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Using Household and Intrahousehold Data To Assess Food Insecurity: Evidence From Bangladesh

Anna D'Souza and Sharad Tandon

United States Department of Agriculture

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Abstract

This report finds that many women and children in rural Bangladesh are undernourished in households in which their male head of household is adequately nourished, based on an analysis of the Bangladesh Integrated Household Survey. The survey covered household food consumption and expenditure for a given 7 days and individual-level consumption for a given 24 hours (2011 to 2012). Quantitative assessments of food security for each type of data found that, if only household-level data were used, a significant number of women and children were misclassified as receiving adequate nutrition because calories in a household previously were assumed to be equitably distributed. These findings suggest that intrahousehold data can contribute to the identification of undernourished populations, particularly women and children. Such identification, with the objective of improving nutritional status, is of particular interest to the U.S. Government's interagency Feed the Future initiative.

Keywords: Food security, Bangladesh, intrahousehold consumption

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A report summary from the Economic Research Service August 2015

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Using Household and Intrahousehold Data To Assess Food Insecurity: Evidence From Bangladesh

Anna D'Souza and Sharad Tandon

What Is the Issue?

Despite a substantial increase in global per-capita food production over the past two decades, estimates show the size of the global undernourished population also has grown over the same period. Many factors contribute to the persistently large size of the food-insecure population worldwide, but, in particular, increasing and highly volatile food prices have reduced household access to an adequate diet. These challenges have highlighted the importance of measuring food insecurity and evaluating the efficacy of food aid policies.

To assess food insecurity and undernourishment at the household level, researchers assume food is distributed equitably within the household; that is, all household members are believed to share the same food security status. However, if food within a household is actually distributed inequitably, estimates based on household-level data may inaccurately identify food-insecure populations. Discrepancies between household and intrahousehold assessments might suggest that food aid distributed based on household-level assessments would be unavailable to a substantial portion of the food-insecure population.

What Did the Study Find?

An analysis of calorie consumption at both the individual and household levels in Bangladesh in 2011-2012 showed that:

- The assessment of undernourishment varied significantly by the design of the survey used to collect data. Approximately 22 percent of the population was undernourished when households were asked to recall 7 days of household consumption of raw ingredients (the typical method used in household-level surveys). Approximately 33 percent were undernourished when households were asked to recall the finished recipes they had consumed in 24 hours. More research and validation are needed to understand which of the two estimates better approximates the household's nutritional status.

- There were inequities in the distribution of household calorie consumption. The data show that household heads consumed a disproportionately large share of calories relative to other household members. Thus, when using only household-level data, which assume an equitable distribution of calories among members, many household members who were not household heads were misclassified as adequately nourished; some household heads were misclassified as undernourished.

These findings suggest that the depth of undernourishment for certain household members may be greater than traditional household consumption surveys would suggest. Even in households in which it is possible to meet each member's daily food requirements, a significant share of women and children are still undernourished. Thus, accounting for the intrahousehold distribution of food is important to food aid programs such as the Feed the Future initiative to improve the nutritional status of women and children. (Feed the Future is led by the U.S. Agency for International Development and involves 10 other agencies, including the U.S. Department of Agriculture. For more information, see: http://www.feedthefuture.gov/.)

How Was the Study Conducted?

USDA's Economic Research Service researchers estimated calorie consumption using data from the first wave of the Bangladesh Integrated Household Survey conducted by the International Food Policy Research Institute. The survey collected food consumption in two separate modules: one collected household consumption and expenditure levels typically reported in household-level surveys, and a second collected information based on how the household's female in charge of food preparation described consumption of finished recipes by each individual household member over the prior 24 hours. Researchers compared the resulting assessments of undernourishment from each module and compared estimates of undernourishment based on individual-level and aggregated household data from the 24-hour module.

Using Household and Intrahousehold Data To Assess Food Insecurity: Evidence from Bangladesh

Introduction

Despite a substantial increase in global per capita food production over the past two decades, the size of the undernourished population has grown over the same time period (Barrett, 2010). There are many factors contributing to the persistently large size of the food-insecure population, but increasing and highly volatile food prices, and population growth, in particular, have significantly reduced household access to an adequate diet (Godfray et al., 2010; Lobell et al., 2008; Mitchell, 2008).[1]

While undernourishment is essentially an individual-level construct, much of the measurement of food insecurity and undernourishment has centered on national-level and, more recently, household-level statistics (United Nations, Food and Agriculture Organization (UN/FAO), 2012). Global assessments of undernourishment most often use aggregate production and trade statistics for each country under analysis to derive the total number of available calories, and then make assumptions about how those calories are distributed across individuals in each country to estimate the size of the undernourished population (UN/FAO, 2013; Rosen et al., 2014). However, it is difficult for these assessments to precisely estimate how total available calories are distributed among individuals and, subsequently, can provide misleading assessments of undernourishment (Barrett, 2010). Furthermore, assessments based on household-level consumption make strict assumptions about the division of calories within a household such that all members share the same undernourishment (or food-insecure) classification.

Although collecting individual-level data is costly (Fiedler et al., 2012), there is a growing recognition of the importance of more accurately identifying the undernourishment status of each individual within the household (Barrett, 2010). If there are inequities in the intrahousehold distribution of food, estimates based on household-level data might not accurately identify food-insecure populations.

In this report, we use data from the Bangladesh Integrated Household Survey (BIHS) to explore the intrahousehold allocation of food, with an emphasis on the measurement of undernourishment at both the individual and household levels. Bangladesh supplies many examples of the need for better characterization of the intrahousehold distribution of calories. Assessments of undernourishment based on aggregate food availability and based on household-level data suggest that a significant portion of the country suffers from malnutrition (Ahmed et al., 2013; UN/FAO, 2013). Furthermore, studies repeatedly have demonstrated that household resources are not distributed equitably across household members in Bangladesh. For example, studies have demonstrated that Bangladeshi households prefer to have more sons than daughters (Mannan, 1988), that sons receive preferential treatment (Chen et al.,1981), and that there are different patterns in household expenditure and

[1]For a discussion of the implications of poor nutrition on health, see Behrman and Deolalikar (1988); for a discussion of the implications of poor nutrition on child education, see Glewwe and Miguel (2008).

investments in human capital if women in the household have more power in allocating household resources (Quisumbing and Maluccio, 2003).

The BIHS covers over 5,000 households and is representative of rural Bangladesh. The salient components of the survey, for our purposes, are the food-consumption modules. Responses are solicited from the female household member in charge of cooking, supervising, and serving. One module solicits standard information collected in household surveys on food consumed by anyone in the household over the past 7 days, based on recall of over 300 food ingredients used in final recipes. A second module solicits detailed information on foods consumed over the prior 24 hours based on the survey participant's recall about finished food items. In this latter module, the female also provides information on how much each individual household member consumes.

Using the BIHS, daily calorie availability is estimated first, then the related prevalence of undernourishment, based on each module. This comparison sheds light on potential differences due to survey design.[2] Average calorie availability turns out to be much higher in the 7-day recall module than in the 24-hour recall module, with 11 percentage points more of the population categorized as undernourished in the latter module. It is difficult to discern whether the difference is driven by varying recall periods or by collection of information on consumption of ingredients as compared with finished recipes. However, identifying such differences within the same survey is informative, given the prevalence of household survey data in measuring undernourishment.

We then analyze the household-level and individual-level data solicited in the BIHS by:

1. estimating calorie consumption of each household member,
2. categorizing household members who do not meet their minimum daily energy requirement (MDER) and are therefore undernourished,
3. classifying households as adequately nourished based on whether total household calorie availability exceeds the sum of individual MDERs.

This allows us to identify individuals who would be misclassified when solely relying on household-level estimates; these are individuals who are undernourished but living in adequately nourished households and individuals who are adequately nourished but living in undernourished households. Understanding such misclassification is particularly important, given that one of the primary benefits of using household-level surveys is being able to identify people suffering from undernourishment.

The data further demonstrate that households do not distribute calories equitably across household members relative to each member's MDER. Household heads (the vast majority of whom are male) are more likely to obtain their MDER than their spouses or children. Over a quarter of the population of rural Bangladesh would be misclassified when using aggregated household-level data to characterize undernourishment; this includes adequately nourished individuals living in undernourished households and undernourished individuals living in adequately nourished households. Finally, we find that the intrahousehold inequities in calories are more pronounced in undernourished and poorer households, with household heads consuming disproportionate shares.

[2]Calorie availability refers to the calories associated with food acquired by the household rather than actual calorie-intake levels, which are difficult to measure without detailed food diaries.

This article contributes to the literature on intrahousehold allocation and household survey measurement, as well as a growing literature that uses household surveys to analyze food security. It analyzes how surveys that report intrahousehold consumption might deepen our understanding of undernourished populations and aid in targeting resources to these most vulnerable individuals. The findings are consistent with a number of studies that demonstrate that there are inequities in the distribution of household resources (Beaman and Dillon, 2012; Chen, et al., 1981; Strauss et al., 2000) and that the bargaining power of individual household members affects household expenditure (de Mel et al., 2009; Martínez, 2013; Thomas, 1990; Udry, 1996). Further, the findings suggest that the depth of food insecurity for certain household members is even greater than traditional household consumption surveys would suggest, and that even in households in which it is possible to meet each member's daily energy requirement, there are still undernourished individuals. This is especially important for identifying undernourished women and children, who are the focus for the Feed the Future Initiative's objective of improving nutritional status.

Data

Data for this report came from the Bangladesh Integrated Household Survey (BIHS), designed and supervised by the International Food Policy Research Institute (IFPRI). The survey was conducted between December 2011 and March 2012.[3] A male and female enumerator visited each household and collected very detailed information in 27 separate survey modules. Different modules of the survey used different enumerators depending on the sensitivity of the information requested and the knowledge of individual household members. The sample was selected based on a stratified, multistage design. In the first stage, the selection of primary sampling units (villages) within seven strata (seven administrative divisions in Bangladesh) was based on probability proportional to the total numbers of households in each stratum.[4] Then in the second stage, 20 households were selected from each village. Our sample includes 5,319 households. Using sampling weights, the sample is representative of rural Bangladesh.[5,6]

This article primarily uses two food consumption modules which are directed at the female member in charge of cooking, supervising, and serving.[7] The first module reports overall household food consumption for the past 7 days (HH module), and the second reports consumption of each individual household member over the past 24 hours (intra-HH module). The HH module is similar to data collected by other household-level consumption surveys, such as the National Sample Survey conducted in India, the Living Standard Measurement Surveys conducted by the World Bank, and the Household Income and Expenditure Surveys conducted by the Bangladesh Bureau of Statistics. Questions include the quantity and value of household consumption of nearly 300 separate food items over the past 7 days, including food bought on the market, produced, or obtained through other methods like food aid or gifts. There are also questions on the value of household expenditure on more than 30 types of food prepared outside the household, including both processed foods and finished recipes that are commonly eaten.[8]

The intra-HH module includes food consumption data for each household member over the past 24 hours.[9] In particular, the enumerator collected details on foods consumed in the household in the previous day (morning, noon, and night, as well as snacks). The enumerator also collected data on the weight of each ingredient used in the recipe, where the ingredient list matches the food items reported in the household-level data. The female was then asked about the amount of each recipe

[3]The survey timeframe does not include traditional lean seasons in Bangladesh, in which food insecurity is at its peak. Thus, our estimates of the population of individuals in rural Bangladesh who are food insecure are likely to be low compared to estimates done using data from other times of the year. Ramadan, the Muslim holy month of fasting, is not included either.

[4]The total number of households in each stratum was based on the 2001 population census.

5The sample weights were adjusted using the 2011 population census sampling frame.

[6]The survey includes households sampled from zones where a U.S. Government-led program to reduce food insecurity (Feed the Future) was engaged in programs providing aid to poor households. However, all patterns discussed are robust to restricting the sample to areas where the program was not operating (http://www.feedthefuture.gov/).

[7]It is important to note that using the female in charge of cooking, supervising, and serving as a proxy to report on behavior of other household members can potentially introduce "projection bias," where the reported behavior of other individuals is biased towards the behavior of the proxy (Hogset and Barrett, 2010; Rossandet al., 1977).

[8]An example of a recipe is chicken curry, which includes the ingredients chicken, onions, and tomatoes.

[9]To capture individual-level consumption, nutritionists prefer to use observed-weighed food records (OWFR) or individual 24-hour recall surveys to more accurately characterize food consumption (Fiedler et al., 2012). OWFRs are a recordation of the food an individual consumed over a specified time period that is precisely weighed so as to more accurately capture food consumption; 24-hour recall surveys elicit what an individual consumed over the past 24 hours.

eaten by individual household members, as well as guests, including information on whether a meal was not taken (e.g., because the individual was sick or fasting). Data on leftovers, food given away and fed to animals, as well as food eaten away from home, were also collected.

Table 1 displays rural population averages of key characteristics of the households, as well as for household heads and the spouses of household heads. Consistent with the high prevalence of food insecurity in global assessments, households in rural Bangladesh are relatively poor and at risk for a high prevalence of food insecurity (United Nations, Food and Agriculture Organization (UN/FAO), 2013; Rosen et al., 2014). Households devote a large share of their overall budget to food expenditures, are primarily involved in agriculture, and nearly 50 percent of adults are illiterate and have never attended school.

The composition of households is an important factor in better understanding the intrahousehold distribution of calories. In this study, we analyze food security status separately for the head of the household, the head's spouse, and male and female children.[10] The average household size is 4.75. Most household heads are male, with an average age of 44 and the vast majority married. Fewer than half of the household heads ever attended school and fewer than half are literate. Approximately 55 percent of heads are employed in the agricultural sector.[11]

The spouses of the household heads are younger (on average, 37 years old) and have similar rates of literacy, schooling, and agriculture employment as the heads of household. Finally, on average, rural Bangladeshi households spend approximately 58 percent of their total household expenditures on food.[12]

[10]Approximately 81 percent of households contain each of these types of household members, and include working-age adults. Alternatively, approximately 17 percent of households in the sample do not include a spouse but have children; whereas approximately 3 percent of households do not include a spouse or children.

[11]Aside from households employed in agriculture, there are not large numbers of individuals employed in any single occupation (e.g., electricians, barbers, truck drivers, etc.). The most common occupations after those involved in agriculture were individuals operating rickshaws and individuals operating a roadside stand selling goods (e.g., agricultural produce, etc.).

[12]The value of food expenditure is the sum of the value of food purchased outside the home and the value of food produced at home and gifts. To value food produced at home and gifts, we use median unit-value prices taken from the nearest geographical area, given a minimum of three unit-price observations. The minimum of three price observations helps to ensure that the price represents the area and to guard against potential outliers. Ideally, one would use shadow prices to calculate the value of food produced at home. The survey instrument does not provide enough information to create shadow prices; therefore, we use market prices. The value of nonfood expenditure is the sum of all reported expenditures on nonfood items. Items were either reported for the previous month or the previous year; annual expenditure was divided by 12 to get monthly figures.

Table 1
Rural Bangladeshi households (representative sample), 2011 and 2012

	2011	2012
Per capita weekly nonfood expenditure (in Taka)	300.3	(20.18)
Per capita weekly food expenditure (in Taka)	331.78	(12.95)
Share of expenditure devoted to food	0.58	(0.38)
Household size	4.75	(1.33)
Adult equivalents	4.22	(1.27)
Number of boys	0.96	(0.94)
Number of girls	0.98	(0.98)
Observations	5,319	
Characteristics of the household head		
Share of household heads who are male	0.87	(0.58)
Average age of household head	44.22	(3.66)
Share of household heads who are married	0.94	(0.48)
Share of household heads who are literate	0.46	(0.71)
Share of household heads who never attended school	0.50	(0.71)
Share of household heads who finished secondary school	0.08	(0.53)
Share of household heads who are employed in agriculture	0.55	(0.71)
Observations	5,319	
Characteristics of the household head's spouse		
Average age of spouse	37.1	(3.40)
Share of spouses who are male	0.005	(0.27)
Share of spouses who are literate	0.47	(0.71)
Share of spouses who never attended school	0.49	(0.71)
Share of spouses who finished secondary school	0.04	(0.44)
Share of spouses who are employed in agriculture	0.53	(0.71)
Observations	4,294	

Notes: Population-weighted means, with standard deviations in parentheses.

Source: USDA, Economic Research Service based on data from Bangladesh Integrated Household Survey.

Household-Level Calorie Estimates

Household-level calorie measures, in particular, daily calories per adult equivalent, are estimated and compared, based on the HH and intra-HH food consumption modules. To construct the measure, we calculate total daily household calories and divide by total household adult equivalents. Ages and genders of children and adults are used to adjust household size to "young adult equivalents," based on a requirement of 2,100 daily kilocalories.[13] These MDERs are estimated by the Government of India based on average physical characteristics and activity levels of the Indian population, which are likely very similar to that of Bangladesh (Government of India, National Institute of Nutrition, 2009). Table 2 presents the MDER used for each type of household member. (Also taken into account: whether women are pregnant or lactating, using higher requirements for them than other women; this differs from the Indian MDER estimates, which assume same nutritional requirements for all women of childbearing age.)

To calculate total daily household calories, nutritional information from Gopalan et al. (1989) is mapped to quantities for each of the 300 individual ingredients included in the modules.[14] For the HH module, the weekly calories are aggregated from purchases, home production, and foods prepared inside the home, then divided by 7 to get a daily average. The share of calories given to

Table 2
Adult equivalence scales

Age	Male	Female
Younger than 1 year	0.43	0.43
1 - 3 years	0.54	0.54
4 - 6 years	0.72	0.72
7 - 9 years	0.87	0.87
10 - 12 years	1.03	0.93
13 - 15 years	0.97	0.80
16 - 19 years	1.02	0.75
20 - 39 years	1.00	1.71, 1.00 *
40 - 49 years	0.95	0.68
50 - 59 years	0.9	0.64
60 - 69 years	0.8	0.51
Older than 70 years	0.7	0.5

*Notes: For women ages 20 to 39, we use a weight of 1.71 if she is pregnant or lactating, and 1.00 for all others. There are a small number of women who are pregnant or lactating in the sample, and all patterns discussed in the text are qualitatively identical if these women are excluded from the analysis.

Source: Gopalan, et al. (1989).

[13]Some studies report per capita calories without taking into account the genders or ages of household members (Subramanian and Deaton, 1996; Deaton and Dreze, 2009), while others partially account for differing calorie requirements by counting each child as half an adult household member (Hicks, 2015). Still others create household equivalence scales using data to estimate parameters associated with the resource cost of children relative to adults and household economies of scale; see Cutler and Katz (1992) for an application to U.S. income and consumption.

[14]We convert liquid amounts to grams using the density of each liquid.

guests in the HH module is estimated by calculating the share of total calories in the intra-HH module that were given to guests, and then this share is subtracted from daily household calories derived from the HH module. For the intra-HH module, the total calories consumed by household members are aggregated, then total daily household calories are divided by adult equivalents to get a calorie measure: daily calories per adult equivalent.

Calorie estimates can vary greatly when processed foods and foods bought outside the home are included; the shares of these foods already represent large diet shares in developed countries and are growing in developing countries. While the intra-HH module includes quantities of these food items, the HH module only includes values for these food items. Therefore, the method used in Subramanian and Deaton (1996) is followed to estimate calories for processed foods and foods purchased outside the home. They assume that calories from processed foods and foods purchased outside the home are twice as expensive as calories from foods prepared at home. So to calculate calories for these food items, we multiply the value by one-half the calories per taka (Bangladeshi currency) obtained from food prepared inside the home.

The top and bottom panels of table 3 present summary statistics from the HH and intra-HH modules, respectively. Average daily calories per adult equivalent are nearly 300 calories higher in the HH module than in the intra-HH module, leading to large differences (22 percent versus 33 percent, respectively) in the estimated share of Bangladesh's rural population that is undernourished, defined here as daily calories per adult equivalent of less than 2,100.[15,16]

While we cannot account for wastage in the 7-day recall data, it is difficult to believe that such large differences between the two modules could be driven by food wastage alone. This is especially true given that the majority of the average diet is composed of grains, and uncooked grains do not spoil easily. Thus, there does appear to be evidence that the two different modules are producing significantly different estimates of undernourishment.

Table 3
Undernourished rural Bangladeshi household members, 2011 and 2012

Based on 7-day household recall data		
Average daily calories per adult equivalent	2,718	(28.07)
Share of population that is undernourished	0.21	(0.64)
Based on 24-hour intra-household recall data		
Average daily calories per adult equivalent	2,436	(26.12)
Share of population that is undernourished	0.33	(0.68)
Observations	5,319	

Notes: Population-weighted means, with standard deviations in parentheses.
Source: USDA, Economic Research Service based on data from Bangladesh Integrated Household Survey.

[15]We do not report calories by source in the bottom panel given the potential of a large amount of inter-day variance in consumption from particular sources (i.e., a household member consumes a lot of fruit and vegetables on one day, and very little on the next, but overall calorie consumption remains more similar). Thus, longer recall periods are likely a better source of consumption by particular source (Hébert et al., 2014).

[16]It is also possible to construct other measures of more severe household undernourishment, such as the share of households where all household members do not meet their MDER. However, this is true for only 6.2 percent of households, and of those households, many are made up of only one or two members.

In the literature, there is evidence that calorie and nutrient estimates derived from household data (for example, from household budget surveys) are higher than estimates derived from individual-level nutrition surveys (Naska et al., 2007). However, other studies find little difference between consumption estimated from 24-hour recall periods for each individual surveyed and estimated from 7-day recall periods for an entire household (Dary and Jariseta, 2012; Jariseta et al., 2012; Sekula et al., 2005). In those studies, however, data are gathered from each individual member. In the BIHS, consumption data on all household members are gathered from the female in charge of cooking and serving.

Recent experimental work on Tanzania reveals large discrepancies in estimates of undernourishment stemming from survey design. For example, in the same village, estimates of undernourishment range from 18.8 percent to 68.4 percent using alternative survey designs (de Weerdt et al., 2014). The large differences in the household-level calorie estimates may stem from potential reporting errors associated with the recall period, mode of item solicitation (list versus free response), or information collected (quantities and values versus ingredients and their weights). Examples of reporting errors include recall error (the respondent does not correctly remember consumption over the period); telescoping (the respondent includes consumption that occurred outside the period); misreporting (due to respondent fatigue); and social desirability bias (the respondent exaggerates or understates consumption in hopes of receiving future aid) (de Weerdt et al., 2014). Additionally, studies have demonstrated differences based on ingredient lists of different lengths (Jolliffe, 2001) and varying definitions of a household (Beaman and Dillon, 2012).

All of these potential biases could differentially impact estimates derived from the two types of modules, given the substantial differences in the data collection. Of particular concern when comparing a 24-hour recall to a 7-day recall, telescoping tends to cause households to underreport consumption over longer recall periods (Clarke et al., 2008), but 24-hour recall is particularly poor in accounting for inter-day variation in caloric intake (Hébert et al., 2014). However, the size of the difference in the estimates is surprising, and suggests more research needs to investigate how the survey design affects estimates of undernourishment.

Regardless of the module used, however, it is clear that households in rural Bangladesh exhibit significant signs of calorie and nutrient deficiencies. Large portions of the population are not meeting their basic energy requirements and are likely consuming poor quality diets. Based on the HH module, households receive the vast majority—over 73 percent—of their calories from cereal grains and a limited share from produce (fruits and vegetables) and pulses (beans and lentils).[17]

[17]The total consumption of protein, calcium, iron, and fiber are all below recommended daily allowances (Government of India, National Institute of Nutrition, 2010).

Intrahousehold Distribution of Food

To best understand calorie-consumption differences among household members, individual-level consumption is calculated using the 24-hour recall data. Consumption by guests is excluded, as are leftovers and food given to animals. The intra-HH module of the BIHS survey provides a window into intrahousehold dynamics between men and women, between boys and girls, and between household heads and their spouses.

The literature on intrahousehold allocation of goods, including food, reveals (at times) large variation among household members. There are many reasons for inequity in the distribution of food within a household. Households may base their allocations of food on age, sex, pregnancy or lactation status, body composition, and activity levels (e.g., those working out in the field may require more calories than those staying at home). They may also base the allocation on cultural practices and preferences, for example, favoring one sex over another or favoring the household head relative to other members. Given the available data, we look to see whether interesting and informative patterns emerge when looking across groups of individuals, specifically, household heads and their spouses, and boys and girls under the age of 18.

Table 4 displays the shares of individuals whose undernourishment status is misclassified when using aggregated household data. Specifically, we identify individuals who are undernourished, living in adequately nourished households, and those who are adequately nourished living in undernourished

Table 4
Share of rural Bangladeshi individuals misclassified with household-level measures, 2011 and 2012

Full sample	Heads	Spouses	Boys	Girls
(1)	(2)	(3)	(4)	(5)
		All households		
0.264	0.245	0.182	0.325	0.322
(0.004)	(0.008)	(0.007)	(0.008)	(0.009)
21,795	5,319	4,281	4,345	4,306
		Adequately nourished households		
0.245	0.030	0.149	0.465	0.429
(0.005)	(0.003)	(0.007)	(0.011)	(0.012)
14,679	3,617	2,950	2,690	2,696
		Undernourished households		
0.302	0.685	0.251	0.094	0.141
(0.005)	(0.013)	(0.014)	(0.008)	(0.011)
7,116	1,702	1,331	1,655	1,610
		Differences between adequately nourished and undernourished households		
-0.062***	-0.630***	-0.079***	0.368***	0.295***
[0.006]	[0.009]	[0.012]	[0.013]	[0.014]

Notes: Population-weighted means, with standard deviations in parentheses, and number of observations listed below. In adequately nourished households, total calorie availability exceeds total household minimum daily energy requirements (MDER); in undernourished households, total calorie availability is less than total household MDER. The fourth row presents the differences between the second and third rows, where * denotes statistical significance at the 10-percent level, ** denotes statistical significance at the 5-percent level, and *** denotes statistical significance at the 1-percent level.

Source: USDA, Economic Research Service based on data from Bangladesh Integrated Household Survey.

households. Assessing the magnitude of such misclassification is valuable since a primary benefit of household-level data is identification of undernourishment.

The top panel reports the overall share of the population that is misclassified; the middle panel presents the share of individuals who are undernourished but living in adequately nourished households; and the bottom panel presents the share of the population that is adequately nourished but living in undernourished households. Column (1) presents estimates for the full sample, while columns (2)-(5) separate the household by the head, the head's spouse, male children, and female children. A household is defined as adequately nourished if average daily calories per adult equivalent are greater than 2,100.

Overall, approximately 26.4 percent of the population is misclassified; this number ranges from approximately 18 to 33 percent, depending on the household members who are being assessed. When adequately nourished and undernourished households are examined separately, there are observable patterns that reflect the intrahousehold allocation of food. Household heads are more likely to meet their MDER than other members in both adequately nourished and undernourished households. These differences are exacerbated in undernourished households, in which households heads are over twice as likely to meet their MDERs than members of any other group. Strikingly, the bottom panel of column (2) suggests that approximately 69 percent of household heads in undernourished households meet their MDERs at the expense of the other members. That so many children and women fail to meet their dietary requirements in adequately nourished households is concerning, particularly given the long-term implications of poor nutrition.[18,19]

As may have been expected, the shares of household members meeting their MDER in adequately nourished households are larger than those same shares in undernourished households. What may not have been expected (and is a key finding of this study) is that nearly 25 percent of individuals in adequately nourished households fail to meet their MDER. That is, even in households where total daily calories would allow all members to meet their MDER if allocated according to each member's requirements, there are individuals who fall short of these nutritional needs. Key implications of this finding are that intrahousehold allocation of food seems to be extremely important and that solely looking at household-level measures does not capture this important dimension of intrahousehold undernourishment.

These findings survive important robustness checks. Given that the MDER estimates drive our estimation of undernourishment, there could be a concern about measurement error in those estimates. The MDERs for the head of the household and for young children could be especially problematic. The former may be performing more strenuous forms of labor and thus require more calories; the latter require relatively few calories, and thus small mistakes in their MDER could have significant impacts on measurement of undernourishment.

[18]Although these figures suggest that the spouse is more likely to reach his or her MDER than children in both adequately nourished and undernourished households, this might not be the case, given that nearly 50 percent of spouses are engaged in agricultural labor and might have significantly higher MDERs than are used in the table. When adjusting the MDER for spouses who work in agriculture, the figures more closely resemble those of children. These results are available from the authors upon request.

[19]It is unlikely that the difference in figures for spouses and children is being driven by other sources of food for children that might have been missed in the data collection. The individual-level intake data is supposed to include sources of food outside the household. Furthermore, even if the respondent was not aware of all the food children consumed at school, very few households (153 out of 5319 total) had a child who received assistance.

Therefore, sensitivity of our results was tested to examine assumptions about household members' MDERs. First, it is assumed that the MDER of household heads engaged in agricultural labor is 2,400 daily calories and that the MDERs of all the other household members (including children) are reduced by 10 percent. Then, the misclassification shares based on these modified MDERs are re-estimated (see table 5). These assumptions make it less likely to misclassify each type of household member and thus provide and important robustness check.[20] The results are qualitatively similar to this study's earlier findings, suggesting that the measure of misclassification is detecting relatively large inequities in the intrahousehold distribution of calories. As a second sensitivity test, households in which the head is involved in agricultural labor were excluded, which likely excludes household heads with an MDER significantly higher than 2,100 daily calories (results not shown). Again, the results are qualitatively identical to the main results above.

Characterizing the intrahousehold distribution of calories by the share of the households that meet their MDER might not fully capture the depth of the inequity. For example, it could be the case that the misclassified members are still consuming very close to their MDER. Thus, to further investigate those inequities, we create a measure to capture the depth of undernourishment in a household and for groups of individual members. First, the percentage deviation in consumption from the MDER for each undernourished individual in the household is calculated:

$$Deviation_{ih} = \begin{cases} \dfrac{MDER_{ih} - Consumption_{ih}}{MDER_{ih}} & if\ Consumption_{ih} < MDER_{ih} \\ 0 & otherwise \end{cases}$$

Table 5
Misclassification under varying nutritional requirements, rural Bangladesh, 2011 and 2012

Full sample	Heads	Spouses	Boys	Girls
(1)	(2)	(3)	(4)	(5)
		All households		
0.232	0.188	0.163	0.308	0.294
(0.004)	(0.006)	(0.006)	(0.008)	(0.009)
21,795	5,319	4,281	4,345	4,306
		Adequately nourished households		
0.208	0.075	0.118	0.373	0.338
(0.004)	(0.005)	(0.006)	(0.011)	(0.011)
16,228	3,959	3,228	3,044	3,063
		Undernourished households		
0.302	0.513	0.297	0.149	0.184
(0.007)	(0.016)	(0.016)	(0.011)	(0.014)
5,567	1,360	1,053	1,301	1,243

This table reports population weighted means of the share of the sample that is misclassified, the standard deviations in parentheses, and the number of observations below the standard deviation. In adequately nourished households, total calorie availability exceeds total household minimum daily energy requirements (MDER); in undernourished households, total calorie availability is less than total household MDER.

Source: USDA, Economic Research Service based on data from Bangladesh Integrated Household Survey.

[20]Alternatively, the patterns in misclassification are similar when changing the MDER for only the household heads or for changing the MDERs only for the rest of the household.

where *i* denotes the individual in household *h*, *MDER* continues to denote the minimum daily energy requirement, and *Consumption* denotes the daily calorie consumption. Then, based on these deviations, we calculate the depth of food insecurity at the household level as:

$$Depth\,of\,undernourishment_h = \frac{\sqrt{\sum_i^N Deviation_i^2}}{N}$$

where *N* denotes the total number of household members.[21] Additionally, a similar measure to characterize the depth of undernourishment for subsets of the household can be used.

Summary statistics of the depth of undernourishment in the household and among subsets of the household are presented in table 6. Similar to the results above, the household head is found to be consuming a disproportionate share of the available calories at the expense of all other household members. The depth of undernourishment is the largest among spouses and children, and the smallest among household heads.

We also examine how the depth of undernourishment is associated with nonfood household expenditure—a proxy for income. In surveys conducted in developing countries, total expenditure or consumption is often used as a proxy for income since income data are often less reliable. Here, nonfood expenditure alone is used, and food expenditure is excluded, since undernourishment is defined directly from the food expenditure data, and measurement error in the data could produce spurious correlations (Borjas, 1980). Given the standard limitations in cross-sectional data, this empirical exercise documents the statistical associations between these variables and should not be interpreted in a causal way.[22]

Table 6
Depth of undernourishment in rural Bangladesh, 2011 and 2012

Full sample	Heads	Spouses	Boys	Girls
0.16	0.03	0.09	0.19	0.19
(0.003)	(0.002)	(0.003)	(0.005)	(0.005)
5,319	5,319	4,271	3,140	2,978

This table reports population weighted means of the depth of undernourishment, the standard deviations in parentheses, and the number of households below the standard deviation. The depth of undernourishment is the square root of the sum of the squared percentage deviations from the minimum daily energy requirements (MDER) for each member who consumes below his or her MDER.

Source: USDA, Economic Research Service based on data from Bangladesh Integrated Household Survey.

[21]This measure of the depth of undernourishment is similar to the poverty measure developed by Foster et al. (1984) and shares similar properties.

[22]First, it is possible that an omitted factor is driving both the depth of undernourishment and nonfood expenditure. We use the village indicator variables to account for potential omitted factors at the village level (such as food prices); however, there may be such factors at the household level which we cannot control for using cross-sectional data. Second, this relationship may suffer from reverse causality to the extent that severe undernourishment can impair the ability to work and thus derive income.

Specifically, we estimate the following specification:

$$(1)\ \text{Depth of Undernourishment}_{hv} = \alpha_v + \beta \ln(\text{Nonfood Expend}_{hv}) + \pi \text{Controls}_{hv} + \mu_{ihv}$$

where *h* denotes the household and *v* denotes the village; α denotes village indicator variables that absorb unobserved (and observed) heterogeneity at the village level that may be correlated with the depth of undernourishment and nonfood expenditure; *Nonfood Expend* denotes the nonfood expenditure by the household; and *Controls* include a number of household characteristics, including the number of boys and girls and household head characteristics.[23] The coefficient of interest, β, captures how the depth of undernourishment varies with nonfood expenditure. Based on the results above, we would expect β to be negative, where households that have more resources should have a lower depth of undernourishment.

The estimates from specification (1) are presented in table 7. Columns (1)- (3) analyze the depth of undernourishment for all household members. Column (1) estimates a sparse specification, column (2) adds control variables, and column (3) adds village indicators. As expected, the depth of undernourishment decreases as nonfood expenditure rises. Furthermore, the estimate is very stable across specifications, suggesting that the correlation is robust to the inclusion of unobserved heterogeneity.

Additionally, we estimate an analog to specification (1) at the individual level to analyze whether the relationship between the depth of undernourishment for individuals and nonfood expenditure might be different for different types of household members. In particular, we estimate the following specification:

Table 7
Relationship between depth of food insecurity at the household level and nonfood household expenditures, rural Bangladesh, 2011 and 2012

	Full sample		
	(1)	(2)	(3)
ln(nonfood expenditure)	-0.020*** [0.003]	-0.017*** [0.003]	-0.022*** [0.003]
Control variables	N	Y	Y
Village dummy variables	N	N	Y
R^2	0.009	0.135	0.228
Observations	5,319	5,319	5,319

This table reports population-weighted regression coefficients with heteroskedastic-robust standard errors clustered at the village level in brackets. Control variables include number of boys, number of girls, age of household head, and indicators for household head being male, married, literate, working in agriculture, having no formal schooling, and having secondary schooling. * denotes statistical significance at the 10-percent level, ** denotes statistical significance at the 5-percent level, and *** denotes statistical significance at the 1-percent level.

Source: USDA, Economic Research Service based on data from Bangladesh Integrated Household Survey.

[23]The control variables included in the specification are the number of boys, the number of girls, an indicator equaling 1 if the household head is male, the age of the household head, an indicator equaling 1 if the household head is literate, an indicator equaling 1 if the household head never attended school, an indicator equaling 1 if the household head attended secondary school or above, an indicator equaling 1 if the household head is employed in agriculture. Results are qualitatively identical if we include spouse characteristics and restrict the sample to households with spouses.

$$\text{(2) Individual Deviation}_{ihv} = \alpha_v + \beta \ln(\text{Nonfood Expend}_{hv}) + \gamma_1 \text{Spouse}_{ihv} * \ln(\text{Nonfood Expend}_{hv}) + \gamma_2 \text{Girl}_{ihv} * \ln(\text{Nonfood Expend}_{hv}) + \gamma_3 \text{Boy}_{ihv} * \ln(\text{Nonfood Expend}_{hv}) + \gamma_4 \text{Non-HeadOther}_{ihv} * \ln(\text{Nonfood Expend}_{hv}) + \pi \text{Controls}_{ihv} + \mu_{ihv}$$

where i denotes individual, h denotes household, v denotes village, *Individual Deviation* denotes the percentage that each individual i falls short of his or her MDER (as captured by the formula for *Deviation* above), and *Spouse, Girl*, *Boy*, and *Non-HeadOther* denote indicator variables equal to one if the individual is that type of household member.[24] In this specification, β corresponds to how much the depth of undernourishment increases in response to a 1-percent increase in nonfood expenditure for household heads, while γ_i report by how much more the depth of undernourishment increases for each type of individual household member than the increase for the household head.

The estimates of specification (2) are presented in table 8. Column (1) estimates a sparse specification excluding all control variables, interaction terms, and fixed effects; column (2) adds control variables; column (3) adds village fixed effects; and column (4) adds the interaction terms. As suggested in the household-level estimates, in all individual-level specifications, a larger nonfood expenditure suggests a smaller depth of undernourishment for an individual. However, in column (4), we see that nonhousehold heads have a much greater sensitivity to changes in nonfood expenditure than household heads.[25] Thus, as suggested by the misclassification estimates in tables 3 and 4, the consumption of the household head appears to be much more stable in the presence of added stressors.

[24]Controls include the same variables as in specification (1), but also includes the variables *Spouse, Girl, Boy, and Non-HeadOther.*

[25]The p-value from a test of the response of all household members being identical (a test of all the coefficients on the higher order terms equaling zero) is equal to .0000.

Table 8

Correlation of individual depth of food insecurity and nonfood expenditures, rural Bangladesh, 2011 and 2012

	Dependent variable: individual percentage deviation from minimum daily energy requirement			
	(1)	(2)	(3)	(4)
ln(nonfood expenditure)	-0.021*** [0.002]	-0.017*** [0.002]	-0.022*** [0.002]	-0.004* [0.002]
ln(nonfood expenditure) X spouse indicator				-0.022*** [0.003]
ln(nonfood expenditure) X boy indicator				-0.023*** [0.005]
ln(nonfood expenditure) X girl indicator				-0.032*** [0.005]
ln(nonfood expenditure) X other Indicator				-0.017*** [0.005]
Indicator for spouse		0.064*** [0.003]	0.064*** [0.003]	0.214*** [0.024]
Indicator for boy		0.155*** [0.004]	0.155*** [0.004]	0.313*** [0.036]
Indicator for girl		0.148*** [0.004]	0.148*** [0.004]	0.368*** [0.035]
Indicator for "other"		0.089*** [0.004]	0.090*** [0.004]	0.202*** [0.035]
Control variables	N	Y	Y	Y
Village indicator variables	N	N	Y	Y
R^2	0.007	0.129	0.168	0.17
Observations	21,795	21,795	21,795	21,795

Notes: Population-weighted regression coefficients with heteroskedastic-robust standard errors clustered at the household level in brackets. Control variables include number of boys, number of girls, age of household head, and indicators for household head being male, married, literate, working in agriculture, having no formal schooling, and having secondary schooling. * denotes statistical significance at the 10-percent level, ** denotes statistical significance at the 5-percent level, and *** denotes statistical significance at the 1-percent level.

Source: USDA, Economic Research Service based on data from Bangladesh Integrated Household Survey.

Conclusion

In this study, the Bangladesh Integrated Household Survey (2011 to 2012), a novel data source, is used to estimate calorie consumption at both the household and individual level in rural Bangladesh. In particular, our analysis focuses on two modules collecting data on food consumption—the HH module includes data from 7-day recall of raw ingredients for food consumed in the household, and the intra-HH module includes data from 24-hour recall of the consumption of finished recipes (including information on how much each individual consumed).

First, large differences in calorie consumption estimates from the HH-module and the intra-HH module are found; these findings support recent evidence that demonstrates the importance of survey design in the measurement of undernourishment. Second, significant inequity in the distribution of calories within the household occurs, with the head of the household consuming a disproportionate share of calories relative to other household members. Third, this inequity in the distribution of calories is worst among the most undernourished, poorest households. Together, these results suggest that quantitative assessments of undernourishment using aggregated household data might misclassify the undernourishment status of a significant share of the population.

These results are potentially important in the targeting of food aid programs. For example, emphasizing food aid programs that target children outside the household (e.g., school lunch programs) or target females in charge of food preparation might be important tools in combating persistent malnourishment in Bangladesh given the potential understatement of undernourishment of nonhousehold heads using household data. While such programs may not be sufficient to improve the intrahousehold distribution of food, our findings suggest that the intrahousehold allocation of food is important in rural Bangladesh and could be taken into consideration by policymakers.

Earlier researchers have reached similar conclusions, particularly Pitt et al. (1990), who found that adult men consumed significantly more calories than adult women in a 1982 survey of 385 households in Bangladesh. Those authors attribute their finding to differences in the return to labor between men and women. Our results generalize their study in a number of ways, demonstrating that:

1. the inequity in household consumption exists in a much larger and more representative sample of households,

2. the asymmetry in calorie consumption between household members has persisted over the past 30 years despite significant increases in income and improvements in the earning power of women,

3. children of both genders consume a disproportionately low share of household calories,

4. the differences in calorie consumption cannot be fully explained by differences in labor productivity between household members (and the higher associated MDER for men), since they persist in households where the head is not engaged in strenuous forms of labor.

Our findings give rise to a number of questions and areas for future research. Since there are a number of differences between the HH-module and the intra-HH module, we are unable to identify which difference in survey methodology leads to the large differences in estimated calorie consumption. There is a difference in recall periods (7 days versus 24 hours) between the two modules, and there is a difference in the list of food items for which consumption information is collected. More

research and validation are needed to better understand these differences and to identify which of these estimates better approximates the household's nutritional status.

The intrahousehold consumption collected in the BIHS is elicited from the female household member in charge of cooking as opposed to elicited from each individual household member, which is the survey method preferred by nutritionists (Fiedler et al., 2012). It is unknown whether respondents are able to accurately capture the undernourishment experiences—both objective and subjective—of other household members, where in other contexts it has been shown that the experiences of the respondent might influence the reported behavior of other household members (Hogset and Barrett, 2010; Ross et al., 1977). Some recent literature speaks to potential differences in the undernourishment experiences of individual household members in both Bangladesh and other countries (Coates et al., 2010; Rose, 1999). Thus, the actual calorie consumption of each individual is potentially imprecisely estimated. Further research in this area is warranted, as food security and undernourishment are largely individual constructs.

It is difficult to understand how well the specific patterns we observe in rural Bangladesh, where household heads consume a disproportionate share of household calories, might generalize to other contexts. In particular, among pastoralists in Eastern Africa, researchers found that the household head makes nutritional sacrifices in the face of hardship (Villa et al., 2011). However, the existence of inequity in household consumption has been corroborated in numerous contexts (Beaman and Dillon, 2012; Chen et al., 1981; Strauss et al., 2000).

This study's results may prove useful for food aid programs that wish to combat persistent malnutrition in Bangladesh by specifically targeting undernourished rural women and children. The programs may wish to provide food to children outside the household (e.g., through school lunch programs) or by reaching the women in charge of household food preparation. While such programs may not be sufficient to improve the intrahousehold distribution of food, our findings suggest that the intrahousehold allocation of food is important in rural Bangladesh and could be taken into consideration by policy initiatives such as U.S. Government's interagency Feed the Future program.

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