, the interval chosen was 22. From the table of random numbers (*Million Random Digits with 100,000 Normal Deviates* by Rand), a random number between 1 and 22 was selected as the starting point. Starting with IV unit 12 every 22nd IV was selected thereafter.

⁵ All urban areas in the country are divided into small areal units called blocks. As per the earlier guidelines of 2002-07 UFS, a norm of about 600-800 population (120-160 households) used to be adopted for formation of a UFS block.

⁶ Following NSSO (2008), a “slum area” is being defined as an agglomeration of densely inhabited, poorly built and/or dilapidated structures predominantly made of kutchha (temporary) or semi-kutchha building materials, often irregularly or asymmetrically constructed in unhygienic surroundings on a patch of land having an area not less than 0.15 acres with poor accessibility and with no or grossly inadequate basic amenities like ventilation, natural light, sanitation, drainage, water and power supply (NSSO 2008).

⁷ Out of the fifteen IV Units thus selected, units 34, 100, 210, 254, 232 and 298 did not have any block with “slum area”. Therefore, they were to be replaced. The replacement procedure was to choose the IV Unit within a range of ± 3 of the number which has been selected earlier, provided it has at least one block with a “slum area” in it. Therefore, IV Units 34, 100, 210 and 254 were replaced by IV Units 33, 98, 211 and 257 respectively.

⁸ For identification of UFS blocks, maps for each Investigator Unit and boundary details of each block within an Investigator Unit are available with the Regional and Sub-Regional Offices of the Field Operations Division (FOD) of NSSO.

⁹ Of late there has developed a growing literature on “feminisation” of poverty which supports the view that female headed households may be poorer or food insecure (Gangopadhyay and Wadhwa; Fuwa 2001; Dreze and Srinivasan 1997; Mallick and Rafi 2010). In food security literature one gets an opposite view too - that female headed households may be less food insecure since women are directly the major decision maker as far as food behavior is concerned (Kennedy 1991).

¹⁰ Stratification works for lowering the variance because the variance within each stratum is often lower than the variance in the whole population. Prior knowledge can be used to save money in the sampling procedure (Lohr 1999).

¹¹ Technical details on Neyman’s allocation and details of calculation available upon request.

¹² There is only one question on social acceptability (borrowing food), a domain not covered by USDA Food Security Module. This has been taken from the Bangladesh module (Webb *et al.* 2001). Besides, the CPS food security supplement had several broad preliminary screening questions which have not been administered in the Kolkata survey. The questions related to food insufficiency have also not been administered.

¹³ The younger age specification (compared with under 18 in the U.S. module) is appropriate for the legal and social conditions of India.

¹⁴ In order to check the consistency of results, USDA was requested to conduct a psychometric analysis of the data set using their own software - ERSRasch—a set of programs in SAS data steps developed by ERS. The results obtained from the two different software were found to be highly consistent.

¹⁵ Calculations not shown and available upon request.

¹⁶ Calculations not shown and available upon request.

¹⁷ Parameters were estimated based on the subsample of 406 households with raw scores of 1 to 8 and with no missing responses. One household was omitted because of a missing response and 93 were omitted because they had a raw score of zero.

¹⁸ Since it is the difference between the household and item score that determines the probability of affirmation, the metric can be transformed by adding a constant to both household and item scores without changing the character of the scale. The Federal inter agency 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.

¹⁹ For most purposes these can be used in linear models without introducing serious distortions because the households affected are few. Assigning an appropriate score to households that affirm no items (raw score=0) is more problematic, however. Categorical assignments are clear. These households are food secure but the appropriate scale score is not obvious. How food secure are they? For communication purposes a score of zero is appropriate. For analytic purposes, however, no single score is necessarily. Depending on the association under investigation, the researcher will have to make adjustments to this assignment or assign lower weights to these households to reflect the imprecision of the measure for them or exclude them from the analysis (Hamilton et al. 1997b). In the present case, these households have been assigned a scale score of zero.

²⁰ The corresponding child item includes the phrase “or felt weak.” If that was included in the adult item, it may account for the much lower severity.

²¹ The intuition behind this lies in the typical response pattern of the surveyed households. Because the model indicates that responses are sufficiently well ordered, a typical response pattern involves the characteristic that a household which has affirmed an item of mid-range severity is also likely to affirm the items which are less severe. In fact, this is the pattern of the “modal” households. Modal households are those showing a perfectly ordered response pattern, i.e., whatever the most severe question the household answered affirmatively, it also answers all less severe questions affirmatively (Hamilton *et al.* 1997a).

²² As has been discussed before, this item must have been understood differently by the survey population in Kolkata and further exploration is needed regarding the wordings of the question.

²³ But the statistic is presented with some reservation because, “alpha”, may not always serve its purpose well. Cronbach’s alpha was designed to assess a set of continuous, interval-level variables as a measure of latent trait whereas most food security modules collect dichotomous responses or collapsed responses to dichotomies. Furthermore, because the severity of the items differ substantially, in order to represent a wide range of severity of food security, some of the items are affirmed by a substantial proportion of respondents while other items are affirmed by only a very small proportion. These characteristics of food security data often distort “alpha” so that it does not reflect the actual quality of the scale. Cronbach’s alpha may be depressed by items of different severity and may hardly reflect the poor performance of a single item (communication with Mark Nord).

²⁴ The adult “ever” scale was checked for Differential Item Functioning for households with and without children. Given the small sample size of households without children (apparently only 145 after dropping the extremes), scaling analysis could not be done properly. But preliminary checks on DIF was attempted by plotting the severity parameters for the two groups of households against each other and adding a linear trend to it to see if one item is clearly out of line. In this comparison only “eatless” seemed to have significant DIF.

²⁵ A household was defined as poor if it fell below the poverty line expenditure of urban West Bengal, for the year 2010-11. The poverty line expenditure for 2010-11 was set at Rs.856.28 by updating the poverty line expenditure of urban West Bengal for 2004-05, using Consumer Price Index for Urban Industrial Workers (base 2001). Thus poverty status is a binary variable which takes the value of 1 if Monthly Per Capita Expenditure (MPCE) < Rs. 856.28 and 0, otherwise.

²⁶ It could be argued, though, that food security is a necessary, but not sufficient condition for adequate intake (Barrette 2002). One can see cases of inadequate food intake by food-secure individuals. This could result from lack of appetite, lack of knowledge about food needs, being too busy to eat, consuming low calorie diet etc.

²⁷ This is based on “Nutritive Values of Indian Foods” by C. Gopalan, B.V. Ramasastry and S.C. Balasubramanian, revised and updated by B.S. Narasinga, Y.G. Deosthale and K.C. Pant, 1991.

²⁸ This grouping may not match exactly with NSSO (2010) which presents nine food groups: cereals, pulses, milk & milk products, roots and tubers, vegetables and fruits, sugar & honey, meat-egg-fish, oil & fat and miscellaneous food products. In the present study, 'roots and tubers' have been included in the food group “vegetables”.

²⁹ Nutrient intake was adjusted for “meals taken outside home” and meals provided to guests and employees by applying the adjustment formula suggested by Minhas (1988).

³⁰ Based on the recommendations of the Expert Group (1988) constituted by the Indian Council of Medical Research (ICMR).

³¹ This may indicate increasing dietary diversification with increase in income. Majority of food secure households are non-poor and have higher preferences for higher quality diet like meat, fish etc. compared to cheaper sources of calorie like cereals.

³² The information on socio-economic characteristics of households (including expenditure data) and all nutrient- related information collected in the Kolkata survey are highly consistent with the results published by NSSO (2010) for urban West Bengal.

Table 1: Candidate food insecurity scale items and their abbreviations by hypothesized conceptual domain.

Item No.	Item description	Item abbreviation	Domain
Q1.	worried that food would run out before you could buy more?	worried	anxiety, insecurity
Q3.	food stored in home ran out and there was no money to buy more	ran out	anxiety, insecurity
Q4.	borrowed food from relatives or neighbours to make a meal	borrowed food	acceptability
Q5.	cooked “bhalo mondo” (“rich food” such as shemai, paish, or polao)	rich food	quality
Q6.	had to eat the same kind of food every day	same food	quality
Q7.	adults could not eat at least two square meals a day	two square meals	quantity
Q8.	personally ate less food so that there would be more for the rest of the family	ate less	quantity
Q10.	adult skipped entire meal so that there would be more food for the family	skip meal	quantity
Q11.	adults were hungry but did not eat because you couldn’t afford enough food	hungry	consequence of reduced intake
Q12.	adult lost weight because you didn't have enough money for food	lost weight	consequence of reduced intake
Q13.	adult not eat for a whole day because there wasn't enough money for food	whole day	quantity
Q14.	child/children had to rely on only a few kinds of low-cost food	low cost food	quality
Q15.	child/children in the family couldn’t eat at least three square meal each day	child three square meals	quantity
Q16.	child/children couldn’t be given a varied and healthy diet	child varied and healthy	quality
Q17.	child/children were not eating enough	child not eat enough	quantity
Q18.	skipped child’s/children's meal because there wasn't enough money for food	child skip meal	quantity
Q19.	child/children in the family were hungry but couldn't afford more food	child hungry	quantity
Q20.	child/children didn’t eat for whole day because there wasn't enough money for food	child whole day	consequence of reduced intake
Q21.	child/children in the household lost weight/felt weak because you couldn’t afford enough food	child lost weight	consequence of reduced intake

Note: Q2 and Q9 in the main questionnaire are not scale items and hence not included in this table.

Table 2: Item Severity Parameters and Fit Statistics, 9-Item Adult Food Security Scale (N=406), Kolkata, 2010-11.

Item	Severity Parameter	Std. Error	Infit	Outfit
Never cooked rich meals	0.48	0.41	1.02	5.00
Worried food would run out	5.53	0.21	1.05	0.75
Had to eat same kind of food every day	-	-	-	-
Adult lost weight	6.03	0.22	0.78	0.42
Ate less so there would be more for others	6.15	0.22	0.88	0.95
Food ran out	6.44	0.22	1.30	0.46
Adult could not eat two square meals	6.90	0.22	0.80	0.62
Borrowed money for food	-	-	-	-
Adult skipped meals	9.74	0.30	0.89	1.11
Adult hungry but didn't eat	10.87	0.44	1.05	0.26
Adult did not eat for whole day	10.87	0.44	0.70	0.16

Note: Estimation method: Conditional Maximum Likelihood. No. of groups: 10 (8 of them are used to compute the statistics of test). Number of individuals: 499 (1 household removed for missing values). Number of households with null or perfect score is 93 and these households are omitted from the psychometric analysis. Conditional log-likelihood: - 275.405. Reported item severities have been obtained by adding seven to severity parameters reported by Stata.

Table 3: Household Severity Parameters on the 9-item Adult Food Security Scale and Distribution of Households by Raw Score, Kolkata, 2010-11.

Raw Score	Severity	Std. Error	Number	Percent	Cumulative Percent
0	Not defined		87	17.4	17.4
1	3.57	2.34	260	52.0	69.4
2	5.03	0.62	34	6.8	76.2
3	5.84	0.39	22	4.4	80.6
4	6.54	0.37	20	4.0	84.6
5	7.32	0.49	18	3.6	88.2
6	8.54	0.76	46	9.2	97.4
7	9.98	0.73	5	1.0	98.4
8	11.09	0.88	2	0.4	98.8
9 ^a	12.59	3.01	6	1.2	100

Note: Household Severity Parameters are Maximum Likelihood Estimates based on the item parameters in Table II. The zero point of the adult scale (which is arbitrary) was set such that the mean of item scores was 7.0, a value which ensures that all household scores are greater than zero. The severity of food insecurity in households with raw score 0 and 9 is not known.

^aThe tabled value of raw score 9 was calculated as if for raw score 8.5, and may be used analytically since relatively few households are affected.

Table 4: Comparison of Item Severity Parameters in the 9-item Adult Food Security Scale, Kolkata 2010-11 Survey versus U.S CPS-FSS 2008 and 2009.

Kolkata Adult Items	Kolkata Item Severity	U.S Adult Items	U.S Item Severity	U.S Items Severities Adjusted to Kolkata
worried*	5.53	worried*	1.49	5.52
ran out*	6.44	ran out/food not last*	2.79	6.53
rich food	0.48	balanced meal	3.67	7.21
two square meal	6.90	cut size & skip meals	5.37	8.53
eat less	6.15	eat less	5.53	9.35
adult skip meal	9.74	-	-	-
hungry*	10.87	hungry*	7.55	10.21
lost weight	6.03	lost weight	8.61	11.04
whole day*	10.87	whole day*	9.12	11.44
Mean of items used to adjust metric	8.43			
SD of items used to adjust metric	2.85			

Note: U.S. severity parameters have been adjusted by the mean and S.D of items in the metric adjustment set (4 equivalent items in the two surveys), denoted by *. These four items were used as a basis for equating the two scales. The unadjusted U.S. parameters were taken from Bickel et al. (2000), which is the official documentation of the U.S. Household Food Security Scale.

Table 5: Comparison of Household Severity Parameters in 9-item Adult Food Security Scale, Kolkata 2010-11 Survey versus U.S CPS-FSS 2008 and 2009.

Raw Score	Kolkata HH Severity	U.S HH Severity	U.S HH Severity Adjusted to Kolkata
1	3.57	1.72	5.70
2	5.03	3.10	6.77
3	5.84	4.23	7.65
4	6.54	5.23	8.42
5	7.32	6.16	9.14
6	8.54	7.07	9.84
7	9.98	8.00	10.57
8	11.09	8.98	11.32
8.5	12.59	10.15	12.23
Mean of items used to adjust metric	8.43		
SD of Items used to adjust metric	2.85		

Note: U.S. severity parameters have been adjusted by the mean and S.D of items in the metric adjustment set (4 equivalent items in the two surveys).

Table 6: Household Scale Scores, Food Security Status Categories and Prevalence Rates According to the 9-item Adult Food Security Scale, Kolkata 2010-11.

Raw Score	Severity	Frequency	Percentage Households (N=500)	Cumulative Percent	Category
0	Not defined	87	17.4	17.4	Food Secure (76.2%)
1	3.57	260	52.0	69.4	
2	5.03	34	6.8	76.2	
	5.43	Threshold Marginally Food Secure			Marginally Food Secure (8.4 %)
3	5.84	22	4.4	80.6	
4	6.54	20	4.0	84.6	
	6.93	Threshold Moderately Food Secure			Moderately Food insecure (12.8%)
5	7.32	18	3.6	88.2	
6	8.54	46	9.2	97.4	
	9.26	Threshold Severely Food Insecure			Severely food insecure (2.6%)
7	9.98	5	1.0	98.4	
8	11.09	2	0.4	98.8	
9	12.59	6	1.2	100	

Notes: The zero point on the Rasch Scale is arbitrary. Prevalence rates have been computed for 500 households having no missing responses. The severity of food insecurity with raw score 0 and 9 is unknown. The tables for raw score 9 was calculated as if for raw score 8.5. Food security scale has a measured range of 7.52 logistic units - 3.57 to 11.09 (12.59 not considered being a kind of pseudo-value based on raw score 8.5).

Table 7: Food Security Status by Households' Socio-Economic & Demographic Characteristics, Kolkata 2010-11

	Highly Food Secure (raw score <3)	Marginally Food Secure (raw score >=3 and raw score<5)	Food Insecure (raw score>=5)
Expenditure Group			
Lowest 25%	41.6	12.8	45.6
Middle 50%	74.4	12.8	12.8
Top 25%	94.78	3.61	1.61
Poverty Status			
Poor (MPCE<Rs.856.28)	30.3	7.58	62.12
Non-poor	83.37	8.31	8.31
Asset Ownership			
Zero or only fan	39.68	7.94	52.39
At least one asset other than fan	81.65	8.26	10.1
Employment Status			
Casual labour	58.04	8.93	33.03
Others (self-employed, regular salaried etc.)	81.65	8.01	10.34
Participation in Government Program			
Ration card	77.46	8.92	13.62
No ration card	69.86	4.11	26.03
Household Composition			
Household with kids (members <15 years of age)	72.14	8.02	19.85
Households without kids	81.01	8.44	10.55
Households with dependency ratio>1	73.39	8.56	18.04
Households with dependency ratio<1	81.98	7.56	10.46
Gender of Household Head			
Male	79.95	6.93	13.12
Female	61.05	13.68	25.26
Education of Household Head			
Illiterate	60.74	12.27	26.99
Primary-Middle	82.13	7.22	10.65
Graduate & above	95.56	0	4.44

Table 8: Average Intake of Nutrients and Selected Food Items and Food Adequacy by Food Security Status, Kolkata 2010-11.

Nutrients and Food Items	Mean Consumption		
	Food Secure (N=422)	Food Insecure (N=77)	t
Calorie (kcal per person per day)	1968.7	1370.4	8.61
Fat (gm. per person per day)	47.16	20.96	4.43
Protein (gm. per person per day)	55.61	33.72	9.5
Cereals (gm. per person per day)	286.41	239.58	3.48
Vegetables (gm per person per day)	276.05	201.75	5.11
Fish (gm per person per day)	32.48	13.74	4.97
Meat (gm per person per day)	27.58	10.36	4.57
Milk (gm per person per day)	89.47	27.56	5.1
Oil (gm per person per day)	23.98	14.77	5.43

Figure 1: Slum areas in Kolkata Municipal Corporation (GOI 2001)

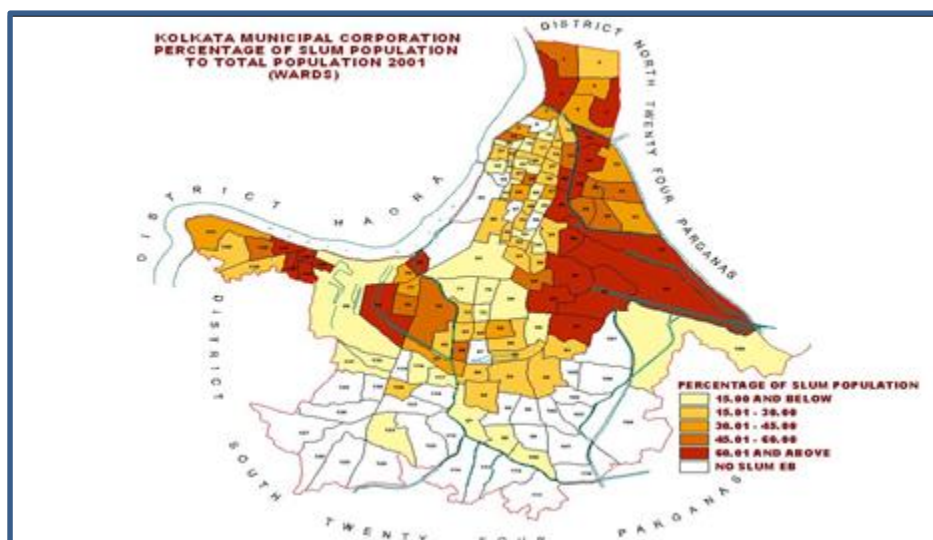


Figure 2: Comparison of Severity Parameters, Kolkata 2011 Survey vs. U.S CPS-FSS 2008 and 2009

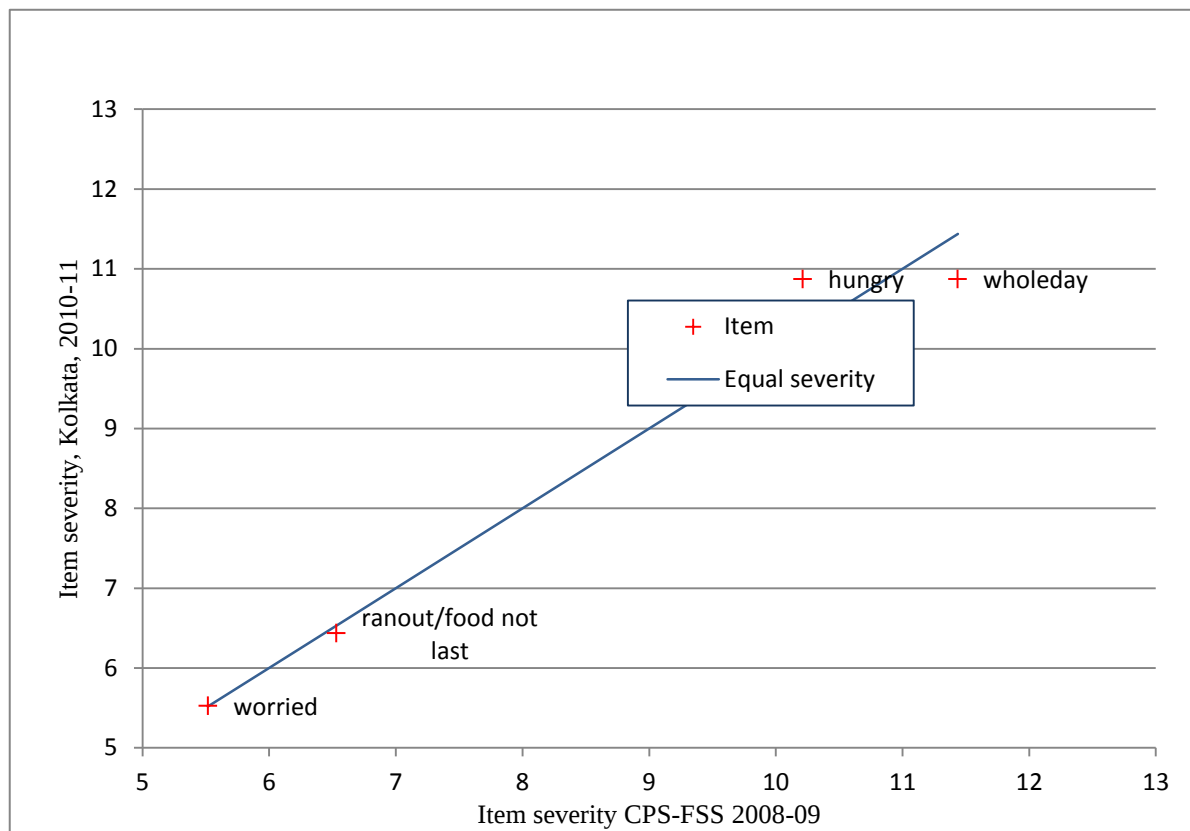
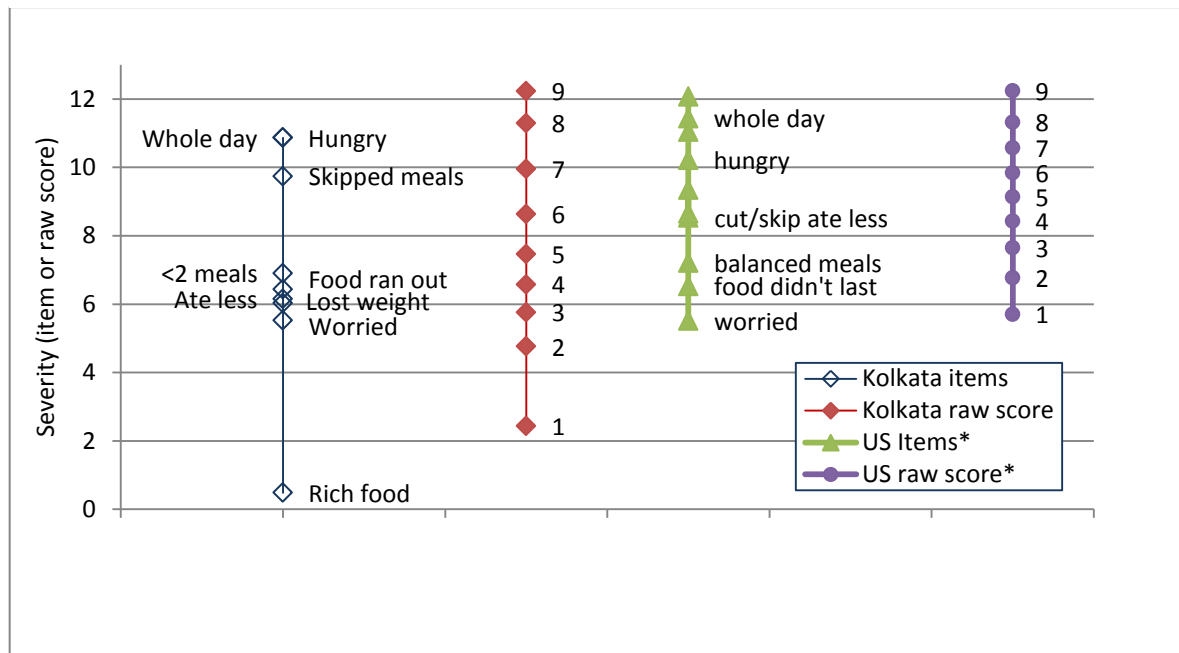


Figure 3: Item-Raw Score Map: Severities of Items and Raw Scores for the Kolkata 9-item Adult Scale and the U.S. Adult Scale



Note: *U.S. item parameters and household measures were adjusted to the metric of the Kolkata scale based on four items that appear to be equivalent in the two scales, worried, food didn't last/ran out, hungry, and whole day

Figure 4: Responses to Items in the 9-Item Kolkata Scale, 2010-11

