# *Women's empowerment and gender-differentiated food allocation in Bangladesh*

# Women's Empowerment and Gender-Differentiated Food Allocation in Bangladesh

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**Abstract**: This paper analyzes the impact of women's empowerment on two aspects of food security – calorie and protein intake of children - using data on agricultural households from the Bangladesh Integrated Household Survey. We are interested both in the differential impact of mother's empowerment on the food security of boys and girls as well as in whether different aspects of empowerment have different effects. There are 10 different aspects of empowerment including making production decisions, owning and selling assets, being a member of a group and so on. Our estimates suggest that, in households with more empowered women, children enjoy higher calorie and protein intake but that daughters are disadvantaged relative to sons. Most importantly, mother's empowerment is an important source of gender discrimination. When considering the sub-components of empowerment, we find that input into production decisions are important for both calorie consumption and protein. These findings are robust to a host of controls including household poverty, sibling composition, community social norms and individual characteristics.

**Key words:** Intra-household food allocation, food security, women's empowerment

**JEL classifications:** D13, I10, I30, I34

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## 1 Introduction

In this paper, we focus on the impact of women's empowerment on food security in rural agricultural households of Bangladesh, a country where the prevalence of under-nutrition is very high.[1] Like other South Asian societies, Bangladesh too has a strongly patriarchal culture in which female mobility is restricted and most women have no independent sources of income or assets. Traditionally, agriculture in South Asia was male-dominated, with women's roles being largely post-harvest (FAO 2011; Akter et al. 2017), but there have been significant changes in recent years, with the share of the economically active women involved in agriculture rising from 42.4 in 1980 to 44.5 in 1995 and 63% in 2015 as per Labor Force Survey data (BBS 2015, 2017). During the same period, Bangladesh has made significant improvements on a range of food security indicators, recording one of the fastest decreases in child underweight and stunting prevalence in history – 1.1 to 1.3% points per annum (Headey et al. 2015). Mortality rates for children below 5 years in Bangladesh have also decreased from 221 deaths per 1000 live births in 1970 to 46 in 2014 (Nisbett et al. 2017). Whether these two trends - changes in women's position in agriculture and improvements in food security indicators – are related, has become a growing area of research in recent years.

There is a large literature on various factors influencing the food security of households (for existing reviews, see Poulsen et al. (2015); Charlton et al. (2016); Béné et al. (2016)) but a more limited, though growing literature, on the impact of women's empowerment more specifically within marriage[2]. This increasing interest is not surprising given that women constitute about 43 percent of the world's farmers and grow much of the world's food (FAO, 2011). They influence both food production and consumption[3] by providing paid and unpaid labor in agricultural operations and being intimately involved in food preparation within most households in South Asia. Given this centrality of women in food security, it is not surprising

[1] About one-fifth of the country's ever-married women aged between 15-49 years are malnourished (BMI<18.5) and so are one-third of the country's under-five children (stunted) (NIPORT et al. 2016).

[2] Some exceptions are: Malapit and Quisumbing (2015) and Sharaunga et al. (2016). For existing reviews of the literature on women's roles in achieving food security, see Meinzen-Dick et al. (2011) and on nutritional security, see Cunningham et al. (2015) and Rao et al. (2019). Also see Duflo (2012) for an extensive survey of the studies on the impact of women's empowerment.

[3] Women play a significant role in agricultural households as unpaid workers in post-harvest operations (preparation of threshing floor, threshing, beating, parboiling, drying, husking, winnowing, sieving, and storing alongside taking care of livestock, poultry, and homestead gardening) (Begum 1989) as well as earning an income as wage laborers.

that many agricultural interventions target women's empowerment (Ruel and Alderman 2013; Pandey et al. 2016; Bird et al. 2019).

Analysing the impact of agriculture on food security, Ruel et al. (2018) identify 6 pathways through which agricultural interventions can impact nutrition, of which three relate to the role of women. These are improving food access through own production, increased incomes, changes in food prices, women's social status and empowerment through access to resources, increased participation of women in agriculture[4] and finally, women's health and nutrition through exposure to toxic agents on farm and also energy intake expenditure. Kadiyala et al. (2014) analysing a similar set of 6 pathways in India, conclude that they found very little recent research looking at the links between gender, agriculture and nutrition, particularly in relation to women's time use. Malapit and Quisumbing (2015) also argue that while 'the biological processes underlying optimal nutrition are relatively well understood, knowledge regarding which dimensions of women's empowerment matter for good nutrition is limited, both because empowerment is culture- and context-specific and because of the difficulty of measuring empowerment' (p.54).

As we will see in the conceptual framework in section 2, women provide a strong link between agriculture and household food security because they are the primary carers within households in developing countries. Child nutrition and health indicators are affected by women's role in child feeding, health seeking and/or hygiene practices within the household. Since women are generally considered to make pro-nutrition choices (Gillespie et al. 2019), their limited bargaining power is likely to undermine the household's nutritional status considerably. There is a growing body of evidence documenting whether, and how, empowered mothers matter for the food security of household members in developing countries. Using South African data, Sharaunga et al. (2016) have shown that if the primary female member of a household is empowered then the household is more likely to be food secure because empowerment increases women's access to and control over productive resources, increases household livelihood diversity and decreases the barriers women face to access markets. Smith et al. (2003) found that women with higher status relative to men had more control over household resources, better access to information and more self-confidence and esteem. They therefore have better nutritional status and provide higher quality care to

[4] For instance, narrowing the empowerment gap between spouses is associated with higher levels of technical efficiency (Seymour 2017). This is regardless of the agricultural plots jointly managed by women with their spouses or those for which women did not report any involvement in agricultural decision-making.

their children. Similar conclusions have been reached by Harris-Fry et al. (2015) in their study on Bangladesh. In addition, Sraboni et al. (2014) analysing the impact of women's empowerment in agriculture on household food security in Bangladesh found that average per capita calorie availability and household dietary diversity increased with the primary female's empowerment. Shroff et al. (2009) found that mothers with the ability to set money aside in Andhra Pradesh, India had lower odds of their child being stunted than mothers without financial autonomy. Bhagowalia et al. (2012) found a positive association between household dietary diversity and mother's decision making power and Malapit et al. (2015) found that women's empowerment in Nepal especially group membership, control over income and decreased workload were positively associated with greater dietary diversity for mothers. They also found that control over income and a lower gender parity gap was associated with higher child height.

There is a growing literature of the impact of women's empowerment on household food security. However, few of these studies consider the intra-household gendered impact of women's empowerment or the various domains of empowerment[5]. Our analysis in this paper aims to fill this gap in the literature.

In this context, we are interested in three specific questions: do empowered women influence food security within their households? To what extent do women have a gender-differentiated impact i.e. do they have a different effect on the consumption of boys relative to girls? Which aspects of empowerment are important – production, leisure, income or community activities? To answer these questions, we use data from the Bangladesh Integrated Household Survey for our analysis. This data provides a Women's Empowerment in Agriculture Index (WEAI), which is a multi-dimensional index capturing women's empowerment across a range of activities and dimensions[6].

Our analytical strategy involves regressing the food security indicators on empowerment while controlling for a range of demographic, socioeconomic, household, and regional factors in a multivariate framework. Our study goes on to consider the impact of 10 sub-components of the WEAI and makes two scholarly contributions. First, we add to the literature on gender

[5] Two exceptions are Novella (2019) and Malapit and Quisumbing (2015). Novella finds that the impact of women's empowerment varied by country, with maternal power having a larger effect on girls in Peru and Vietnam, a negative effect in India and no significant effect in Ethiopia. Malapit and Quisumbing found that in Ghana, girls are more likely to consume diversified diets in households where mothers have decision making power with regard to credit.

[6] For a review of the literature on definitions and measures of empowerment, see Pereznieto and Taylor (2014).

bias in intra-household allocation. While there are numerous studies on the impact of maternal education, income and autonomy (e.g. Malapit et al. 2015; Bhagowalia et al. 2012; Shroff et al. 2009; Novella 2019), to our knowledge, this is the first attempt to formally link women's empowerment to gender bias within the household in the context of the food security of children. Capturing the ability of women to contribute to decision-making in production is especially important in the context of agricultural households which are both productive and consumptive units. Second, we contribute to the growing body of evidence on the importance of women's empowerment in agricultural development in South Asia (e.g. Sraboni et al. 2014; Kadiyala et al. 2014) as well as the literature on the gender differentiated treatment of children by parents (e.g. Novella 2019; Malapit and Quisumbing 2015; Slade, Beller and Powers 2017; Karbownik and Myck 2017). This study departs from existing studies of food security by simultaneously accounting for multidimensionality in the domains both of food security as well as women's empowerment.

The remainder of this paper is organised as follows. The next section discusses a conceptual framework along with review of literature. This section is followed by a discussion of the sample, empirical techniques, and measurement of the key variables. Empirical results and their robustness checks are presented in section 4; while their discussion is provided in section 5. Finally, the paper concludes with few remarks in section 6.

## 2. Conceptual framework

Why might we expect empowered women to improve food security of the household? What are the pathways by which such effects take place? According to Becker's (1973) theory of marriage and Grossbard-Shechtman (1993) conditions in the marriage market may have an impact on the value of a woman's time in the home. This may take the form of changes in the market value of women's household labor (including their agricultural labor in household farms in the case of agricultural societies) or in the bargaining power of husbands and wives. Consequently, when sex ratios in marriage markets change and lead to increased value of women's time in married household production, once married, women have healthier sons, while men consume less tobacco and alcohol, as illustrated for China (Porter, 2016). This assumes that men and women in households have different preferences, with women more likely to have household welfare as their objective, as has been illustrated in a large body of evidence (Haddad 1999; Alderman et al. 1995; Houston and Huguley 2014; Smith et al. 2003). Other theoretical models consistent with Becker's marriage market model in his

(1973) theory of marriage include Manser and Brown (1980), McElroy and Horney (1981) and Chiappori (1992). It follows from all these models that the increased empowerment of women results in positive welfare outcomes such as better health and nutrition, especially for children (Houston and Huguley 2014; Thomas 1990).In the context of rural economies, women are producers, consumers, home-makers and social agents and therefore empowerment can be in any of these domains. Women's empowerment in this paper is therefore seen as a holistic change in the agency of women across many different domains. In the context of food security, women can influence food availability, food access as well as food use, making women's empowerment an important factor affecting household food security (Sharaunga et al. 2015, 2016; Sraboni et al. 2014; Yimer and Tadesse 2015). Malapit et al. (2015), for instance, showed that children's diet improves significantly in households where the empowerment gap between father and mother is small. In this section, we will explicitly consider the pathways by which women's empowerment might affect household food security.

*Empowerment in production*: Women who are involved in production can make decisions regarding what to produce on family farms and how to produce it. These decisions are likely to influence the total production of the household as well as how much is retained. Women's influence may occur in three ways. First, empowered women are more likely to be working on farms and in household enterprises and therefore help increase household income. Productivity gains in agriculture from women's empowerment (Anderson et al. 2020) are likely to increase household production and incomes. They can be used by the household for improved food and nutrition (Balagamwala et al. 2015). Second, when women are empowered, there are now two adults whose cognitive and decision making capabilities are focused on production and this is likely to improve outcomes. Seymour (2017) showed that closing the empowerment gap between husband and wife in farm households in rural Bangladesh would imply a 2.2 percent increase in farm technical efficiency. This is because when agricultural decisions are made jointly, they are more efficient and the outcome of joint decisions is often less risky. Third, if women are more likely to spend on household welfare as many studies have found, then a woman who was empowered to influence what is produced on farms may well prioritise home consumption.

*Social Empowerment*: Women's social empowerment (as measured through membership in groups and public speaking) can help improve food security in a number of ways. First, the ability to move freely within the community, meet with group members and speak in social

gatherings implies that the woman has exposure to best practice outside her home. This relates not only to best practice in productive activities but also in food preparation, child health and so on. Women's involvement in such fora may increase their knowledge of new technologies, crops and technical know-how. Their engagement in social networks may provide them with the means to access credit which they can use for productivity enhancing techniques. Second, expanded networks, exposure to non-traditional role models and the confidence gained by such associations would all help improve women's effectiveness both in economic activities as well as within the home. Third, in Bangladesh, men go to the market and buy food while women prepare it. In households where women are free to go to the market, there is likely to be greater streamlining of knowledge and skills with regard to food purchase and preparation. Finally, when empowered mothers go outside and interact and exchange information with people outside the home, they acquire knowledge and advice beneficial for children's care, feeding, and nutrition.

*Leisure*: satisfaction with leisure is a proxy variable that captures the woman's time constraints. A woman who is very tightly time constrained is likely to have less time for food prep and for worrying about nutrition.

Each of these dimensions will affect food security of the household separately but will also positively affect other dimensions. Thus, empowerment in production is likely to help improve social empowerment by enabling a woman to move outside her home with greater freedom and is likely to give her confidence to engage with the community. Similarly, social empowerment is likely to help with production empowerment because it brings the woman into contact with best practice in the community. The additional literature reviewed in section 1 identifies the way in which some of these pathways have been considered within the literature.

Lastly, in general, one might expect that empowered women would be better for household food security and especially for that of children. However, given gender norms in Bangladesh, we hypothesise a differential impact on the food security of boys relative to girls. There are two main reasons for this. First, in the 'male breadwinner' society that Bangladesh currently is, a boy's manual labor is a household's income source (either now or in the future, depending on how the household is). Providing boys with better food is therefore an investment in a future income stream for both mothers and fathers. This is reinforced by the second reason, which is that the marital norm in Bangladesh is for sons to

look after their parents in their old age and for daughters to move away to their husband's home. Investing in daughters is therefore often considered to be like 'watering your neighbour's garden'. For both these reasons we might expect mothers to improve the food intake of boys more than girls.

## 3 Data, measurement, and empirical strategy

As indicated earlier, we have three main research questions in this paper. First, do empowered women improve calorie and protein intakes within their households? To what extent do they have a gender-differentiated impact? And, finally, is there a difference in the impact of empowerment in various domains – production, leisure, income or community activities? Before we consider our estimation strategy, we will describe our sample, and the measurement of key variables in this section.

### 3.1 Data

In this paper, we use data from the Bangladesh Integrated Household Survey (BIHS) a nationally representative survey of agricultural households conducted by the International Food Policy Research Institute (IFPRI)[7]. Our sample comprises 2,913 rural households in Bangladesh. The child sample has 5,857 children (aged less than 18 years), of whom 2,993 are boys and 2,864 are girls. The BIHS contains detailed modules on food consumption and on a multi-dimensional measure of empowerment (based on Alkire et al. (2013)). In each sample household, the primary male and female respondents are co-residing household members who additionally supplied detailed information on the consumption patterns of all members of the household, particularly children.

### 3.2 Measurement of the key variables

Our analysis examines food security (calorie and protein intakes) for each household member.

#### i. Food security indicators

[7] The survey was conducted during months that did not coincide with the two lean periods in Bangladesh. For further details on BIHS sampling design, please see Sraboni et al. (2014).

The BIHS collected data on quantities of food consumed by household members, using a 24-hour recall method. We use these data to calculate the i-th individual's daily energy intake in kilocalories ($kcal_i$) and daily intake of protein in grams ($protein_i$) by using an appropriate conversion factor (Aromolaran 2004). Formally, $kcal_i = \sum_{j=1}^{m} A_{ij}B_j$ and $protein_i = \sum_{j=1}^{m} A_{ij}C_j$. Data on quantities of consumed food, $A_{ij}$ (or weight of j-food item consumed by i-individual), are available in the BIHS, which we have converted into calorie content by using respective food-calorie conversion factors $B_j$ (or per unit food energy content of the j-food item), and into protein content by using the respective food-protein conversion factors $C_j$ (i.e. per unit protein content of j-food item). The subscript j ranges between 1, 2, …, m and captures the number of food items consumed by individual i on the reference day. For appropriate $B_j$ and $C_j$, we have used the conversion factors provided by the Institute of Nutrition and Food Science of the University of Dhaka (Shaheen et al. 2013).

**ii. Empowerment**

The empowerment measure we use in our analysis is a weighted multidimensional index which takes into account a woman's empowerment in 10 indicators over five domains. Alkire et al. (2013) provide details of the five domains and their weights. A score of 1 is assigned to an indicator if the woman is empowered in the respective indicator; otherwise 0 is assigned. The five-domain empowerment index for a primary woman ($x$) of h-household then is $x_h = \sum_{i=1}^{10} Indicator_i \times weight_i$. If score for $x_h$ is less than 0.80, it would mean the woman is not empowered in at least 4 out of 5 domains and she would not be regarded as empowered (Alkire et al. 2013). In addition, our analysis will also study each of the 10 indicators separately.

### 3.3 Empirical strategy

Since both of our dependent variables – calorie and protein intake of children - are continous, our empirical strategy involves estimating models of individual-level food security using Ordinary Least Squares (OLS). We regress the food security indicator on the index of women's empowerment together with individual characteristics, household-level variables, household expenditure , and the price of staples. The estimated equation is as follows:

$$y_i = \beta_0 + \beta_1 Empowerment x_{h,i} + \beta_2 girl + X_{p,i}\beta_3 + X_{h,i}\beta_4 + R_i\beta_5 + \varepsilon_i \qquad (1)$$

Where $y_i$ stands for individual-level calorie or protein intake by child-i, $Empowermentx_{h,i}$ is the empowerment of the mother of the household in which child-i lives. This variable is included either as the empowerment index which summarises all the 10 indicators or as the 10 indicators separately. $girl$ stands for the gender of child-i. The vectors $X_{p,i}$, $X_{h,i}$, and $R_i$ represent vectors of personal, household, and region level characteristics, respectively. The $\beta_i$s are the regression parameters to be estimated, and $\varepsilon_i$ is the disturbance term.

To test whether female empowerment has a gender-differentiated effect on calorie and protein intake, we extend Equation 1 to include an interaction term between female and empowerment as shown below:

$$y_i = \beta_0 + \beta_1 Empowermentx_{h,i} + \beta_2 girl_i + \beta_3 (Empowermentx_{h,i} \times girle_i) + X_{p,i}\beta_4 + X_{h,i}\beta_5 + R_i\beta_6 + \varepsilon_i \quad (2)$$

In equation 2, $\beta_1$ captures the effect of the mother's empowerment on boy's calorie (or protein) intake; while the impact on girls will be $(\beta_1 + \beta_3)$.

In all our models, we include a wide range of control variables, including the mother's completed years of schooling, ratio of her age to husband's age; personal characteristics such as age, physical activity level; household-level variables namely size of household, age and gender composition of household, occupation of household head, log of per capita monthly expenditures, price of the staple food (rice), exposure to financial shock, and possession of land, number of food crops grown by the household, hygiene practices (source of drinking water and defecation facilities) and the co-residence of mother-in-law in the household[8]. Geographical dummies account for divisions, the largest administrative unit in Bangladesh. In addition to the base models, we estimate an additional set of regressions to test the sensitivity of our results to a number of household and community specific characteristics. We discuss the justification for this separately in section 5.

### 3.4 Data description

The summary statistics are presented in **Appendix Table 1**. Data on protein and calorie consumption by gender confirms a sizable gap. On average, sons consume 1709.14 kcal and

[8] The presence of the mother-in-law may negatively affect a woman's decision making ability. The shift of 'household keys', a symbolic act of passing over control, to the daughter-in-law is a major event in most South Asian households. A mother-in-law who resides in the household is often seen as holding the reins firmly.

33.27 grams of protein and daughters consume 1570.49 kcal and 30.33 grams. To quantify the gender gap in consumption across children, **Appendix Figure 1** plots raw scores by age. The graphs indicate that consumption rises monotonically with the children's ages. While there is no gender difference in early ages, a significant divergence occurs in consumption in the early adolescence stage. **Appendix Figure 1** also reproduces the consumption profiles by sibling composition. Regardless of (the household's demographic structure), the age-gender profiles look similar for protein and calorie consumption. In the next section, we further explore the role of gender, maternal empowerment and other relevant factors using multiple regression models.

## 4. Main results

The impact of the mother's empowerment index on children's calorie and protein intake are presented in Table 1. Following on from this, we will consider the impact of each of the 10 individual empowerment indicators in Tables 2 and 3.

### *4.1 Women's Empowerment and Children's Food Intake*

Table 1 provides the results for the calorie and protein intake of children in our sample (**Appendix Table 2** presents the same by gender). In this table, we provide the results for all our controls but, in the interests of space, we do not present controls in later Tables. The estimated coefficient on Empowerment (150.21) in the calorie regression is positive and statistically highly significant suggesting that women's bargaining power is associated with an increase in children's calorie intake. Turning to model 2 in which we consider whether this effect varies with gender of the child, we find that for daughters, too, the effect is positive [$\hat{\beta}_1 + \hat{\beta}_3$ (231.90-170.79) or 61.11] though smaller in magnitude than for boys (231.9). Thus, while the mother's empowerment is associated with an increase of 61 kcal for girls, it is associated with an increase of 232 kcal for boys.

**Table 1**: OLS estimates of the determinants of children's calorie and protein intake

| Variables | (1) All kcal | (2) All kcal | (3) All protein | (4) All protein |
|---|---|---|---|---|
| Empowerment index | 150.212*** | 231.901*** | 2.340** | 4.612*** |
| | (35.077) | (48.965) | (1.116) | (1.600) |
| Girl=1, otherwise 0 | -117.142*** | -22.520 | -2.274*** | 0.357 |
| | (15.983) | (39.156) | (0.517) | (1.214) |
| Empowerment index*Girl | | -170.789*** | | -4.749** |
| | | (66.140) | | (2.127) |
| Age (years) | 159.534*** | 159.450*** | 2.981*** | 2.979*** |
| | (7.907) | (7.902) | (0.240) | (0.240) |
| Age squared | -2.643*** | -2.635*** | -0.054*** | -0.054*** |
| | (0.428) | (0.428) | (0.014) | (0.013) |
| Physical activity, moderate=1, otherwise 0 | -82.369 | -83.474 | -0.784 | -0.814 |
| | (55.325) | (55.379) | (1.668) | (1.667) |
| Physical activity, heavy=1, otherwise 0 | 42.191 | 39.922 | 1.821 | 1.758 |
| | (41.741) | (41.733) | (1.380) | (1.379) |
| Breast-fed=1, otherwise 0 | -225.152*** | -224.658*** | -4.931*** | -4.917*** |
| | (25.527) | (25.530) | (0.712) | (0.713) |
| Number of HH members | -6.337 | -6.333 | -0.180 | -0.180 |
| | (5.574) | (5.573) | (0.175) | (0.175) |
| Ratio of male aged 0-4 to total HH member | -323.141** | -312.637** | -6.813 | -6.521 |
| | (128.194) | (128.135) | (4.216) | (4.202) |
| Ratio of male aged 5-9 to total HH member | -409.774*** | -404.811*** | -9.819** | -9.681** |
| | (125.382) | (125.169) | (4.052) | (4.040) |
| Ratio of male aged 10-14 to total HH member | -494.847*** | -492.644*** | -13.898*** | -13.837*** |
| | (121.979) | (121.832) | (4.421) | (4.414) |
| Ratio of male aged 15-55 to total HH member | -267.087** | -267.586** | -10.184** | -10.198** |
| | (112.544) | (112.480) | (3.982) | (3.978) |
| Ratio of female aged 0-4 to total HH member | -253.008** | -253.394** | -6.994* | -7.005* |
| | (125.578) | (125.378) | (4.106) | (4.098) |
| Ratio of female aged 5-9 to total HH member | -289.813** | -284.624** | -9.863** | -9.718** |
| | (126.293) | (126.063) | (4.028) | (4.021) |
| Ratio of female aged 10-14 to total HH member | -525.830*** | -518.884*** | -14.209*** | -14.016*** |
| | (127.685) | (127.565) | (4.398) | (4.391) |
| Ratio of female aged 15-55 to total HH member | -853.006*** | -847.155*** | -15.080*** | -14.918*** |
| | (140.655) | (140.359) | (4.475) | (4.470) |
| Ratio of female aged 56+ to total HH member | -888.035*** | -872.644*** | -12.577* | -12.149 |
| | (218.983) | (218.313) | (7.445) | (7.431) |
| HH head's occupation, trader=1, otherwise 0 | -97.705*** | -98.166*** | -2.949*** | -2.962*** |
| | (21.657) | (21.671) | (0.655) | (0.656) |
| HH head's occupation, other=1, otherwise 0 | -33.116** | -33.787** | -0.245 | -0.263 |
| | (16.139) | (16.140) | (0.566) | (0.567) |
| Ratio of mother's age to father's age | 219.727*** | 224.239*** | 7.630*** | 7.756*** |
| | (74.774) | (74.734) | (2.427) | (2.429) |
| Mother's years of schooling | -2.960 | -2.929 | 0.071 | 0.072 |
| | (2.095) | (2.094) | (0.069) | (0.069) |
| Log of per capita monthly expenditures | 163.344*** | 164.008*** | 7.688*** | 7.707*** |
| | (13.999) | (13.989) | (0.446) | (0.446) |
| Price of rice (Tk/Kg) | -7.710*** | -7.815*** | -0.094 | -0.097 |
| | (2.186) | (2.189) | (0.082) | (0.082) |
| Female headed HH=1, otherwise 0 | -105.120 | -100.750 | 0.126 | 0.248 |
| | (66.873) | (66.489) | (5.504) | (5.698) |
| Mother-in-law co-resides=1, otherwise 0 | 53.218* | 52.011 | 1.018 | 0.984 |
| | (32.207) | (32.144) | (1.016) | (1.015) |
| Number of food crops grown | 35.894*** | 35.873*** | 1.245*** | 1.245*** |
| | (3.858) | (3.858) | (0.113) | (0.113) |
| Uses closed latrine=1, otherwise 0 | 7.434 | 7.754 | 2.214*** | 2.223*** |
| | (15.989) | (15.981) | (0.544) | (0.544) |
| Drinks water from well=1, otherwise 0 | 10.339 | 11.070 | -0.224 | -0.203 |
| | (16.672) | (16.669) | (0.522) | (0.522) |
| Landless household=1, otherwise 0 | -66.864*** | -67.609*** | -1.986*** | -2.007*** |
| | (13.569) | (13.562) | (0.432) | (0.432) |
| HH experienced shock=1, otherwise 0 | -29.345* | -28.449* | -0.798 | -0.773 |
| | (15.196) | (15.204) | (0.494) | (0.495) |
| Constant | -24.492 | -78.084 | -32.657*** | -34.156*** |
| | (177.931) | (178.841) | (5.827) | (5.853) |
| Observations | 5,857 | 5,857 | 5,857 | 5,857 |
| R-squared | 0.614 | 0.614 | 0.399 | 0.399 |
| *$R^2$ decomposition results (group %)* | | | | |
| *-Child characteristics* | 69.32 | 68.90 | 56.36 | 55.93 |
| *-Household characteristics: Empowerment index* | 1.29 | 1.87 | 1.25 | 1.88 |
| *-Household characteristics: demographic structure* | 19.65 | 19.48 | 16.63 | 16.45 |
| *-Household characteristics: others* | 8.52 | 8.52 | 21.30 | 21.28 |
| *-Regional effects* | 1.20 | 1.20 | 4.46 | 4.46 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for division dummies.

In the protein intake regressions in Table 1 (columns 3 and 4), the effect of mother's empowerment is statistically highly significant and positive for sons (4.612) but it is negative for daughters (4.61 - 4.75 = -0.14). Thus, while mother's empowerment helps improve the nutrition quality of sons by increasing protein intake, it is associated with a decrease in the protein intake of daughters. Overall, therefore, our results seem to indicate that women's empowerment has a differentiated effect on sons and daughters, both with regard to calorie as well as protein intake.

Among the other controls, we find that when mothers are closer in age to fathers (the ratio of age of the mother to the age of the father), then both calorie and protein intake is higher for children. The relative age of the mother is one of the traditional empowerment indicators used in the literature. However, another proxy indicator for empowerment (i.e. women's years of schooling) is not significant in influencing food security. Our results confirm that children in landless households consume significantly fewer calories and protein than children in households with cultivable land. In addition, both calorie and protein consumption is higher in households which grow more food crops. The effect of household expenditure is found to have the expected positive sign, which is also statistically significant.

To further quantify the contribution of the empowerment index, we present the Shapley value decomposition of the explained variation[9] in terms of individual and group specific share in the explained variation as percentage of the model $R^2$ (see bottom rows in **Table 1)**. Although child characteristics dominate in terms of percentage of explained variation, nearly 40% of the variation in the case of protein relates to household specific factors including women's empowerment. Women's empowerment (including the interaction term) accounts for nearly 2% of the overall model variation.

### *4.2 Impact of Individual Domains of Empowerment*

We now turn to consider the impact of the 10 separate sub-components of empowerment (ep1 – ep10) on the food security of boys and girls. Our results in Table 2 on calorie consumption indicate that mothers who are able to act on their own values (ep2), have an input into the use

[9] We implemented the Shapley value decomposition approach using –rego- command in STATA; for details, see Huettner and Sunder (2012). For an alternative way to conduct a regression-based decomposition analysis, see Fields (2004).

of income (ep6) and are comfortable with public speaking (ep8) have a significant positive impact on the calorie intake of both boys and girls. In all cases, however, the impact is larger and/or more significant for boys than for girls. In addition, our results in this table indicate that mothers who have an impact on production (ep1) have a negative impact on calorie intake among girls but not on boys. There is also a larger negative effect on calorie intake by girls if mothers work less than 10.5 hours a day (ep9)). Overall, our results indicate that the sub-components which have an impact tend to have a larger positive impact on boys' calorie intake.

The impact of empowerment on protein intake is less clearcut, as seen in Table 3. For girls, a mother's ability to buy and sell assets (ep4) or speak publicly (ep8), has a positive impact on protein intake but her involvement in production decisions has a negative impact. Mother's empowerment has almost no impact on boys' protein intake, with a marginal negative impact of ep5 (input into borrowed money usage) and a positive impact of ep6 (use of income) and ep8 (public speaking).

In only one instance is the gendered pattern in our data counter-intuitive and this is where women have input into how borrowed money is used (see Table 3 contd.). The more input women have in this, the less protein boys have. This could reflect the fact that women who borrow money in Bangladesh (for instance from the Grameen Bank or other such NGOs) might have received extensive gender-related training. Since these households are poor and cannot really increase the total amount of protein consumed, the negative coefficient might reflect a fairer distribution of the existing protein. In fact, a formal test of the difference between the respective gender specific coefficients confirms that the difference is not statistically significant (z-test statistic value -0.88).

Our results indicate that having an input into the use of income (ep6) and the ability to speak publicly (ep8) have especially benign impacts on intra-housheold food consumption. Similarly, a woman's autonomy in buying/selling assets (ep4) has a positive impact on the protein intake of girls though surpirisngly, this is not true of a woman's input into production. This might well be because women working on farms have less time for food preparation though again, we note that the impact seems to be larger for girls.

Table 2: OLS regressions on children's calorie intake: Effect of empowerment indicators

| Variables | (1) All | (2) Boys | (3) Girls | (4) All | (5) Boys | (6) Girls | (7) All | (8) Boys | (9) Girls | (10) All | (11) Boys | (12) Girls | (13) All | (14) Boys | (15) Girls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Girl=1, otherwise 0 | -117.902*** | | | -117.849*** | | | -117.725*** | | | -117.818*** | | | -117.696*** | | |
| | (16.018) | | | (16.015) | | | (16.020) | | | (16.011) | | | (16.020) | | |
| ep1, Input in production decision=1, otherwise 0 | -9.612 | 9.505 | -36.696** | | | | | | | | | | | | |
| | (13.063) | (18.997) | (17.816) | | | | | | | | | | | | |
| ep2, Able to act on own values=1, otherwise 0 | | | | 25.110* | 41.192** | 12.909 | | | | | | | | | |
| | | | | (13.878) | (20.007) | (19.026) | | | | | | | | | |
| ep3, Own asset=1, otherwise 0 | | | | | | | -10.405 | -13.775 | -8.040 | | | | | | |
| | | | | | | | (12.950) | (19.168) | (17.114) | | | | | | |
| ep4, Input in buy,sell,transfer of asset=1, otherwise 0 | | | | | | | | | | 20.050 | 19.654 | 22.600 | | | |
| | | | | | | | | | | (13.891) | (20.152) | (18.850) | | | |
| ep5, Input in borrowed money usage=1, otherwise 0 | | | | | | | | | | | | | -9.113 | -18.327 | -1.017 |
| | | | | | | | | | | | | | (12.775) | (18.722) | (17.192) |
| ep6, Input in decision on use of income=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep7, Member in a group=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep8, Comfortable in public speaking=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep9, Works less than 10.5 hours in a day=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep10, Satisfied with leisure=1, otherwise 0 | | | | | | | | | | | | | | | |
| Constant | 14.483 | 42.994 | -283.934 | 7.969 | 39.581 | -287.213 | 11.203 | 47.053 | -286.496 | 5.412 | 42.956 | -292.887 | 12.822 | 52.702 | -288.287 |
| | (178.023) | (259.985) | (251.194) | (177.955) | (259.809) | (251.324) | (178.146) | (260.274) | (251.636) | (178.089) | (260.190) | (251.640) | (178.021) | (260.239) | (251.389) |
| Control | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 |
| R-squared | 0.613 | 0.632 | 0.592 | 0.613 | 0.633 | 0.591 | 0.613 | 0.632 | 0.591 | 0.613 | 0.632 | 0.592 | 0.613 | 0.632 | 0.591 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for division dummies.

Table 2 (continued): OLS regressions on children's calorie intake: Effect of empowerment indicators

| Variables | (16) All | (17) Boys | (18) Girls | (19) All | (20) Boys | (21) Girls | (22) All | (23) Boys | (24) Girls | (25) All | (26) Boys | (27) Girls | (28) All | (29) Boys | (30) Girls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Girl=1, otherwise 0 | -117.222*** | | | -117.621*** | | | -118.062*** | | | -118.108*** | | | -117.430*** | | |
| | (15.988) | | | (16.013) | | | (15.937) | | | (16.022) | | | (16.014) | | |
| ep1, Input in production decision=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep2, Able to act on own values=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep3, Own asset=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep4, Input in buy,sell,transfer of asset=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep5, Input in borrowed money usage=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep6, Input in decision on use of income=1, otherwise 0 | 89.080*** | 124.832*** | 47.217* | | | | | | | | | | | | |
| | (18.217) | (26.607) | (24.358) | | | | | | | | | | | | |
| ep7, Member in a group=1, otherwise 0 | | | | 17.125 | 13.916 | 22.248 | | | | | | | | | |
| | | | | (13.611) | (19.536) | (18.759) | | | | | | | | | |
| ep8, Comfortable in public speaking=1, otherwise 0 | | | | | | | 101.003*** | 115.911*** | 90.391*** | | | | | | |
| | | | | | | | (13.627) | (19.573) | (18.719) | | | | | | |
| ep9, Works less than 10.5 hours in a day=1, otherwise 0 | | | | | | | | | | -46.635** | -43.348 | -49.199* | | | |
| | | | | | | | | | | (19.277) | (28.135) | (26.217) | | | |
| ep10, Satisfied with leisure=1, otherwise 0 | | | | | | | | | | | | | 24.330* | 34.457* | 14.235 |
| | | | | | | | | | | | | | (13.584) | (19.895) | (18.483) |
| Constant | -69.665 | -72.810 | -328.114 | 21.074 | 53.582 | -267.793 | 52.345 | 91.921 | -247.742 | 38.761 | 74.260 | -255.775 | 9.183 | 43.413 | -288.520 |
| | (179.216) | (261.671) | (253.599) | (178.560) | (260.460) | (253.307) | (177.227) | (259.751) | (249.637) | (178.091) | (259.673) | (252.396) | (178.218) | (260.515) | (251.565) |
| Control | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 |
| R-squared | 0.614 | 0.635 | 0.592 | 0.613 | 0.632 | 0.592 | 0.616 | 0.637 | 0.595 | 0.613 | 0.633 | 0.592 | 0.613 | 0.633 | 0.591 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for division dummies.

Table 3: OLS regressions on children's protein intakes: Effect of empowerment indicators

| Variables | (1) All | (2) Boys | (3) Girls | (4) All | (5) Boys | (6) Girls | (7) All | (8) Boys | (9) Girls | (10) All | (11) Boys | (12) Girls | (13) All | (14) Boys | (15) Girls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Girl=1, otherwise 0 | -2.286*** | | | -2.283*** | | | -2.284*** | | | -2.287*** | | | -2.279*** | | |
| | (0.517) | | | (0.517) | | | (0.517) | | | (0.517) | | | (0.517) | | |
| ep1, Input in production decision=1, otherwise 0 | -0.158 | 0.829 | -1.244** | | | | | | | | | | | | |
| | (0.408) | (0.599) | (0.550) | | | | | | | | | | | | |
| ep2, Able to act on own values=1, otherwise 0 | | | | -0.124 | 0.064 | -0.147 | | | | | | | | | |
| | | | | (0.442) | (0.638) | (0.615) | | | | | | | | | |
| ep3, Own asset=1, otherwise 0 | | | | | | | 0.264 | 0.245 | 0.249 | | | | | | |
| | | | | | | | (0.413) | (0.624) | (0.536) | | | | | | |
| ep4, Input in buy,sell,transfer of asset=1, otherwise 0 | | | | | | | | | | 1.145*** | 0.910 | 1.435*** | | | |
| | | | | | | | | | | (0.435) | (0.670) | (0.535) | | | |
| ep5, Input in borrowed money usage=1, otherwise 0 | | | | | | | | | | | | | -0.750* | -1.136* | -0.427 |
| | | | | | | | | | | | | | (0.405) | (0.605) | (0.532) |
| ep6, Input in decision on use of income=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep7, Member in a group=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep8, Comfortable in public speaking=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep9, Works less than 10.5 hours in a day=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep10, Satisfied with leisure=1, otherwise 0 | | | | | | | | | | | | | | | |
| Constant | -32.176*** | -36.032*** | -30.933*** | -32.221*** | -35.671*** | -31.028*** | -32.222*** | -35.618*** | -31.047*** | -32.620*** | -35.962*** | -31.425*** | -32.165*** | -35.564*** | -30.975*** |
| | (5.829) | (8.131) | (8.560) | (5.833) | (8.139) | (8.572) | (5.832) | (8.153) | (8.569) | (5.824) | (8.128) | (8.564) | (5.825) | (8.141) | (8.558) |
| Control | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 |
| R-squared | 0.398 | 0.408 | 0.393 | 0.398 | 0.407 | 0.392 | 0.398 | 0.407 | 0.392 | 0.399 | 0.408 | 0.393 | 0.399 | 0.408 | 0.392 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for division dummies.

Table 3 (continued): OLS regressions on children's protein intakes: Effect of empowerment indicators

| Variables | (16) All | (17) Boys | (18) Girls | (19) All | (20) Boys | (21) Girls | (22) All | (23) Boys | (24) Girls | (25) All | (26) Boys | (27) Girls | (28) All | (29) Boys | (30) Girls |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Girl=1, otherwise 0 | -2.274*** | | | -2.286*** | | | -2.289*** | | | -2.287*** | | | -2.279*** | | |
| | (0.517) | | | (0.517) | | | (0.516) | | | (0.517) | | | (0.517) | | |
| ep1, Input in production decision=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep2, Able to act on own values=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep3, Own asset=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep4, Input in buy,sell,transfer of asset=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep5, Input in borrowed money usage=1, otherwise 0 | | | | | | | | | | | | | | | |
| ep6, Input in decision on use of income=1, otherwise 0 | 1.684*** | 2.626*** | 0.631 | | | | | | | | | | | | |
| | (0.571) | (0.805) | (0.808) | | | | | | | | | | | | |
| ep7, Member in a group=1, otherwise 0 | | | | -0.239 | -0.432 | 0.084 | | | | | | | | | |
| | | | | (0.443) | (0.654) | (0.591) | | | | | | | | | |
| ep8, Comfortable in public speaking=1, otherwise 0 | | | | | | | 1.780*** | 2.433*** | 1.287** | | | | | | |
| | | | | | | | (0.442) | (0.671) | (0.582) | | | | | | |
| ep9, Works less than 10.5 hours in a day=1, otherwise 0 | | | | | | | | | | -0.450 | -0.979 | -0.176 | | | |
| | | | | | | | | | | (0.623) | (0.867) | (0.896) | | | |
| ep10, Satisfied with leisure=1, otherwise 0 | | | | | | | | | | | | | 0.314 | 0.802 | -0.198 |
| | | | | | | | | | | | | | (0.418) | (0.635) | (0.540) |
| Constant | -33.754*** | -38.219*** | -31.540*** | -32.446*** | -35.955*** | -30.907*** | -31.606*** | -35.016*** | -30.439*** | -31.969*** | -35.092*** | -30.896*** | -32.231*** | -35.708*** | -31.015*** |
| | (5.889) | (8.202) | (8.671) | (5.896) | (8.193) | (8.728) | (5.822) | (8.141) | (8.544) | (5.860) | (8.181) | (8.638) | (5.835) | (8.152) | (8.569) |
| Control | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 | 5,857 | 2,993 | 2,864 |
| R-squared | 0.399 | 0.409 | 0.392 | 0.398 | 0.407 | 0.392 | 0.400 | 0.410 | 0.393 | 0.398 | 0.408 | 0.392 | 0.398 | 0.408 | 0.392 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for division dummies.

### 4.3 Robustness analysis

It should be noted that our results presented in Tables 1-3 do not imply causality for at least three reasons. First the estimated effect of empowerment could suffer from an upward bias to the extent economically better-off households are also more likely to have an empowered woman, partly because working women add to household-income. Second, empowered women may live in progressive communities. If so, our results could be simply driven by omitted community level norms. Third, in South Asia, women's empowerment effect may be capturing the omitted influence of the sibling composition of children on consumption[10]. In this section, we address these three concerns.

**i. Are disempowered women proxying for household poverty?** The correlation matrix reported in the online **Appendix Table 3** indicates that the correlation coefficient between the empowerment index and expenditure or assets is between 0.13 and 0.28. This implies that while there's a positive relationship, it is not large. The presence of an empowered mother is not just a proxy for the household's economic status. Moreover, women's work participation in Bangladesh and much of South Asia is low and U-shaped. Therefore, the relationship between empowerment and household income is not straightforward. For instance, poorer households which are more reliant on women's economic productivity can be more equitable than well-off households (Chen et al. 1981). Nonetheless, we have implemented three tests to explore the empowerment-poverty nexus (**Table 4**). First, we re-estimated our model dropping the expenditure variable. This did not significantly and qualitatively alter our main results relating to the empowerment index. Second, we replaced the expenditure variable with a measure of household wealth. While log of household asset value is indeed positively associated with calorie and protein consumption, its inclusion in lieu of the per capita expenditure variable does not qualitatively change the impact of empowerment. Third, we attempted a non-linear specification using asset-quintile specific dummies. Once again, the results confirm a monotonic relationship between household wealth and children's consumption. However, regardless of the way we specify the wealth variable, the main result relating to the interaction term between mother's empowerment and child gender remains unchanged.

[10] Li and Wu (2011) report a positive impact of having a first-born son on women's household decision-making and mother's nutritional well-being although Zimmermann (2018) finds no effect of son preference on maternal empowerment. On sibling effects on gender gaps in nutrition, see Pande (2003).

**ii. Do community social norms explain the empowerment effect?** Women's life choices in rural Bangladesh are constrained by a range of patriarchal norms. They include the practice of purdah (restrictions on independent movement), the custom of child marriage, the practice of dowry payment to the groom's household and religious conservatism (objection to girls' schooling). Therefore **Tables 5-7** repeat our analysis controlling for these three aspects of community norms. In our data, dowry norm refers to the proportion of households in the community who reported paying some dowry for daughter's marriage. Early marriage custom is proxied by data on the proportion of women in the community who reported marrying before 15 years of age. The historical provision of Islamic schools (i.e. total number of madrasas in 1990) is used as a proxy for religious orientation of the community[11]. A number of interesting results follow from our analysis. First, children in communities with strong dowry practices have systematically lower protein intake (Table 5). However, empowered mothers continue to be associated with higher calorie intake for both boys and girls and higher protein intake for boys. Second, consumption patterns among children do not vary by prevalence of early marriage in the community (Table 6). Third, children in communities with historical concentration of Islamic schools have systematically higher protein intake (Table 7). The result is statistically significant only for girls, consistent with the hypothesis of complementary human capital: communities with historical supply of Islamic schools saw a sharp increase in girls' schooling and this may have led to increased returns to investment in girls. However, controlling for the supply of Islamic schools does not alter the bias towards boys among empowered women.

**iii. Is women's empowerment confounded by differences in sibling composition?** Instead of exerting an independent effect, the son-bias in food allocation among empowered women may simply reflect sex preference in fertility and hence sibling composition in the household. We test for this possibility by exploring in detail the sensitivity of our results to the gender composition of children. In our regression sample, the first-born child is a boy in 40% households. Girls in all-girl families tend to have more siblings compared to those belonging to a family where there is at least one brother. Therefore, we first control for whether the household has 1 son and 1 daughter only (a two-child household of different genders) (see Table 8). Then we replace this with a set of 3 dummies: "number of sons is greater in the HH=1, otherwise 0"; "number of daughters is greater in the HH=1, otherwise 0" and "number

[11] These schools at that time offered single sex education but later converted into co-educational institutions to facilitate female schooling in conservative communities (for details, see Asadullah and Chaudhury (2009)).

of sons and daughters is equal in the HH=1, otherwise 0". In an alternative specification, we also control for the gender of the first-born child. In no instance did the addition of these variables wash out the empowerment-female interaction effect. However, we do find evidence that protein consumption is better in households with 2 children of different genders as well as where there are either equal number of boys and girls or more brothers than sisters. Moreover, the first born child, if son, enjoyed significantly higher calorie consumption though no such advantage exists in protein allocation. Again, the lower consumption of all-girl or majority girl households is clear.

**Table 4** OLS estimates of the determinants of children's calorie and protein intake: testing for household poverty effects

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dropping expenditure variable | | | | Controlling for log of asset value | | | | Controlling for asset quintiles | | | |
| Variables | kcal | kcal | protein | protein | kcal | kcal | protein | protein | Kcal | kcal | protein | protein |
| Empowerment index | 168.576*** | 242.692*** | 3.205*** | 5.119*** | 149.710*** | 226.284*** | 2.176* | 4.229*** | 153.459*** | 228.624*** | 2.173* | 4.173** |
| | (35.272) | (49.382) | (1.137) | (1.632) | (35.770) | (49.603) | (1.150) | (1.631) | (35.946) | (49.747) | (1.143) | (1.625) |
| Girl=1, otherwise 0 | -116.117*** | -30.343 | -2.226*** | -0.010 | -116.583*** | -27.754 | -2.251*** | 0.130 | -116.509*** | -29.302 | -2.252*** | 0.068 |
| | (16.232) | (39.557) | (0.534) | (1.241) | (16.188) | (39.521) | (0.529) | (1.235) | (16.179) | (39.487) | (0.529) | (1.233) |
| Empowerment index*Girl | | -154.813** | | -3.999* | | -160.334** | | -4.298** | | -157.402** | | -4.188* |
| | | (66.478) | | (2.159) | | (66.515) | | (2.155) | | (66.412) | | (2.152) |
| Log of asset values | - | - | - | - | 25.048*** | 25.295*** | 1.366*** | 1.373*** | - | - | - | - |
| | | | | | (5.775) | (5.776) | (0.186) | (0.186) | | | | |
| Asset quintile2 | | | | | | | | | 2.625 | 3.153 | 0.190 | 0.204 |
| | | | | | | | | | (16.884) | (16.880) | (0.514) | (0.514) |
| Asset quintile3 | | | | | | | | | 25.600 | 26.299 | 2.717*** | 2.736*** |
| | | | | | | | | | (18.965) | (18.956) | (0.601) | (0.601) |
| Asset quintile4 | | | | | | | | | 74.073*** | 74.725*** | 4.237*** | 4.255*** |
| | | | | | | | | | (22.279) | (22.278) | (0.762) | (0.762) |
| Asset quintile5 | | | | | | | | | 96.226*** | 96.807*** | 4.697*** | 4.712*** |
| | | | | | | | | | (26.225) | (26.202) | (0.853) | (0.853) |
| Constant | 1,104.772*** | 1,060.359*** | 22.281*** | 21.130*** | 913.116*** | 865.231*** | 12.046** | 10.759** | 1,104.362*** | 1,059.181*** | 22.523*** | 21.317*** |
| | (149.298) | (149.962) | (5.210) | (5.209) | (153.612) | (154.327) | (5.280) | (5.286) | (149.283) | (149.904) | (5.194) | (5.193) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 |
| R-squared | 0.604 | 0.605 | 0.366 | 0.366 | 0.605 | 0.606 | 0.371 | 0.372 | 0.606 | 0.606 | 0.373 | 0.373 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for full set of controls as shown in Table 1.

**Table 5** OLS estimates of the determinants of children's calorie and protein intake: controlling for dowry norms

| Variables | (1) All kcal | (2) All kcal | (3) All protein | (4) All protein | (5) Boys kcal | (6) Boys protein | (7) Girls kcal | (8) Girls protein |
|---|---|---|---|---|---|---|---|---|
| Empowerment index | 150.177*** | 231.859*** | 2.496** | 4.763*** | 206.913*** | 4.053** | 89.925* | 0.958 |
| | (35.120) | (49.031) | (1.120) | (1.607) | (50.243) | (1.647) | (47.949) | (1.496) |
| Girl=1, otherwise 0 | -117.141*** | -22.517 | -2.280*** | 0.346 | | | | |
| | (15.982) | (39.153) | (0.516) | (1.216) | | | | |
| Empowerment index*Girl | | -170.792*** | | -4.739** | | | | |
| | | (66.141) | | (2.129) | | | | |
| Dowry prevalence in the community | 1.185 | 1.487 | -5.331** | -5.323** | -6.929 | -3.641 | -1.499 | -7.043** |
| | (66.207) | (66.182) | (2.337) | (2.337) | (94.972) | (3.469) | (92.342) | (3.082) |
| Constant | -25.137 | -78.895 | -31.536*** | -33.034*** | -8.560 | -35.876*** | -300.697 | -29.876*** |
| | (184.258) | (185.022) | (5.878) | (5.901) | (267.585) | (8.155) | (259.986) | (8.665) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,857 | 5,857 | 5,857 | 5,857 | 2,993 | 2,993 | 2,864 | 2,864 |
| R-squared | 0.614 | 0.614 | 0.399 | 0.400 | 0.634 | 0.409 | 0.592 | 0.393 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for full set of controls as shown in Table 1.

**Table 6** OLS estimates of the determinants of children's calorie and protein intake: controlling for early marriage

| Variables | (1) All kcal | (2) All kcal | (3) All protein | (4) All protein | (5) Boys kcal | (6) Boys protein | (7) Girls kcal | (8) Girls protein |
|---|---|---|---|---|---|---|---|---|
| Empowerment index | 160.113*** | 240.345*** | 2.668** | 4.872*** | 213.094*** | 4.234** | 101.816** | 1.060 |
| | (36.203) | (49.626) | (1.135) | (1.604) | (51.394) | (1.643) | (50.013) | (1.557) |
| Girl=1, otherwise 0 | -116.871*** | -23.351 | -2.266*** | 0.303 | | | | |
| | (15.978) | (39.093) | (0.517) | (1.217) | | | | |
| Empowerment index*Girl | | -168.823** | | -4.638** | | | | |
| | | (66.086) | | (2.131) | | | | |
| Early marriage 20-29%=1, otherwise 0 | 37.113 | 37.410 | -1.175 | -1.167 | 51.975 | -0.788 | 23.799 | -1.584 |
| | (29.438) | (29.466) | (1.062) | (1.062) | (40.926) | (1.390) | (42.080) | (1.602) |
| Early marriage 30-39%=1, otherwise 0 | 26.077 | 25.487 | -0.744 | -0.760 | 53.959 | -0.460 | -5.054 | -1.147 |
| | (31.020) | (31.072) | (1.128) | (1.129) | (42.654) | (1.447) | (44.720) | (1.745) |
| Early marriage 40+%=1, otherwise 0 | 54.715 | 52.840 | 0.103 | 0.052 | 72.912 | 0.383 | 29.199 | -0.410 |
| | (35.227) | (35.269) | (1.258) | (1.260) | (49.048) | (1.689) | (50.267) | (1.854) |
| Constant | -82.822 | -134.770 | -32.422*** | -33.871*** | -95.403 | -36.588*** | -339.367 | -30.547*** |
| | (179.739) | (180.637) | (5.822) | (5.844) | (259.255) | (8.102) | (256.954) | (8.556) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,857 | 5,857 | 5,857 | 5,857 | 2,993 | 2,993 | 2,864 | 2,864 |
| R-squared | 0.614 | 0.615 | 0.399 | 0.400 | 0.635 | 0.409 | 0.592 | 0.392 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for full set of controls as shown in Table 1.

**Table 7** OLS estimates of the determinants of children's calorie and protein intake: controlling for Islamic schools

| Variables | (1) All kcal | (2) All kcal | (3) All protein | (4) All protein | (5) Boys kcal | (6) Boys protein | (7) Girls kcal | (8) Girls protein |
|---|---|---|---|---|---|---|---|---|
| Empowerment index | 154.316*** | 236.038*** | 2.431** | 4.704*** | 209.084*** | 4.016** | 96.142** | 0.856 |
| | (35.118) | (49.060) | (1.109) | (1.593) | (50.309) | (1.621) | (47.874) | (1.498) |
| Girl=1, otherwise 0 | -116.927*** | -22.270 | -2.269*** | 0.363 | | | | |
| | (15.989) | (39.147) | (0.517) | (1.213) | | | | |
| Empowerment index*Girl | | -170.851*** | | -4.751** | | | | |
| | | (66.117) | | (2.127) | | | | |
| Supply of Islamic schools in the community | 1.051* | 1.052* | 0.023 | 0.023 | 0.593 | 0.013 | 1.491* | 0.033 |
| | (0.574) | (0.573) | (0.019) | (0.019) | (0.796) | (0.029) | (0.823) | (0.025) |
| Constant | -48.271 | -101.898 | -33.047*** | -34.547*** | -28.271 | -36.906*** | -326.846 | -31.439*** |
| | (178.431) | (179.379) | (5.860) | (5.883) | (260.297) | (8.137) | (251.767) | (8.615) |
| Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 5,857 | 5,857 | 5,857 | 5,857 | 2,993 | 2,993 | 2,864 | 2,864 |
| R-squared | 0.614 | 0.615 | 0.399 | 0.399 | 0.634 | 0.409 | 0.592 | 0.392 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for full set of controls as shown in Table 1.

**Table 8.** OLS estimates of the determinants of children's calorie and protein intake: Controlling for children composition

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (Controlling for single gender child HH) | | | | (Controlling for mixed gender children HH) | | | | (Controlling for first son) | | | |
| Variables | kcal | kcal | protein | protein | kcal | kcal | protein | protein | kcal | kcal | protein | protein |
| Empowerment index | 149.334*** | 229.830*** | 2.301** | 4.512*** | 149.982*** | 229.960*** | 2.247** | 4.481*** | 148.134*** | 232.331*** | 2.319** | 4.572*** |
| | (35.059) | (48.977) | (1.113) | (1.598) | (35.101) | (49.003) | (1.112) | (1.597) | (35.050) | (49.050) | (1.112) | (1.602) |
| Girl=1, otherwise 0 | -117.900*** | -24.739 | -2.312*** | 0.246 | -116.501*** | -23.930 | -2.353*** | 0.233 | -113.447*** | -15.792 | -2.287*** | 0.326 |
| | (16.028) | (39.170) | (0.519) | (1.214) | (16.083) | (39.171) | (0.519) | (1.213) | (16.081) | (39.216) | (0.515) | (1.220) |
| Empowerment index*Girl | | -168.116** | | -4.617** | | -167.117** | | -4.669** | | -176.002*** | | -4.710** |
| | | (66.161) | | (2.127) | | (66.139) | | (2.126) | | (66.121) | | (2.137) |
| Child's birth order | 0.841 | 0.592 | 0.024 | 0.017 | 1.548 | 1.313 | 0.051 | 0.044 | 5.729 | 5.476 | 0.126 | 0.119 |
| | (9.881) | (9.880) | (0.318) | (0.319) | (9.948) | (9.946) | (0.320) | (0.320) | (9.797) | (9.795) | (0.316) | (0.316) |
| HH has son & daughter=1, otherwise 0 | 21.163 | 20.204 | 1.036** | 1.010** | | | | | | | | |
| | (15.157) | (15.157) | (0.490) | (0.490) | | | | | | | | |
| No. of son is greater in the HH | | | | | 2.613 | 1.883 | 1.182* | 1.161* | | | | |
| | | | | | (21.326) | (21.321) | (0.683) | (0.683) | | | | |
| No. of daughter is greater in the HH | | | | | 31.631 | 30.099 | 0.267 | 0.225 | | | | |
| | | | | | (21.342) | (21.344) | (0.671) | (0.670) | | | | |
| No. of son & daughter is equal in the HH | | | | | 25.919 | 25.061 | 1.231** | 1.207** | | | | |
| | | | | | (16.775) | (16.777) | (0.542) | (0.542) | | | | |
| First child and boy=1, otherwise 0 | | | | | | | | | 33.690** | 35.342** | -0.220 | -0.175 |
| | | | | | | | | | (16.545) | (16.547) | (0.562) | (0.564) |
| Constant | -16.343 | -69.202 | -32.211*** | -33.671*** | -11.695 | -64.690 | -32.855*** | -34.345*** | -74.115 | -131.109 | -32.541*** | -34.074*** |
| | (178.392) | (179.300) | (5.818) | (5.843) | (178.568) | (179.474) | (5.802) | (5.826) | (179.310) | (180.247) | (5.832) | (5.865) |
| Observations | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 | 5,857 |
| R-squared | 0.614 | 0.614 | 0.399 | 0.400 | 0.614 | 0.615 | 0.399 | 0.400 | 0.614 | 0.615 | 0.399 | 0.399 |

**Notes**: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for full set of controls as shown in Table 1.

## 5. Discussion

While we have presented evidence on the gender differentiated effect of mother's empowerment, our analysis also highlighted a number of other findings. In all regressions, the child's age has the strongest influence on protein and calorie consumption. This is also confirmed by child-level analysis of consumption data. The Shapley decomposition in Table 1 shows that household characteristics account for less than 40% of the explained variation (i.e. overall $R^2$). Nonetheless, the household demographic structure also has a significant share in the overall $R^2$. Given these results, we have also studied whether and how child age and gender interact with household structure to shape consumption patterns. A full set of age-consumption profiles (see Online Appendix **Figure 1**) by household structure do not show systematic differences in consumption. If the household level influence (beyond mother's empowerment) was important, we would expect the age-consumption profiles to vary significantly by household composition (e.g. all-girls vs all-boys vs mixed households). While we do not find such difference, we do note a significant divergence in consumption in early adolescence. The pattern that adolescent boys are more likely to consume more protein and calories than girls is consistent with Aurino (2017) who, for India, finds that the pro-boy advantage widens at 15 years old. However, unlike the evidence for India as summarized by Aurino (2017), we do not find that boys are advantaged at all ages.

Our results, while not causal, are robust to controls for a range of omitted variables. We acknowledged that the magnitude of son bias is likely to be reinforced by household wealth and education among women (Rossi and Rouanet 2015). However, the results remained unchanged when the analysis is repeated with better controls for household wealth (Table 4). Similarly, though community level social norms (relating to dowry, early marriage and female schooling) influence children's food consumption significantly, they do not wash out the effect of mother's empowerment which remains robust (Tables 5-7). For instance, girls in high dowry (i.e. more patriarchal) regions get significantly less protein. These results are consistent with the fact that published studies find OLS estimates of women's empowerment to be conservative -- modelling women's empowerment or bargaining power as an endogenous regressor produces an even larger effect (Lépine and Strobl 2013; Fielding and Lepine 2017).

As suggested in the conceptual framework in section 2, a range of explanations are possible for these results. First, households provide more protein to adolescent boys as they are expected to grow physically in order to undertake manual labor outside the home. Second, the way all food is distributed in Southeast Asia (including Bangladesh) is that men eat first, sons next, daughters third and finally the mothers (Van Esterik 2008; Blum et al. 2019). This might relate to the 'male breadwinner' model. The marital norm is for sons to stay with parents while daughters are married off. Therefore the old adage of "watering your neighbour's garden" also weakens the motivation for equal allocation of food across gender groups. Finally, protein is a luxury item in most household budgets in South Asia and therefore, given the above points, is more likely to be given to boys.

While results relating to the impact of empowerment on food consumption are highly robust, there is heterogeneity in the precise aspect of empowerment that has an effect. Our results generally indicate that public speaking is a highly effective empowerment aspect in improving food security as is the woman's input into the use of income or to buy and sell assets. Surprisingly, a mother with involvement in production is associated with a worsening of food consumption and this might relate to lack of time for food preparation.

## 6. Conclusion

In rural South Asia, millions of women belong to agricultural households where they play an important role both in food production and consumption. In this paper, we were concerned especially with the food security of children within such households. We considered, in particular, whether women's empowerment in these households has a differential impact on boys and girls and whether certain aspects of empowerment were more effective than others. We analyzed this using the BIHS data, which provides a multi-dimensional empowerment indicator for women in agricultural households.

Our results lead us to conclude that women's empowerment in agricultural households improves food security in terms of children' intake of nutrients, both calories and protein. This strong, positive effect on food security indicators persists even after controlling for a wide range of personal, household, financial, and regional factors. Having said this, we also find that women's empowerment advantages boys more than girls. Our analysis indicates that input into the use of income and ability to speak publicly have especially benign effects on

girl's food security. When mothers have an input into production decisions, the impact is (if anything) negative.

In sum, our analysis confirms the extrinsic value of women's empowerment in the context of food security, making it an effective policy tool for addressing under-nutrition in rural Bangladesh. However, we also highlight the limits of this channel by presenting evidence that young daughters remain the most vulnerable subgroup even within empowered agricultural households in terms of energy and protein intake. This implies that without large-scale changes in social customs and norms governing attitudes towards girls, women's empowerment per se is unlikely to address gendered forms of food insecurity and break the intergenerational cycle of malnutrition.

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## Appendices: For ONLINE publication only

Appendix Table 1: Summary statistics of the variables of interest

| | Definition | Mean / % share | SD |
|---|---|---|---|
| Dependent variable | | | |
| | Individual calorie intake (kcal) | 1641.34 | 759.64 |
| | Sons | 1709.14 | 808.90 |
| | Daughters | 1570.49 | 697.62 |
| | Individual protein intake (gm) | 31.83 | 19.35 |
| | Sons | 33.27 | 20.57 |
| | Daughter | 30.33 | 17.86 |
| Independent variables | | | |
| Individual characteristics | | | |
| | Girl=1, otherwise 0 | 48.90% | |
| | Age (years) | 8.69 | 4.59 |
| | Age squared | 96.56 | 81.07 |
| | Physical activity, Sedentary=1, otherwise 0 | 94.45% | |
| | Physical activity, Moderate=1, otherwise 0 | 1.79% | |
| | Physical activity, Heavy=1, otherwise 0 | 3.76% | |
| | Breast-fed=1, otherwise 0 | 11.41% | |
| Mother related variables | | | |
| | Empowerment index | 0.55 | 0.18 |
| | Mother's years of completed schooling | 2.95 | 3.34 |
| | Ratio of Mother's age to father's age | 0.81 | 0.08 |
| | Mother is household head=1, otherwise 0 | 0.10% | |
| Household level variables | | | |
| | Number of HH members | 5.13 | 1.52 |
| | Ratio of male aged 0-4 to total HH member | 0.06 | 0.10 |
| | Ratio of male aged 5-9 to total HH member | 0.08 | 0.12 |
| | Ratio of male aged 10-14 to total HH member | 0.08 | 0.12 |
| | Ratio of male aged 15-55 to total HH member | 0.25 | 0.11 |
| | Ratio of male aged 56+ to total HH member | 0.03 | 0.07 |
| | Ratio of female aged 0-4 to total HH member | 0.06 | 0.10 |
| | Ratio of female aged 5-9 to total HH member | 0.08 | 0.11 |
| | Ratio of female aged 10-14 to total HH member | 0.09 | 0.11 |
| | Ratio of female aged 15-55 to total HH member | 0.26 | 0.10 |
| | Ratio of female aged 56+ to total HH member | 0.02 | 0.06 |
| | Mother-in-law co-resides=1, otherwise 0 | 11.54% | |
| | HH head's occupation, Farming=1, otherwise 0 | 70.77% | |
| | HH head's occupation, Trader=1, otherwise 0 | 9.10% | |
| | HH head's occupation, Other=1, otherwise 0 | 20.13% | |
| Socioeconomic variables | | | |
| | Log of per capita monthly expenditures | 6.99 | 0.53 |
| | Landless household=1, otherwise 0 | 46.27% | |
| | Negative shock occurred, yes=1, otherwise 0 | 22.21% | |
| | Log of asset values | 9.59 | 1.28 |
| Access to food | | | |
| | Price of rice (Tk/Kg) | 30.64 | 3.48 |
| | Number of food crops grown | 2.42 | 1.84 |
| Hygiene practice related variables | | | |
| | Uses closed latrine=1, otherwise 0 | 24.47% | |
| | Drinks water from well=1, otherwise 0 | 21.68% | |
| Sibling composition within the household | HH has son and daughter=1, otherwise 0 | 61.91% | |
| | No. of son is greater in the HH=1, otherwise 0 | 18.83% | |
| | No. of daughter is greater in the HH=1, otherwise 0 | 19.10% | |
| | No. of son and daughter is equal in the HH=1, otherwise 0 | 23.97% | |
| Community social norms | Dowry prevalence in the community (Proportion of households paying dowry in the district) | 0.40 | 0.21 |
| | Early marriage <20%=1, otherwise 0 | 14.60% | |
| | Early marriage 20-29%=1, otherwise 0 | 17.04% | |
| | Early marriage 30-39%=1, otherwise 0 | 49.41% | |
| | Early marriage 40+%=1, otherwise 0 | 18.95% | |
| | Supply of Islamic schools in the community (total no in sub-district, 1990) | 16.09 | 12.75 |
| Observations | | 5,857 | |

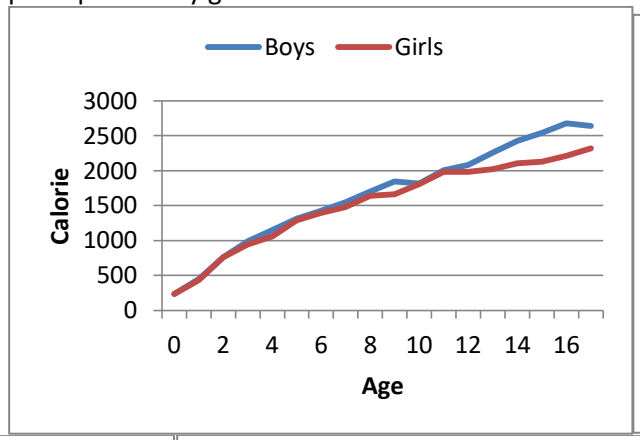
**Notes**: Data on child marriage and dowry prevalence is from WiLCAS 2014 (https://www.integgra.org/cms/index.php/research-design/2014-wilcas). Data on Islamic school availability is from BANBEIS school census. While the data relates to 5,857 children, information on household characteristics are based on 2,913 households.

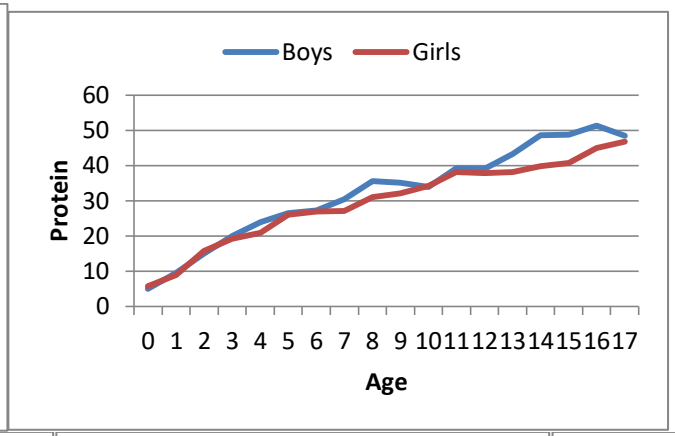
**Appendix Table 2:** OLS estimates of the determinants of calorie and protein intake by gender

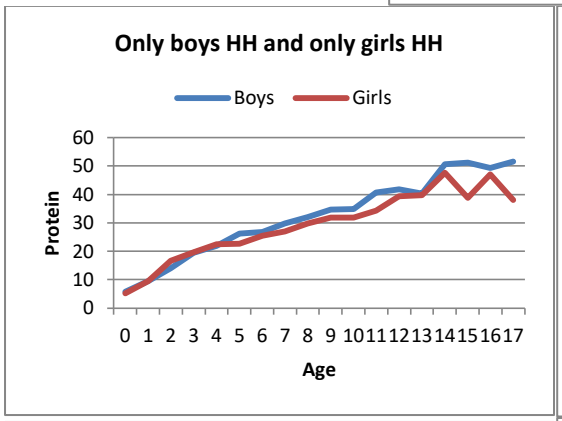
| | Boys | | Girls | |
|---|---|---|---|---|
| | Calorie intake | Protein intake | Calorie intake | Protein intake |
| | (1) | (2) | (1) | (2) |
| Variables | kcal | protein | kcal | protein |
| Empowerment index | 206.743*** | 3.963** | 89.874* | 0.718 |
| | (50.155) | (1.637) | (47.941) | (1.500) |
| Age (years) | 146.179*** | 2.931*** | 168.144*** | 2.956*** |
| | (12.368) | (0.362) | (11.658) | (0.354) |
| Age squared | -1.456** | -0.042** | -3.864*** | -0.063*** |
| | (0.667) | (0.020) | (0.641) | (0.020) |
| physical activity, moderate=1, otherwise 0 | 45.577 | 2.556 | -46.000 | -0.316 |
| | (129.062) | (3.153) | (61.842) | (1.897) |
| physical activity, heavy=1, otherwise 0 | 9.600 | 1.269 | -27.467 | 0.456 |
| | (46.302) | (1.552) | (105.716) | (3.424) |
| Breast-fed=1, otherwise 0 | -245.806*** | -5.386*** | -189.963*** | -4.072*** |
| | (38.985) | (1.055) | (34.254) | (0.980) |
| Number of HH members | -0.762 | 0.219 | -10.495 | -0.634*** |
| | (8.528) | (0.268) | (7.226) | (0.228) |
| Ratio of male aged 0-4 to total HH member | -377.365** | -5.393 | 183.955 | 1.294 |
| | (191.371) | (6.354) | (186.567) | (5.939) |
| Ratio of male aged 5-9 to total HH member | -383.630** | -9.270 | -130.748 | -4.138 |
| | (188.491) | (6.135) | (169.402) | (5.265) |
| Ratio of male aged 10-14 to total HH member | -615.219*** | -16.221** | -219.531 | -9.984* |
| | (176.398) | (6.627) | (172.512) | (5.732) |
| Ratio of male aged 15-55 to total HH member | -385.775** | -12.749** | -215.368 | -9.142* |
| | (167.886) | (5.938) | (149.568) | (5.350) |
| Ratio of female aged 0-4 to total HH member | -281.013 | -7.611 | -247.760 | -10.009* |
| | (196.066) | (6.522) | (168.980) | (5.422) |
| Ratio of female aged 5-9 to total HH member | -289.254 | -9.116 | -232.849 | -10.896** |
| | (190.396) | (6.051) | (168.816) | (5.413) |
| Ratio of female aged 10-14 to total HH member | -624.282*** | -13.128** | -202.013 | -12.108* |
| | (188.818) | (6.269) | (175.251) | (6.202) |
| Ratio of female aged 15-55 to total HH member | -774.076*** | -7.523 | -427.463** | -14.513** |
| | (215.569) | (6.921) | (193.097) | (6.178) |
| Ratio of female aged 56+ to total HH member | -876.718*** | -3.202 | -475.626* | -15.378* |
| | (330.681) | (11.545) | (284.201) | (9.162) |
| HH head's occupation, Trader=1, otherwise 0 | -111.342*** | -2.657*** | -82.175*** | -3.290*** |
| | (30.957) | (1.011) | (29.858) | (0.822) |
| HH head's occupation, Other=1, otherwise 0 | -43.527* | -0.096 | -26.458 | -0.258 |
| | (23.443) | (0.851) | (22.283) | (0.762) |
| Ratio of mother's age to father's age | 134.000 | 2.994 | 320.118*** | 11.082*** |
| | (113.342) | (3.660) | (101.649) | (3.274) |
| Mother's years of schooling | -3.709 | 0.026 | -2.051 | 0.116 |
| | (3.035) | (0.102) | (2.880) | (0.093) |
| Log of per capita monthly expenditures | 175.495*** | 8.409*** | 149.045*** | 6.799*** |
| | (20.905) | (0.686) | (18.402) | (0.558) |
| Price of rice (Tk/Kg) | -9.929*** | -0.198** | -5.483 | 0.024 |
| | (2.631) | (0.091) | (3.788) | (0.149) |
| Female headed HH=1, otherwise 0 | -104.557 | -14.785*** | -205.070** | 10.759*** |
| | (109.892) | (4.461) | (102.227) | (3.090) |
| Mother-in-law co-resides=1, otherwise 0 | 43.115 | -0.203 | 25.777 | 1.660 |
| | (48.156) | (1.595) | (42.015) | (1.184) |
| Number of food crops grown | 43.388*** | 1.415*** | 29.013*** | 1.073*** |
| | (5.868) | (0.176) | (4.996) | (0.143) |
| Uses closed latrine=1, otherwise 0 | 20.458 | 2.152*** | -6.318 | 2.334*** |
| | (23.194) | (0.792) | (21.747) | (0.742) |
| Drinks water from well=1, otherwise 0 | 22.319 | 0.040 | -0.097 | -0.355 |
| | (24.856) | (0.768) | (22.081) | (0.701) |
| Landless household=1, otherwise 0 | -77.848*** | -2.391*** | -52.327*** | -1.627*** |
| | (19.686) | (0.632) | (18.455) | (0.583) |
| HH experienced shock=1, otherwise 0 | -30.277 | -0.458 | -28.901 | -1.089* |
| | (22.610) | (0.757) | (20.157) | (0.638) |
| Constant | -12.308 | -36.625*** | -301.452 | -31.074*** |
| | (259.736) | (8.129) | (251.613) | (8.569) |
| Observations | 2,993 | 2,993 | 2,864 | 2,864 |
| $R^2$ | 0.634 | 0.409 | 0.592 | 0.392 |

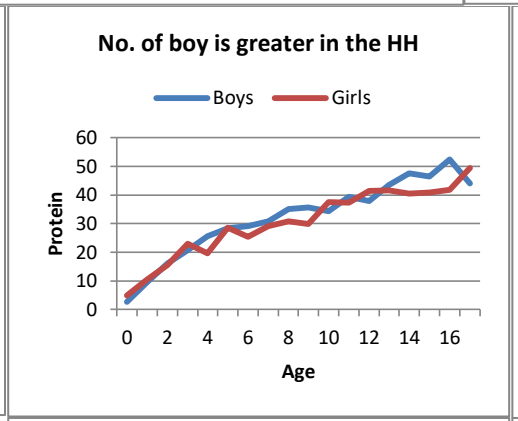
Note: (1) Robust standard errors in parenthesis (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent. (3) All models control for division dummies.

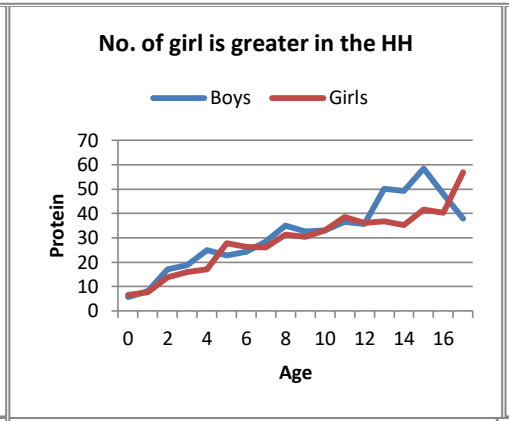
**Appendix Figure 1**: Age-consumption profiles by gender and household structure

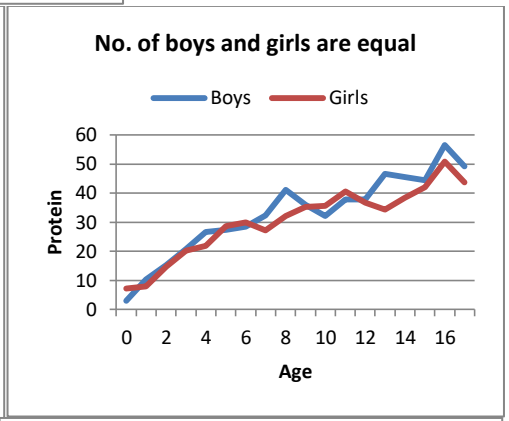


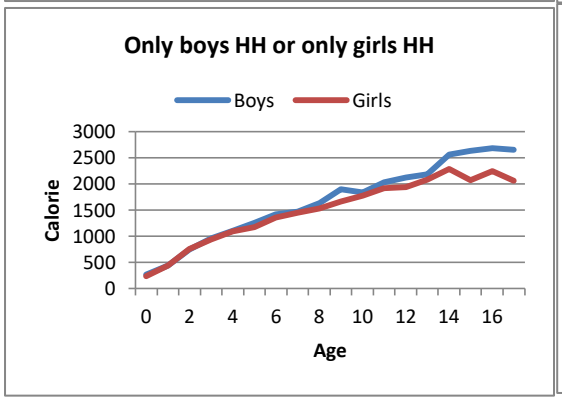



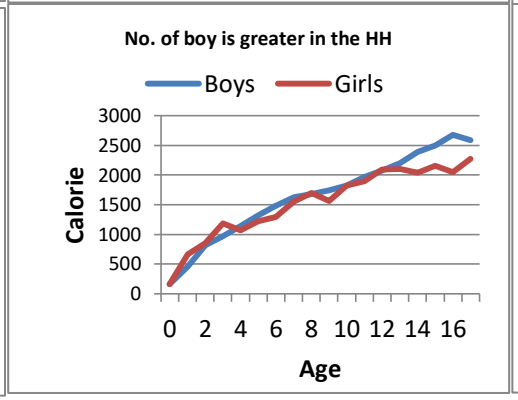



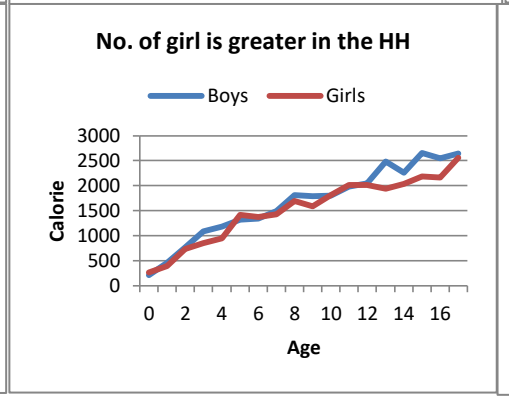



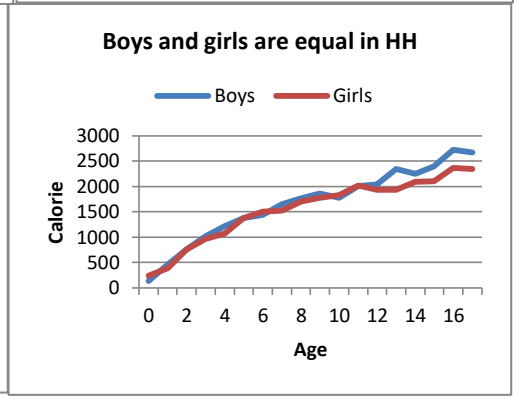



**Appendix Table 3: Correlation matrix**

| | Empowerment index | Log per capita expenditure | Log Asset | kcal intake | protein intake |
|---|---|---|---|---|---|
| Empowerment index | 1.0 | | | | |
| Log per capita expenditure | 0.0562* | 1.0 | | | |
| Log Asset | 0.1677* | 0.2859* | 1.0 | | |
| Kcal intake | 0.1437* | 0.1321* | 0.1325* | 1.0 | |
| Protein intake | 0.1161* | 0.2464* | 0.1883* | 0.7956* | 1.0 |

**Note**: * indicates significance at 5% level.