Nutritional Discordance

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# Introduction

Women and girls are commonly assumed to be at greater risk of food insecurity (e.g., UN Women 2012). Earlier research examined whether women consume a lower percentage of their required daily caloric intake (e.g., Haddad and Kanbur (1990); Berhman and Deolaliker (1990); Pitt et al. (1990); Haddad et al. (1995)), but, as Marcoux (2002) summarized, “evidence of pro-male biases in food consumption is scarce” (p. 275).

In recent years, this claim has been reconsidered, and more recent findings suggest that there is meaningful nutritional inequality within households. Much of the earlier research used caloric intake measures. Recent research has focused on richer nutritional intake and outcome measures, such as dietary diversity (Mangyo (2008); Villa et al. (2011); Rahman (2013)), nutrient adequacy (Coates 2017 and Coates 2018), and body mass index (Sahn 2009; D’Souza and Tandon 2018). This resurgent interest in understanding intra-household nutrition reflects the recognition that calories are just one measure of nutritional status.

The new studies that measure differences in nutritional status within households, which we refer to as nutritional discordance, use both a wide variety of methods and a wide variety of nutritional measures. Researchers have to make a series of choices about how to measure discordance, and there is little-to-no consensus on current best practice. For example, some approaches ignore activity intensity of each individual. Individuals working in higher-intensity occupations may have greater caloric requirements compared to those who do not. If men are expending a greater proportion of energy in high-intensity activities than women, failing to account for energy expenditure can make results appear more inequitable than they truly are. The nutrient-reference tables used in low-income country studies also differ. In some cases, USDA reference tables are used, even though the foods’ nutrients may vary (e.g., banana in the US is different than banana in Uganda). As a result of this variation, we know little from current studies about whether findings of nutritional discordance are sensitive to the choice of method or measure. We intend to disentangle how the choice of method and choice of nutritional measure impact findings for a single country: Bangladesh.

This research has two aims. First, we make a methodological intervention to learn the extent to which measurement choice influences findings of nutritional discordance. This can help us to determine when and where relying on unitary models of households is appropriate. Brown et al. (2017) argue there is “substantial intrahousehold inequality” in sub-Saharan Africa, where being an undernourished woman is poorly correlated with poverty status. Lentz et al. (2019) show that women eat last and least and consume fewer high-quality quality foods than other household members in rural South Asia. These and other studies raise questions about the continued reliance on unitary household models for food, agriculture and nutrition research. An important step is to identify how sensitive results that are discordant are to the choice of method.

Second, based on our findings, we aim to provide guidance on best practices for measurement. A better understanding of nutritional discordance is critical for food, agriculture, nutrition, gender, and social protection policy. For example, while efforts to link agriculture-to-nutrition remain widespread, achieving improved nutrition remains challenging (see Kadiyala et al. 2014). Similarly, an expanding interest on women’s empowerment (e.g., Pratley 2016) raises questions of when and how gender inequality manifests itself within households. A clearer understanding of how to measure such effects, and when it is useful to do so can help researchers and practitioners recognize when household bargaining matters and how to design program interventions better achieve desired impacts.

# Methodology

Decision tree

Physical Activity

Active individuals require more nutrients than sederntary. The delineation of indibiduals by physical activity level can affect the individual nutrient requirements and likelihood of an individual being identified as inadequate. Some papers classify all individuals as moderate, while others allocate activity category between “light”, “moderate”, and “active” based on occupation category, as we have done in Table XX. We relied on recommendations from Steeves et. al. (2015), who used US-based accelerometry data from over 1000 adults.

Household Size

When consumption data is only available at the household level, various methods are used to assign shares to individuals to allocate nutrient consumption. Table XX shows the impact of those choices. *Household size* counts all members equally, regardless of age, lifestage, or size. *AE\_OECD* uses the OECD calculator which assigns 1 to the first member of the house, 0.7 to each additional adult, and 0.5 to each additional child.

1. Variation in Denominator:
   1. HH size (PC)
   2. OECD adult equivalent
   3. AE based on age
   4. AE based on age group
   5. Add on gender
   6. Add on activity as defined by employment category
   7. Add on activity as defined by time use
   8. Add height and weight
   9. Adult Male Equivalent (is this different than AE)
   10. AE benchmarks from Bangladesh./India
   11. AE benchmarks from FAO
   12. AE benchmarks from USDA
2. Variation in Numerator:
   1. Nutrient values from Bangladesh/India Tables
   2. Nutrient values from USDA
3. Inequality Measures
   1. Individual consumption and calculated measure to **regional** EAR/RDA/BMI
   2. Individual consumption and calculated measure to **US** EAR/RDA/BMI
   3. Including pregnant or lactating women or drop category
   4. Include children vs adult only sample
   5. Kuznets curves to both HH income, and to self measure (nonparametric)
   6. Log deviations vs differences in deviations
   7. Average of Mean household deviation vs mean # of household with binary inequality measure
   8. Z-score deviation or other unit free measure

To compare across methodologies, we use the Bangladesh Integrated Household Survey (BIHS). BIHS is a rich, nationally representative survey collected in 2011-12 of over 21,000 individuals across more than 5000 households. Researchers face multiple decisions points when computing nutritional discordance. Our comparisons across key methodological decisions include:

1. Nutritional measures: we will estimate discordance for both calorie and nutrient intake, using 24 hour individual dietary recall data, household food expenditure data, Household Dietary Diversity Scores, and body mass index using anthropometric measurements.
2. Approaches to computing nutrient intake: we will compare several assumptions used to compute individual measures and to convert household level measures to individual measures:
   1. Per capita (PC), Adult Equivalent (AE), and Adult Male Equivalent (AME): We look at the method of distributing calories or nutrients from household level to individuals.
   2. Food composition tables: We examine how calorie and nutrient intake vary by the choice of reference table to calculate calories and nutrients from food diaries, using both the USDA and Indian reference tables (Bangladesh does not have its own reference tables).
3. Calorie and Nutrient Benchmarks:
   1. Methodology: We look at the source and methodology for benchmarks such as Estimated Average Requirement (EAR), Recommended Daily Allowance (RDA), and BMI tables.
   2. Geography: We consider the importance of regional compared to international nutrient benchmarks using USDA, FAO, and Indian reference tables.
   3. Parameters: We evaluate the effects of using age compared to age group, and including activity level, gender, height, weight, and pregnancy or lactation status affect frequency and level of nutritional discordance.
4. Multiple approaches to compute discordance: We consider various methods of computing discordance, such as Kuznets curves, log deviation of inequality, and differences in deviations from minimal required intakes.

We are now computing multiple nutritional measures. We will then compute correlations across the multiple nutritional measures. We will test the sensitivity of the nutrient intake results to the various approaches and parameter choices. By identifying relationships between measures, approaches, and parameters, we can make recommendations for best practices for measuring nutritional inequality, given data and temporal limitations.

**Reference Tables (DRI vs WHO)**

Use WHO for everyone, but adjust for pregnancy and lactation using DRI recommendations

**Notes/thoughts:**

If the EAR requirements are defined as meeting the needs of half the population, then we would expect to see half of the individuals in each age/group strata to not meet the requirement.

No analysis of children under 2. Iron is a question of bioavailability, may want to avoid.

D’Souza and Tandon use Minimum Daily Energy Requirement (MDER) from India to calculate total household calories/adult equivalents, which are based on 2100 (or 2400?) calories per day and age and sex. (HOW? The govt of india gives the nutrient requirement for a 35-year-old woman as X. Then X/2400 = her AE. Total HH AE= sum of individual AE) They use nutrient requirements, not sure how they relate to EAR

Sununtnasuk and Fiedler do that same, but use FAO targets of 3050 and use activity level. They also divide AME-based measured by 24-HR based measures to get % (??)

Major assumptions for use of EAR: % of individuals with intakes below respective EAR corresponds to % of individual with inadequate intakes. Applied to energy, but says it violates assumption that nutrient intakes and requirements are not correlated? Requires distribution of nutrient’s requirements to be symmetrical, thus not good for iron.

Magnitude of energy and nutrient gaps as the percentage of energy requirements/EARs for proportion of population with inadequate intake:

(avg energy requirement or EAR – average actual intake)/energy requirement or EAR

Used Concordance correlation coefficients to compare AME-estimates to 24 HR estimates

Berti used the relative dietary adequacy ratios:

=The energy adequacy ratio of group i (average intake of group i/average energy requirement of group i)

energy adequacy ratio of adult males

IOM recommendations:

EAR cutpoint valid if nutrient assumed to be distributed symmetrically.

If not, use EAR probability method (like for iron) however, EAR cutpoint requires multiple days of intake data to identify within person SD, or you can use SD for age/sex group? Generate z score

If ADMR avail, use equation for AI for lower bound, and equation for UL for upper bound?

Assumption that intakes and requirements are independent is asserted to be false for energy requirement: people feel hungry and so they eat more, reflecting accurate signaling and actions. But the assertion that for macro and micronutrients, intakes and requirements are independent is underwhelming. It assumes that there is no dietary knowledge or planning to consume fats, proteins, and carbohydrates with respect to requirements for those nutrients, either because there is no signal or because of a lack of knowledge.

Does it make sense to use reference intake levels or ranges for the individual’s current weight, or for the reference weight for the individual’s age/sex group? The former could mean that if the individual is meeting requirements, they will maintain that weight, but still might be underweight. If we use the latter, it may be an unrealistic reference weight for the given sample of individuals, but the appropriate intake reference to maintain the healthy weight for that age/sex group.

Identify methods/trends that are used in practice instead of methods which could be used?

1. US-based DRI/IOM standards (Schneider)
2. WHO/FAO standards (PONE/IFPRI) currently only have found for kcal, does everyone else using IOM for the rest?
3. India standards (DST) available for everything but carb
4. AE: allocate food by relative size of energy requirements
   1. AE allocate food by relative size energy requirements and relative nutrient requirements separately (Coates)
5. EAR for individuals: can adjust with population vs sample standard deviation, or just make an assumption and use the formula anyway without adjusting for individual SD
6. Not supposed to use EAR for energy but do it anyway
7. Not supposed to use EAR for individual but do it anyway

# Data

The BIHS data set

# Summary Statistics

# Results

# Discussion

**References**

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