Female Empowerment and Intra-Household Nutritional Status in Rural Bangladesh

Master Thesis – CIPA Writing Requirement

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Abstract

Levels of child malnourishment in South Asia remained much higher than the good progress in developments indicators would suggest. These contradictory findings known as the Asian Enigma are caused by low female empowerment. The relationship between female empowerment and nutritional outcomes is the focus of this paper that uses the baseline data of a survey of 4,000 households in rural Bangladesh from October to December 2015 for the project Agriculture, Nutrition, and Gender Linkages (*ANGeL*) Project of the International Food Policy and Research Institute (IFPRI). This data allows to construct the recently developed Abbreviated Women's Empowerment in Agriculture Index (A-WEAI), a multi-dimensional and agricultural-specific index based on the concept of agency, resources, and achievements. The score, its sub-indices of gender parity and five dimensions of empowerment, and three indicators including input in productive decisions, group membership, and workload are employed as independent variables. Another and partly contradictory measure to the A-WEAI is represented by the subjective measure of *"feeling empowered"*.

Thus, this study investigates weather female empowerment is associated with an increase in nutritional status measured as dietary diversity of female, male, and an average household member, and, secondly, as relative gain of women's nutritional status compared to men. Finally, it is hypothesized that the A-WEAI has greater empirical power than women's perception of self-determination. The stated associations are estimated with multivariate linear regressions with district fixed effects.

The results support the positive relationship of female empowerment and nutritional outcomes for female, male, and average household members. Female empowerment measured as the A-WEAI indicator work burden is positively associated with a relative increase of male dietary diversity compared to female. Therefore, self-determined *"feeling of being empowered"* seems to have greater empirical power in explaining nutritional outcomes than the multidimensional A-WEAI and its composite variables. Reasons for the weak performance of the A-WEAI in this study might be an endogeneity bias due to simultaneity, selection bias due to large number of inadequate male A-WEAI surveys, and perhaps weaker concept

validity as the WEAI for statistical regression analysis. The results imply the necessity to include *"felt empowerment"* as additional performance indicator for interventions with the objective to increase female empowerment.

Contents

1 Introduction

Despite good progress in development indicators like GDP, food supply, and health services in South Asia, child malnutrition has remained higher than in Sub-Saharan Africa that performed worse in above stated indicators (L. C. Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003). This contradiction known as the Asian Enigma is driven by low female empowerment because women's status within the household limits their nutritional well-being and thus their ability to provide optimal conditions for child health during pregnancy and after birth (Ramalingaswami et al., 1996).

Thus, I hypothesis that female empowerment increases the nutritional status of women, their children, and the average household member, and leads to a nutritional benefit to women at the cost of men's nutritional status. One measure of nutritional well-being is dietary diversity reflecting the intake of micronutrients essential for growth. For female empowerment two different measures are employed introducing another hypothesis: the multidimensional and domain-specific Abbreviated Women's Empowerment in Agriculture Index (A-WEAI) should have greater empirical power than the subjective measure of *"feeling empowered"*. The A-WEAI is based on Kabeer (1999)'s agency approach, constructed following the Alkire-Foster (2011) methodology. It consists of two sub-indices: gender parity and empowerment in five dimensions including production, resources, income, leadership, and time. The A-WEAI is the abbreviated version of the Women's Empowerment in Agriculture Index (WEAI) including less indicators and an adjusted set of less time consuming and more effective questions developed to measure female empowerment in Feed the Future zones, the U.S. government's global hunger and food security initiative. Beyond the use for project evaluations, the WEAI is used for further analysis regarding female empowerment, agency, and inclusion in the agriculture sector. This study is one of the first to use the A-WEAI, its sub-indices, and its indicators for a regression analysis. The other measure of female empowerment, perceived self-determination of one's life, tries to capture *"felt empowerment"* that is not represented in the A-WEAI and even contradicts it (Roy, Ara, Das, & Quisumbing, 2015). A comparison of the empirical power of subjective and objective measures

will lead to further insights of the importance of including self-perceived measures, an indicator for female empowerment that has not been employed in similar study considering a nutrition outcome.

The stated associations are examined with cross-sectional data from a baseline survey in rural Bangladesh. The survey included a sample of 4,000 rural households in 16 of the 484 upazilas and was conducted for the Agriculture, Nutrition, and Gender Linkages (*ANGeL*) Project of the International Food Policy and Research Institute (IFPRI) from October to December 2015. To estimate the relationships between variables, a linear regression model is used with district fixed effects.

This paper contributes to the empirical evidence of the link between female empowerment and nutritional outcomes by examining this relationship in greater detail. It is one of the first studies to test the recently developed A-WEAI as an independent variable in a regression model.

The analysis shows divergent findings with respect to the two different measures of female empowerment. When measured in terms of perceived self-determination of one's own empowerment status, female empowerment is positively associated with the nutritional status of women, men, and an average household member. Employing the A-WEAI dimension of time measured as daily work burden, female empowerment is negatively associated with a gain in women's nutritional status relative to men's nutritional status. Given that women's levels of dietary diversity are slightly lower than men's, reducing women's work burden could help increase equality in nutrition status.

The paper finds that the perceived, self-determined *"feeling of being empowered"* seems to have greater empirical power in explaining nutritional outcomes than the multidimensional A-WEAI and its composite variables. This may have been influenced by endogeneity within the regression model or by the A-WEAI's lesser suitability for statistical analysis than the WEAI. Nevertheless, it suggests that interventions to increase female empowerment should include additional performance indicators about perceived empowerment, as they are usually easy to implement – often only one question is required. Perceived self-determination expands the concept of empowerment captured by the WEAI. If development projects were to adopt a more holistic perspective of female empowerment, evaluations could determine more suitable

interventions to increase female empowerment in all relevant dimensions and thus decrease child malnutrition child stunting more effectively.

The next section (Section 2) provides an overview of underlying concepts as well as measures of female empowerment, and summary of the research linking female empowerment with nutritional outcomes. Section 3 introduces the dataset, the variables used, and the methodology, while Section 4 reports summary statistics and regression results. Section 5 provides are short discussion and Section 6 concludes the paper about the overall findings and implications of the results.

2 Conceptual Framework

a) Female Empowerment and Nutrition

Associational Evidence

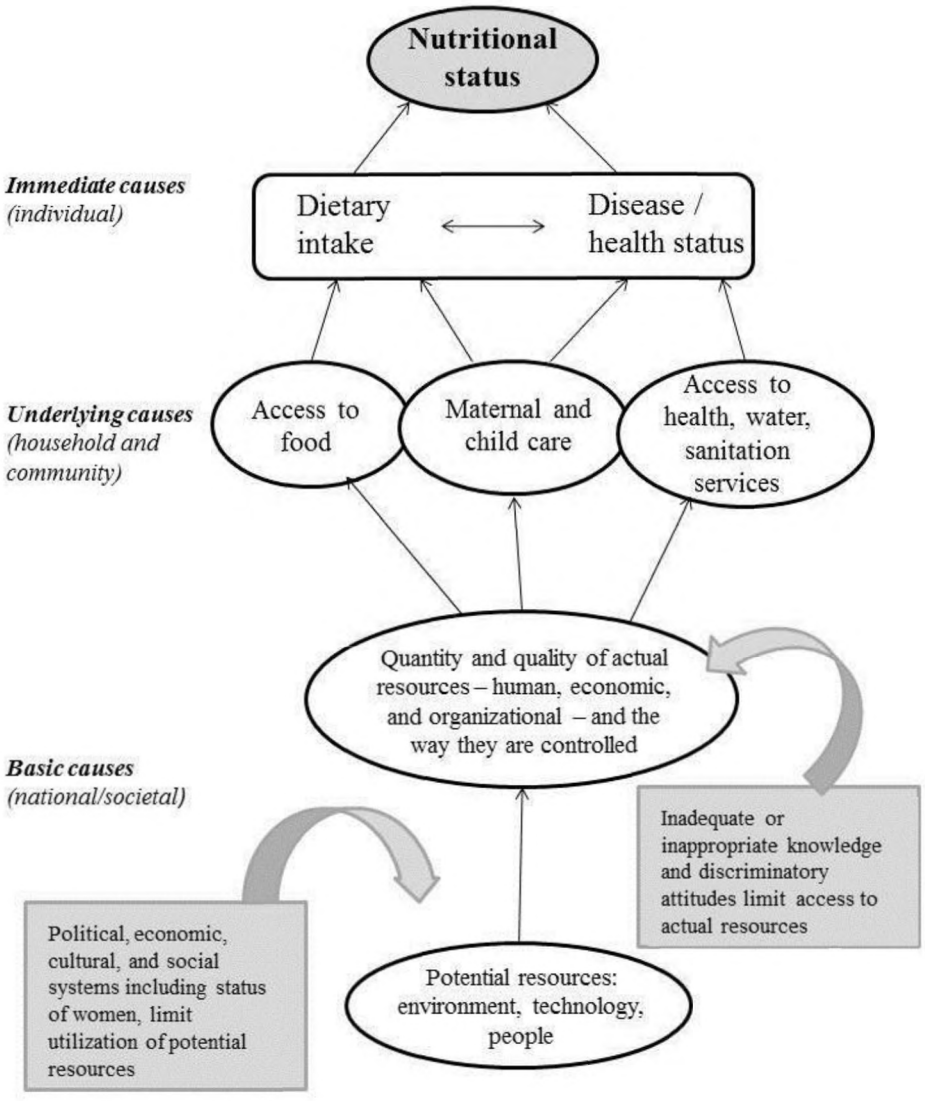
Literature has provided broad associational evidence regarding female empowerment and nutrition (van den Bold, Quisumbing, & Gillespie, 2013). In case of Bangladesh, Bhagowalia et al. (2012) show that female empowerment is positively related to dietary diversity of children and negatively to child stunting. Ziaei et. al (2014) also find positive associations between low levels of female empowerment (indicated by intimate partner violence) and child stunting using data from the 2007 Bangladesh Demographic and Health Survey. Sraboni et al. (2014) also estimate a positive relationship between some dimensions of female empowerment and per capita calorie consumption as well as dietary diversity on the household level but in some cases, negative impacts for male BMI.

Causal Pathways Linking Female Empowerment and Nutrition

The stated associations are linked by a causal pathway first outlined in the 1990 UNICEF framework on determinants of nutrition and later adaptions like the one of Smith et al. (2003) presented in Figure 1 (van den Bold et al., 2013). It shows that not only the state of the household in general but also the situation of mothers therein influences the care and thus the nutritional status of children. Optimal care requires education, physical health, and mental health of the caregiver, usually the mother of the child (L. C. Smith

et al., 2003; UNICEF, 1990). Other important maternal resources are even more tightly linked to female empowerment: female access and control over household resources increase the quality of care whereas a lack of control of resources, knowledge, time, and social support networks decreases it (L. C. Smith et al., 2003; UNICEF, 1990).

Figure 1: Conceptual framework depicting causes of malnutrition and links between women's empowerment and nutrition



Source: Van den Bold (2013, p. 8) based on adaptation from Smith et al. (2003) and UNICEF (1990)

Female access and control over resources is especially important because household decision making and resource allocation does not necessarily follow a unitary model, where household income would be pooled and follow a single common preference order. Rather, resource allocation and decision making depend on

sharing of resources and heterogeneous preferences of different decision makers within the household (Alderman et al., 1995; Becker, 1973; Behrman, 1997; Chiappori, 1992; Doss, 2013, 2013; Haddad et al., 1997; Quisumbing & Maluccio, 2000; Strauss & Thomas, 1995).

For example, Porter (2016) shows in one of the many studies examining micro-finance in Bangladesh that an average female micro-finance institution (MFI) loan compared to a male non-MFI loan increases the household food budget share. Quisumbing & Maluccio (2000) estimate that women's control over assets has a positive and significant effect on spending on children's clothing and education. This is also confirmed by another paper of Quisumbing and de la Brière (2000), however, after controlling for endogeneity of assets, husbands' current assets also have a positive and significant effect on the household food expenditure share. Other findings of empirical studies support that men seem to favor spending their income for personal consumption such as alcohol, cigarettes, or status goods whereas women tend to use their means for general household consumption or goods for children (Doss, 2013; Hoddinott, 1997). To note is that these preferences have not been explicitly examined but are inferred: when the measure for female bargaining power has a significant effect on certain goods and services, it is assumed that women favor this particular outcome (Doss, 2013; Thomas, 1990). So, the underlying assumption of most of the literature and also in this study is that women's and men's preferences differ and follow the above stated trends leading to a causal link between female empowerment and the nutritional status of children, female household members, and the overall household (Doss, 2013).

b) Concepts and Measures of Female Empowerment

Using female empowerment as a correlate for nutritional status requires selecting the most suitable one of the many different definitions, concepts, and operationalizations of female empowerment. The following section reviews the most common concepts in the female empowerment literature briefly before the measures of this study are introduced.

Definitions and Concepts of Female Empowerment

This term has been defined quite diversely, for example, Ibrahim & Alkire (2007) provide an overview of 29 definitions in the literature. Overlapping themes are often related to agency, as conceptualized by Amartya Sen in 1999 (van den Bold et al., 2013). Other common conceptualizations focus on power, options, control, and choice (van den Bold et al., 2013).

Kabeer (1999) has combined similarities of female empowerment definitions and become one of the major sources fircurrent literature (Sraboni et al., 2014; van den Bold et al., 2013). Kabeer defines empowerment as *"the expansion in people's ability to make strategic life choices in a context where this ability was previously denied to them"* (Kabeer 1999a, 437). Empowerment is a change in ability to make important life decisions considering three dimensions: resources, agency, and achievements where agency is defined as the *"ability to define one's goals and act upon them"* (Kabeer 1999a, 438).

As agency and empowerment manifest in different tasks depending on the domains women are involved in, they require differentiated descriptions as well as measurements. Metrics should be chosen in accordance to the examined context (Alkire, 2005). Following this advice one measure of female empowerment used in this study is closely linked to the domain of agriculture.

Agriculture as an Important Domain for Female Empowerment

An important livelihood in developing countries is the agricultural sector, which provides food, nutrition, and income for a large share of the population (Arimond et al., 2010). An increasing number of women are involved in and participate in the agricultural sector (Arimond et al., 2010; FAO, 2011). In Bangladesh, for instance, the participation of women in agriculture increased from less than 20 percent (3.8 million) in 1999-2000 to around 34 percent of the total labor force in the agricultural sector (7.7 million) in 2005-2006 (Jaim & Hossain, 2011). Female labor input contributes significantly to efficiency and productivity in agriculture according to a study of Rahman (2010). Nevertheless, female participation in agriculture in particular outside the homestead does not receive adequate appreciation due to cultural norms favoring female seclusion (Kabeer, 1994; Rahman, 2000). Further, women face constraints in quality and quantity of control of agricultural assets, inputs, resources and returns compared to men (Agarwal, 1994.; Kilic et al., 2013;

Peterman et al., 2010). This gender gap in the control of agricultural inputs based on non-pooling of agricultural resources between female and male household members impedes productivity (Kilic et al., 2013; Peterman et al., 2010; Peterman et al., 2011; Udry, 1996). This state of female disempowerment in the domain of agriculture could be changed by agricultural interventions outlined by Ruel and Alderman (2013), who identify six pathways for agricultural interventions of which three aim to improve the nutritional status in the household through women: a) by a direct increase in social status and empowerment, b) by introducing time saving strategies, and c) by increasing the health and nutritional status of women. In the center of my investigation lies the first stated pathway, i.e. *"women's participation in agriculture can affect their access to, or control over, resources and assets, and increase their decision making power regarding intra-household allocation of food, health, and care"* (Ruel & Alderman, 2013). This increased female empowerment triggered by greater participation will consequently lead to women spending money in accordance to their inferred preferences - that include higher expenditure of food as outlined above – that improves the nutritional status of the household members. Thus, empowerment in the domain of agriculture appears to be highly relevant for women in developing countries. The Women's Empowerment in Agriculture Index (WEAI) seeks to specifically measure female empowerment in the agricultural domain.

Measuring the Agricultural Domain Specific A-WEAI

The WEAI is an agricultural-specific measure of empowerment containing the degree of empowerment as well as an assessment of the gender parity gap (Alkire et al., 2013). The WEAI originated from a collaboration of the United States Agency for International Development (USAID), IFPRI, and the Oxford Poverty and Human Development Initiative (OPHI) to measure women's empowerment in the Feed the Future zones, the U.S. government's global hunger and food security initiative. However, it is not limited to this purpose, but can be used more broadly to assess female empowerment, agency, and inclusion in the agricultural sector (Alkire et al., 2012; Sraboni et al., 2013). As the WEAI follows the Alkire-Foster (2011) methodology, a technique to include multiple dimensions and indicators for a specific contexts for measuring poverty or well-being, it aggregats individual-level data from surveys of both women and men in the same household for countries or regions (Sraboni et al., 2013). Following feedback regarding time

intensity and perceived obstacles of some questions, the Abbreviated Women's Empowerment in Agriculture Index (A-WEAI) was developed by decreasing the number of indicators and adjusting survey modules (Malapit et al., 2015). This will be the measure for further analysis in this paper.

The WEAI and the A-WEAI are constructed of two sub-indexes: five domains of female empowerment (5DE) in agriculture and the Gender Parity Index (GPI) (Malapit et al., 2015). As Table 1 shows, the five domains include decisions about agricultural production (domain 1), access to and decision-making power about productive resources (domain 2), control of use of income (domain 3), leadership in the community (domain 4), and time allocation (domain 5) (Alkire et al., 2012). Each of the six indicators in the five domains of the A-WEAI assess whether a person has an adequate or inadequate achievement. The indicators are then weighted and aggregated to a score between zero and 100 percent (Alkire et al., 2012). Empowerment in the 5DE is reached when either four out of the five domains are adequate or the person's score of the combined weighted indicators is higher or equal to 80 percent (Alkire et al., 2012).

Table 1: The domains, indicators, and weights in the A-WEAI

The domains, indicators, and weights in the A-WEAI

Domain	Indicator	Weight
Production	Input in productive decisions	1/5
Resources	Ownership of assets	2/15
	Access to and decisions on credit	1/15
Income	Control over use of income	1/5
Leadership	Group membership	1/5
Time	Workload	1/5

Source: Adapted from (Alkire et al., 2012; Malapit et al., 2015)

The second sub-index, the GPI, represents the percentage of women who have achieved empowerment in the 5DE or a higher empowerment score than the men in their household (Alkire et al., 2012). If gender parity is not achieved, the GPI shows the gap women have to overcome to reach the same level of

empowerment as their male counterpart in the household (Alkire et al., 2012). The overall score is the sum of the 5DE with the weight 0.9 and GPI with 0.1 (Malapit et al., 2015).

Application of the WEAI in Empirical Studies

Using the score of the WEAI and its indicators, several studies estimate the effect of these on the nutritional status of children, women, or the overall household (Cunningham et al., 2015; Malapit et al, 2015; Malapit & Quisumbing, 2015; Sraboni et al., 2014; Yimer & Tadesse, 2015). They analyze mostly cross-sectional data in developing countries with multivariate regression and instrumental variables techniques to account for possible endogeneity of female empowerment. Most of them focus on associational relationships as causality seems to be particularly hard to establish (Cunningham et al., 2015; Malapit et al., 2015; Malapit & Quisumbing, 2015; Sraboni et al., 2014). Malapit et al. (2015) show that overall empowerment as well as indicators of group membership, control over income, and reduced workload are positively associated with maternal dietary diversity in rural Nepal. Female empowerment also outweighs negative consequences of low production diversity on dietary diversity.

Two studies conduct their analysis in Bangladesh: Malapit & Quisumbing (2015) find that the indicator of women's empowerment in credit decisions is positively and significantly associated with female dietary diversity but not with BMI. Sraboni et al. (2014) identify that overall women's empowerment score, a smaller gender parity gap, and higher levels for WEAI related indicators of active group participation and individual control of assets are positively associated with calorie availability and dietary diversity at the household level. However, the relationships are purely associational and seem less important than other factors like household wealth, education, and occupation. Interestingly, women's access and decision-making regarding credit as well as active group participation has a significantly negative association with adult male BMI. Van de Bold (2013) also raises the concern that *"female empowerment may have opposite effects"* changing women's preference from favoring spending on household and children to dedicating a larger share to her own consumption goods. All peer-reviewed studies to date linking female empowerment and dietary diversity have used the generally version of the WEAI, not the A-WEAI. Thus, to the best of

my knowledge, this study will be one of the first to work with the A-WEAI as an independent variable to examine the relation of female empowerment and nutritional outcomes.

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Alternative Female Empowerment Measures: Self-perception

Another area explored in this paper is the comparison between different kinds of measures of empowerment: a multidimensional empowerment measurement like the A-WEAI and the self-perception of feeling empowered because, as will be explained, these two concepts often are not in harmony.

An example that illustrates the dissonance of self-perception and empowerment based on agency is Roy et al. (2015) who investigate the effect of transfers to women on their control over it, their decision -making power over income, and female empowerment. After a dairy cow has been given to each woman in the treatment group, it is examined whether women still have control over the donated cow and how a possible change in control over the livestock might influence female empowerment. Employing both quantitative and qualitative data, the authors determine that the work load of women within the household increases due to providing care for the cow Consequently, work of women outside the home has shifted to inside the home. This has an impact on women's mobility and decision-making power regarding her own income, purchases for herself, and household budgeting, which all decline, indicating a decrease in female empowerment. Data from focus groups discussions confirm these findings but also add that women *"feel"* more empowered: They report that they feel more confident, as well as experience a gain in social capital in communities and in households. The perceived higher social status results from outside work being culturally frowned upon and violating social norms that favor the seclusion of women. In this case, female empowerment and self-perception appear not only to be distinct but rather contradictory: obedience or the reinforcement of social norms benefits women's reputation in the household and in society by reducing the decision-making power and control over income. Self-perception of empowerment can thus not be treated as an equivalent to the female empowerment measured by the A-WEAI.

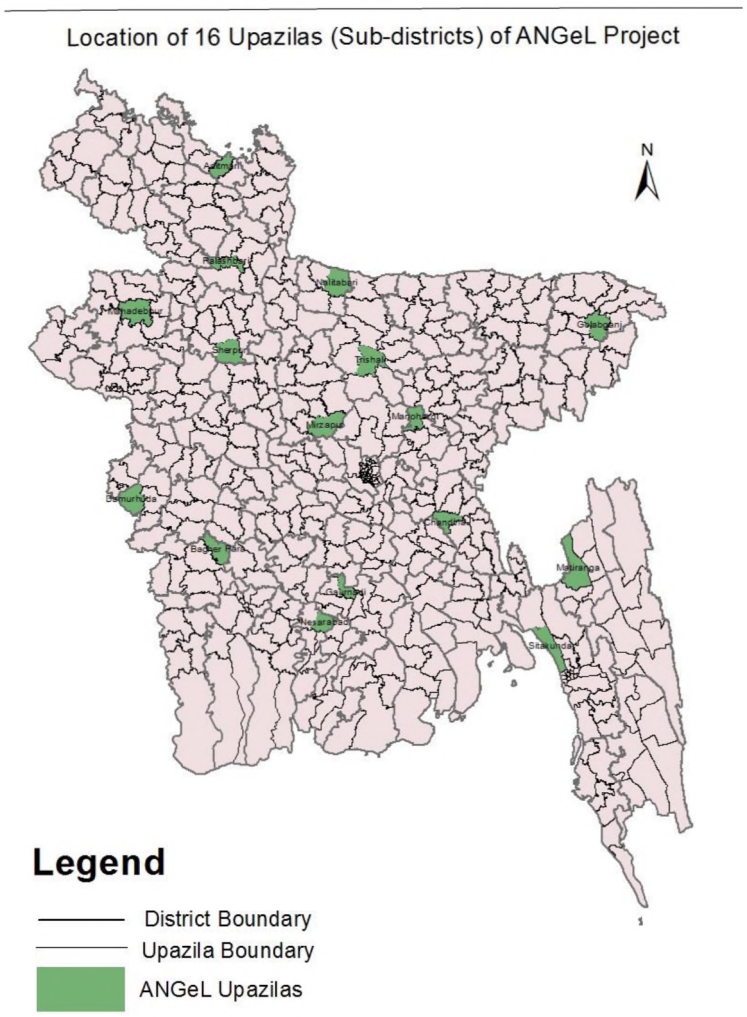
Female empowerment indicators based on psychology like appreciation in the household or sense of self-worth are less frequently used (Malhotra et al., 2002; van den Bold et al., 2013) and mainly in descriptive studies (Kabeer, 1994, 1997). In the next section, this paper will elaborate on the consequences of *"feeling empowered"* by examining its associations with nutritional outcomes.

3 Data, Empirical Specification, and Variables

c) Survey Design, Data, and Sample Selection

The effect of female empowerment on household welfare, and how the empirical power of the A-WEAI and perceived self-determination compare to each other will be examined using data from the baseline survey of the project *ANGeL* of IFPRI. The data is derived from 4,000 household surveys conducted in rural Bangladesh from October to December 2015 in 16 of the 484 upazilas that appeared agro-ecologically suitable for crop diversification and with good connection to markets (Figure 2) (Ahmed, 2015).

Figure 2: Geographic location of the 16 upazilas included in the sample for the project ANGeL



Source: Ahmed (2016)

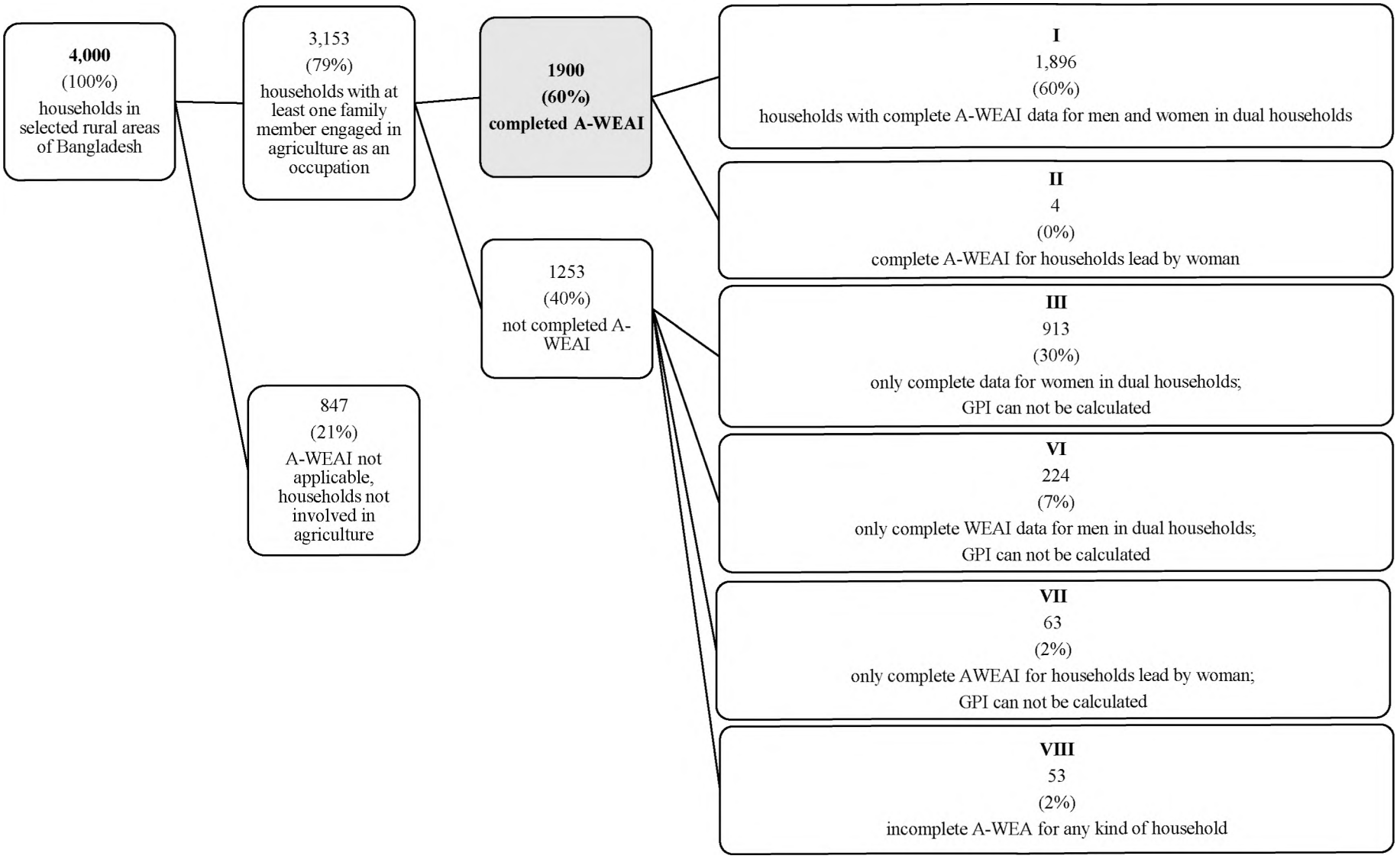
The sample for the baseline survey of the project included 16 purposively selected upazilas. Within them, ten of the available blocks defined by the village census list have been chosen for the final selection of 25 farm households with at least one child aged less than 24 months using village census data (Ahmed, 2015). Data Analysis and Technical Assistance Limited (DATA), a Bangladeshi consulting firm, surveyed male and female household heads (usually the parents of the child under 24 months) regarding agricultural production, food consumption, socio-economic status, and empowerment of women.

The data used in this study focus on a sub-set of observations: only the household head and the female or male counterpart are selected for households in which at least one household member has his or her main occupation in agriculture to ensure that women who do not state their occupation related to agriculture but actively work on the homestead are not dropped. That reduces the number of households included from 3,999 to 3,153 (Figure 3).

Households without sufficient data for both partners are excluded, thus the A-WEAI is only estimated for 1,900 households, which is 60 percent of the households (highlighted in grey in Figure 3). For the remaining 40 percent of households at least one indicator is not available for the aggregate measure of the A-WEAI. Most studies using the WEAI do not disclose the ratio of included households for the WEAI calculation to the all households engaged in farming apart from Sraboni et al. (2014) for their study in Bangladesh and Malapit et al. (2015) in Nepal who report using a sample of 84 percent and 20 percent respectively. Thus, this exclusion rate is supported in the literature. Most of the drop-out of the household goes back to insufficient male questionnaires to compile the empowerment score even though the data supports that the surveys have been taken. An explanation could be that men are not working in agriculture at all even though some of their family members are still active in it and thus do not provide adequate information for this index based on the domain of agriculture. The taken but insufficient A-WEAI parts of female questionnaires might have similar causes. Reasons for less participation in agriculture might be the proximity to towns offering opportunities beyond farming or a higher level of education allowing non-agricultural employment. However, this selection bias does not interfere with the analysis because the focus lies on the rural population whose livelihood is agriculture. Thus, an exclusion of observations whose survey answers reveal that the household heads are not engaged in farming seems appropriate for this study.

For later analysis, the sample size is reduced to those households that have not only completed A-WEAI information but also completed the question about self-perception and dietary diversity for both men and women, leaving the the final sample size at 1,853 female observations.

Figure 3: Sample sizes by household type with requirements for the A-WEAI as exclusion criteria.



Source: 2015/2016 Baseline Survey for ANGeL Evaluation, IFPRI

d) Empirical Specification

I will use the introduced data for testing the association of female empowerment measures and nutritional outcomes. I hypothesize that higher female empowerment increases the level of dietary diversity for the woman, her male counterpart, and the per capita dietary diversity of the household. I also expect that female empowerment leads to a relative increase of female nutritional status compared to male status leading to an equal level of dietary diversity between the interviewed female and male participant. Using the different measures of female empowerment for the four outcome variables will allow judgements regarding the empirical power of the variables related to the multidimensional A-WEAI and the subjective measure of *"feeling empowered"*.

The estimation follows the model of Yimer and Tadesse (2015) considering only the observations of the interviewed female participants as independent variables:

$$N = \beta_0 + \beta_1 E + \beta_2 I + \beta_3 H + \beta_4 D + \varepsilon$$

Where N represents nutritional outcomes like per capita dietary diversity at the household level or female dietary diversity which has been employed by Sraboni et al. (2014) or Malapit et al. (2015) respectively. Beyond these, other measures like male dietary diversity or dietary diversity ratio are addressed. E represents the used measure for female empowerment that will not only contain the overall measures for *"felt empowerment"* and the multidimensional A-WEAI but also the 5DE, the gender parity gap, and indicators contributing most to disempowerment of women. I stands for individual characteristics including age and level of schooling. HH relates to household characteristics like cultivated land size in acres, dependency ratio, household wealth, and distance to markets. D represents geographic characteristics of the district that will enter the equation as district fixed effects and ε is an error term.

The stated associations are non-causal and estimated with multivariate regressions and district fixed effects. The proposed model does not account for endogeneity caused by another factor influencing both dietary diversity and female empowerment simultaneously. The literature employs instrumental variables (IVs) to deal with this endogeneity issue, however, not all studies succeed in finding strong IVs required for using

this technique (Malapit et al., 2015; Sraboni et al., 2014; Yimer & Tadesse, 2015). Consequently, these authors decide to present results only from pure OLS regressions or alongside the IV estimates. Therefore, the chosen method, OLS-regression, is common in the literature linking female empowerment and nutritional outcomes.

a) Dependent Variables

In this study the nutritional outcome is dietary diversity as derived from a 24-hour-recall, in which the female participants had to list the ingredients, quantity, type of meal as well as the consumed amount for each household member. Using the data, I constructed the Women's Dietary Diversity Score (WDDS) to provide insights in the nutritional quality of the diet because this score reflects *"the probability of micronutrient adequacy of the diet"* (Kennedy et al., 2010). That is why, the indicator does not account for fats or oils. The indicator groups food according to nine categories: (1) starchy staples, (2) legumes and nuts, (3) all dairy products, (4) organ meat, (5) eggs, (6) flesh foods and other, (7) vitamin A rich dark green leafy vegetables, (8) other vitamin A rich vegetables and fruits and, (9) other fruits and vegetables (Arimond et al., 2010; Kennedy et al., 2010). The WDDS ranges from zero to nine based on the count of the number of food groups consumed.

The WDDS is the base for the calculation of the four different outcome measures in this study. One outcome is the diet score on the individual level for female participants. The WDDS for male observations represents the second dependent variable. As the index is a sum of consumed food groups, I assume that it applies in the same way for men as for women. The third dependent variable is constructed as the average dietary diversity in a household based on the individual WDDS of all household members with age greater or equal to 15. For all three nutritional outcomes, the dietary diversity score is log transformed to indicate the percentage point change of greater nutritional quality.

The fourth version of dietary diversity score is the difference of the average WDDS of all women and all men in the household (age above 15) weighted with the average male WDDS in the household:

$$Dietary\ diversity\ ratio = \frac{Dietary\ Diversity_{Male} - Dietary\ Diversity_{Female}}{Dietary\ Diversity_{Male}}$$

If this weighted difference is negative, the male dietary diversity score is lower than the female dietary diversity score and the magnitude shows the degree of this difference. This will allow me to determine whether female empowerment is associated with a larger nutritional gain for women than for men.

b) Key Independent Variables

Female Empowerment Based on the A-WEAI

The main predictor of this study is the A-WEAI, its sub-indices, and three indicators that contribute the most to female disempowerment. Thus, I will use six different models related to the A-WEAI to test the relationship between female empowerment and nutritional outcomes.

Model I: A-WEAI Score

The overall score of the A-WEAI is calculated on the individual level as described in section 2 b) consisting of the weighted sum of the two sub-indices, 5DE and GPI. The values range from zero to one with increasing values representing higher levels of empowerment.

Model II: Aggregate Empowerment Score in the 5DE

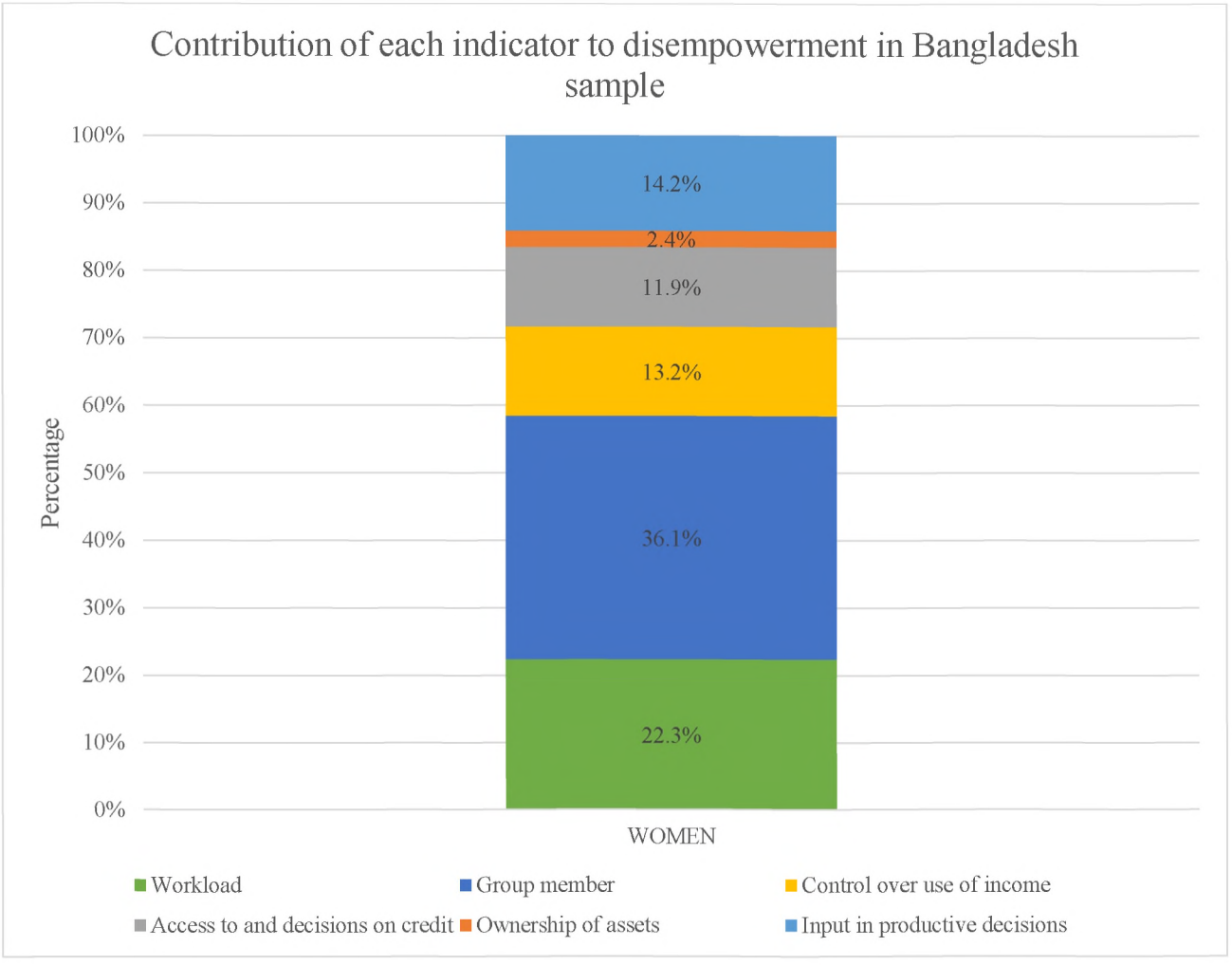
The sub-indices are also included as independent variables on the individual level. One of them, the 5DE is the equally weighted average adequacy achieved within each of the five domains of the A-WEAI. It ranges from zero to one with increasing value indicating increased empowerment.

Model III: Gender Parity Gap

The GPI, the second sub-index of the A-WEAI, reflects the relative empowerment of the surveyed woman in comparison with the interviewed man in the household and is the difference of the male and the female 5DE score. The variable used is the gender parity gap, that has values between negative one to zero. The maximum score of zero is assigned to equal levels of the 5DE for men and women or when the woman has a higher level of 5DE than the man. A smaller absolute value represents a smaller gap that the woman must bridge to become empowered.

This analysis also uses three independent variables derived from the A-WEAI that were chosen because they contribute the most to female disempowerment using the sample-level WEAI diagnostics. They show the percentage contribution of each indicator to women's empowerment for the 1,900 women in dual households with complete survey data (Figure 4). A lack in group membership contributes most to female disempowerment with 36.1 percent followed by workload with 22.3 percent. Low input in productive decisions accounts for the next largest share of disempowerment with 14.2 percent.

Figure 4: Contribution of each indicator of the A-WEAI to disempowerment of the selected sample of 1,900 households in percentage



Source: 2015/2016 Baseline Survey for ANGeL Evaluation, IFPRI

For the hypotheses focusing on indicators related to the A-WEAI, all variables are continuous and on the individual level.

Model IV: Productive Decisions

The continuous indicator for productive decisions counts the number of agricultural domains in which the participant has some input or feels that they could contribute to the decisions made regarding that domain. An increasing number of input areas stands for greater empowerment.

Model V: Group Membership

Group membership is the number of groups in which the respondent has reported to be involved in. The WEAI assumes that greater participation is a sign of greater empowerment because it accounts for the available number of groups for participation - empowerment options - and woman's choice to become active, i.e. take up agency (Alkire et al., 2013).

Model VI: Workload

The workload represents the number of hours a woman works daily. The data come from a 24-hour recall starting at 4:00 am the previous day, in which the participant explains what kind of activity or activities she or he did in every 15-minute period. *"The definition of work-related tasks includes wage and salary employment, own business work, farming, construction, shopping/getting service, fishing, weaving/sewing, textile care, cooking, domestic work, caring for children/adults/elderly, commuting, and traveling."* (Malapit et al., 2015) In the A-WEAI a higher burden of workload is regarded as being disempowering (Alkire et al., 2013).

Thus, six models related to the A-WEAI are estimated: The three indicators that contributed most to disempowerment for women - participation in agriculture (*Model IV*), leadership (*Model V)*, and workload (*Model VI)* –, the two sub-indices (*Model II and Model III)* and the A-WEAI (*Model I)* itself. I hypothesize that the coefficients of *Model I -V* should have a positive sign implying a positive association with nutritional outcomes whereas *Model VI* should be negatively related to the outcome variables.

Female Empowerment as Perceived Self-Determination

The last model that will be estimated turns to the subjective measure of *"feeling empowered"*:

Model VII: Self-Perception

An option for assessing self-perceived control over one's life is the answer to a self-assessment. This approach has not been used for examining the link between female empowerment and nutrition before. In the *ANGeL* questionnaire one question asked the participant: *"Please imagine again a nine-step ladder, where on the bottom, the first step, are those who are totally unable to change their lives, while on step 9, the highest step, stand those who have full control over their own life. On which step are you?"*. This variable indicates how much control a person believes to have over one's life on a scale from zero to nine. The variable will be purposively treated as a continuous variable. Following the ideas of Roy et al. (2015), we expect to see a positive association between perceived self-determination and nutritional outcome.

c) Controls

Individual characteristics like age and years of education are included unchanged after examining the functional form. They reflect the degree of experience a woman has in providing and serving adequate nutritious food. I expect that with increasing education and age, dietary diversity increases. Both variables are also closely linked to female empowerment and should be controlled for because education and age improves women's social capital providing more choices available to her and more respect for her independent decision-making (Alkire et al., 2013; Doss, 2013).

For household level characteristics, only the distance to market remains in its original form. This variable reflects the market access and so the availability of food for consumption that has not been produced within the household. As Bangladesh is densely populated and has a relatively well-developed infrastructure, I expect the effect to be absent.

Another control variable, the area of cultivated land, is log transformed, and should be positively correlated with the nutritional outcome, as greater areas of cultivation increase the opportunity to either generate money to buy nutritious food from the markets or to cultivate products for own consumption in abundance.

Otherwise, if no additional labor is hired, a larger amount of cultivated land implicates a higher workload for the farming family. Thus, women engaged in the homestead might increase their working hours to a level that would characterize them as disempowered.

Instead of including household expenditure, the households are split into terciles because the three groups have different attitudes and behaviors regarding nutrition and empowerment. Poor households' primary objective is to acquire enough calories, not dietary diversity. When a certain income level is reached, households consume more diverse foods. Hence, I hypothesize that being in the poor or medium income group will have a negative association with dietary diversity. The richest tercile is excluded and serves as reference category. Another reason to control for income is that higher income grants women more options from which they could choose and use their independent decision-making (Alkire et al., 2013; Doss, 2013). I expect that different income groups will have different nutrition objectives and different levels of social capital.

The last included control variable is the dependency ratio because this allows to include the information of both, the number of household members and the number of dependents. Otherwise, it would be impossible in this sample due to collinearity. Dependents are all those household members below 15 and above 64 that are assumed to no longer be actively contributing to the household income. As a higher ratio implies that more family members rely on fewer income producers, less income per capita should be available for purchasing food items. The dependency ratio should have a negative association with dietary diversity.

All models are estimated with fixed effects on the district level because within Bangladesh there is variability in agro-ecology and other social as well as economic determinants. . Each of the 16 districts include between 28 and 227 observations. Using lower geographic levels is not feasible as the size of the clusters becomes more unbalanced and the number of observations within clusters decreases drastically.

4 Results

Before the regression results will be discussed, I will present an overview of household and individual level characteristics of the sample. These insights in the context are the base for the analysis.

a) Summary Statistics

The sample for the analysis consists of 1,853 female observations. These households are subject to the household level summary statistics. For the individual characteristic, I will compare the 1,853 female observations to 1,765 male observations that have been selected in the same manner as the female observations: completed A-WEAI for male and female participants of the same household in the survey, answer for self-perception of empowerment, and available data for male and female dietary diversity.

Household Characteristics

An average household of this sample has 5.66 total household members and 2.5 dependents (Table 2). The closest shop is on average 0.55 kilometers away from the household, markets 1.93 kilometers, and the closest town 9.03 kilometers. A household operates on average 0.49 acres of cultivable land. One household spends around USD 51 per capita[1] per month on average and of that USD 33 on food. That implies that our sample consists of rural and mostly poor marginal or small-holder farmer families that are well connected to markets.

[1] The exchange rate Taka to USD is assumed to be 0.01261 according to OANDA for the time period January to December 2015 ("Average Exchange Rates | OANDA,"2017.).

Table 2: Household Characteristics

Household Characteristics

	N	Mean	sd
Control Variables			
I Demographics			
Total number of household members	1885	5.66	2.09
Total number of dependents	1885	2.50	1.24
Distance to the closest shop (in kilometers)	1879	0.55	0.81
Distance to the closest market (in kilometers)	1878	1.93	1.94
Distance to the closest town (in kilometers)	1862	9.03	6.63
II Involvement in Agriculture			
Operated cultivable land (in Acre)	1885	0.49	0.46
Own operated land (in Acre)	1230	0.81	0.96
Not owned operated land (in Acre)	1300	0.85	0.98
III Income			
Assets brought into marriage (in Taka)	1853	46206	65301
Per capita total expenditure per month (in Taka)	1885	4057	2056
Per capita nonfood expenditure per month (in Taka)	1885	1697	1201
Per capita food expenditure per month (in Taka)	1885	2607	1392

Source: 2015/2016 Baseline Survey for ANGeL Evaluation, IFPRI

Individual Characteristics

As this study is mainly using female observations for further analysis, individual characteristics of the household members are reported not only by household but also disaggregated by gender. To examine possible significant differences between the means of women and men, t-tests are conducted. Average age and education differ significantly from each other: women are on average ten years younger and went to school about 1.5 years longer (Table 3). The higher education level of women might derive from the many schemes supporting female education in Bangladesh.

In terms of dietary diversity, a household consumes on average 5.36 out of possible nine food groups with no significant difference of means of male and female participants but slightly lower scores for women.

Female respondents have an empowerment score of 0.61 on average and an empowerment gap of 0.14. In the 5DE women reach 0.67 and men 0.66, however, the standard deviation of female empowerment scores is higher indicating larger variability. Looking at the first dimension of the 5DE participation in agriculture,

women usually participate on average in 3.74 activities and men in 4.87. Regarding dimension two, ownership and access to credit, female respondents own 4.22 productive goods and have access to 0.57 credit sources about which they make joint or own decisions. Men own on average 7.68 productive goods and have access to and make decisions about 0.98 credit sources jointly or on their own. Female interviewees make on average 5.48 own or joint decisions in agriculture and male respondents 6.83. In the next dimension, group participation, women engage in less groups than men with 2.60 compared to 2.66. In the last dimension—time spent working—men spent on average 11.71 hours working per day and women 9.81 hours per day. Reasons for this high amount of time might be that the interviews had been mainly conducted in December, the harvesting season for Aman rice and sorghum, and the sowing season for potatoes, Boro rice, and wheat (FAO, 2016). All indicators of the dimensions have a significant difference between the mean values for women and men.

The values for the female observations are lower compared to the aggregate results of the A-WEAI pilot study in a sample of Bangladesh by Malapit et al. (2015) who record an average A-WEAI score of 0.84, 0.83 for the 5DE for women and 0.9 for men, and an average empowerment gap of 0.22. So, the sample of my study has overall lower empowerment levels but a narrower gap for female respondents to achieve empowerment relative to her male counterpart. The paper of Sraboni et al. (2014) also employs a sample from Bangladesh but constructs the WEAI, therefore, the results are not based on the exact same methodology but might still help to contextualize my findings. Sraboni et al. (2014) report the values on the individual level for only female observations. The average 5DE score lies at 0.67 for women and the gender parity gap at 0.17 on average. These values are like the findings in my study. Other reported indicators of the dimensions in the study by Sraboni et al. (2014) deviate too much in the construction of the WEAI and the A-WEAI and are thus not used for comparison.

Another independent variable for female empowerment, perceived self-determination, is based on self-report about the degree of which the respondent feels can make decisions over one's life: On a ladder from

zero to nine with nine being the level with highest decision-making power of his or her own life, women see themselves on average on step 3.91 and men on step 3.68. This is a significant difference.

Our sample shows that there are mostly significant differences between gender in the considered independent variables whereas dietary diversity is quite homogenous within the household.

Table 3: Major Dependent, Independent and Control Variables by Gender

Major Dependent, Independent and Control Variables by Gender

	Female			Male			Significant difference in means (Male-Female)	All		
	N	Mean	sd	N	Mean	sd		N	Mean	sd
Dependent Variables										
Dietary diversity score (incl 9 food groups)	1853	5.36	1.09	1756	5.37	1.12	0	3609	5.36	1.105
Independent Variables										
II Empowerment										
A-WEAI empowerment score	1853	0.61	0.19				n.a.	3609	0.61	0.17
Empowerment in DE5	1853	0.67	0.23	1756	0.66	0.15	0			
Empowerment gap	1853	-0.14	0.23				n.a.	3609	-0.14	0.23
Dimension 1: Participation in agriculture	1853	3.74	2.25	1756	4.87	1.85	1.13***			
Dimension 2a: Ownership	1853	4.22	2.51	1756	7.68	2.28	3.46***	3609	5.90	2.96
Dimension 2b: Access to credit	1853	0.57	0.77	1756	0.98	0.84	0.41***	3609	0.77	0.83
Dimension 3: Decision-making	1853	5.48	3.78	1756	6.83	2.00	1.35***	3609	6.14	3.12
Dimension 4: Group participation	1853	2.60	0.50	1756	2.66	0.48	0.06***	3609	2.63	0.49
Dimension 5: Time spent working	1853	9.81	2.37	1756	11.71	2.28	1.90***	3609	10.74	2.51
III Perceived Self-Determination										
Degree of self-reported power over own life	1853	3.91	1.50	1756	3.68	1.48	-0.28***	3609	3.78	1.49
Control Variables										
IV Individual Characteristics										
Age	1853	25.47	5.54	1756	35.457	11.05	9.99***	3609	30.33	10.00
Education	1853	6.47	3.25	1756	4.94	4.11	-1.53***	3609	5.73	3.77

Legend: *** p<0.001, ** p<0.05, * p<0.1; Source: 2015/2016 Baseline Survey for ANGeL Evaluation, IFPRI

b) Female Empowerment and Female Dietary Diversity

For the results of the OLS- regression, Table 4 to Table 7 show for each outcome variable the seven different models in the columns and the variables in the rows. The coefficient, the standard error in brackets, and the significance level represented by stars are reported. Additionally, model statistics like number of observations, F-statistic, and adjusted R-squared are presented at the end of the tables. Testing whether female empowerment is associated with the female dietary diversity score, none of the variables related to the A-WEAI has a significant relationship with female dietary diversity (Table 4). On the contrary, the perceived self-determination of empowerment has a significant and positive relationship with dietary diversity (Table 4). For every additional level of reported self-determination, the diet diversity score increases an average of 1.3 percentage points, ceteris paribus.

All control variables are at least significant on the five percent signficance level except age and distance to markets. Considering the control variables with the main predictor of the A-WEAI score, one more year of education is associated with on average a 0.8 percentage point increase in dietary diversity, ceteris paribus. A ten percent increase in the area cultivated is correlated with a rise of 0.3 percentage points on average in the WDD. When one family member becomes a dependent in a household of ten family members, this change would be associated with an average drop of one percentage point of dietary diversity holding everything else constant. A woman in the poorest wealth tercile and a woman in the medium wealth tercile are associated with a 5.9 percentage point or 3.8 percentage point lower dietary diversity score respectively than one in the richest tercile. The magnitude and the significance of the control variables remain stable across all other *Models II* to *VI* with slightly lower sizes of coefficients for *Model VII.*

Looking at features of the estimation model, the F-statistic is significant throughout on the one percent significance level and the adjusted R-squared performs for all around 0.06.

Compared to the A-WEAI, the results of perceived self-determination have greater empirical power. Only female empowerment measured as *"felt empowerment"* is significantly correlated with the dietary diversity

outcome. In contrast, control variables like education, cultivated land, dependency ratio, and income are significant predictors throughout the different models.

Table 4: OLS-Regression Results of Female Empowerment and Female Dietary Diversity

Female Empowerment and Female Dietary Diversity

	I A-WEAI	II 5DE	III Gender Parity	IV Participa-tion in Agricul-ture	V Leader-ship	VI Workload	VII Perceived Self-Determi-nation
A-WEAI empowerment score	-0.018						
	(0.024)						
Empowerment in DE5		-0.013					
		(0.020)					
Gender Parity Gap			0.004				
			(0.020)				
Dimension 1: Participation in agriculture				-0.002			
				(0.002)			
Dimension 4: Group participation					-0.001		
					(0.009)		
Dimension 5: Time spent working						-0.001	
						(0.002)	
Degree of self-reported power over own life							0.013***
							(0.003)
Age	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education (in years)	0.008***	0.008***	0.008***	0.008***	0.008***	0.008***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Dependency Ratio	-0.103***	-0.104***	-0.106***	-0.104***	-0.106***	-0.105***	-0.094***
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.036)
Log operated cultivable land (in Acre)	0.033***	0.033***	0.034***	0.033***	0.034***	0.034***	0.028***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Poorest Tercile	-0.059***	-0.059***	-0.058***	-0.059***	-0.058***	-0.058***	-0.056***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)

	I A-WEAI	II 5DE	III Gender Parity	IV Participa-tion in Agricul-ture	V Leader-ship	VI Workload	VII Perceived Self-Determi-nation
Medium Income Tercile	-0.038***	-0.038***	-0.037***	-0.038***	-0.037***	-0.037***	-0.036***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Distance to the closest market (in kilometers)	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	1.678***	1.676***	1.669***	1.672***	1.670***	1.674***	1.627***
	(0.033)	(0.033)	(0.031)	(0.031)	(0.039)	(0.036)	(0.032)
District Level Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1846	1846	1846	1846	1846	1846	1846
F-statistic	16.229	16.214	16.161	16.238	16.158	16.169	18.444
Adjusted R-squared	0.055	0.055	0.054	0.055	0.054	0.055	0.063

Legend: Standard errors in parentheses; *** p<0.001, ** p<0.05, * p<0.1 Source: 2015/2016 Baseline Survey for ANGeL Evaluation, IFPRI

c) Female Empowerment and Male Dietary Diversity

For the second outcome, male dietary diversity, I draw the same conclusion: A-WEAI related independent variables are not significant correlates whereas self-perception is. Magnitude and significance of the *"feeling empowered"* remain the same compared to female dietary diversity (Table 5).

Across the different models the control variables continue to be stable in terms of signs, magnitude, and significance. In comparison to the previous outcome variable, all control variables are now significant and the coefficient size is comparable. *Model I* is used again for describing the associations of the control variables. Under ceteris paribus, a ten-year older woman is associated with an average three percentage points increased male dietary diversity. An additional year of education is correlated with a rise of 0.7 percentage point in the male nutritional outcome. In the case of a family of ten where one of them becomes a dependent the male dietary diversity is associated with a 1.4 percentage point decrease all else equal. Doubling the amount of cultivated land is related to a three-percentage point increase in male diet diversity score. The poorest households and the medium income households have again a negative association 5.6 and 3.9 percentage point respectively with male dietary diversity compared to the richest income group. Distance to markets matters also for male nutrition; men's diet diversity score is associated with an eight-percentage point decrease for every ten kilometers a household is further away from the market on average. For *Model VII* the magnitudes are slightly lower or equal to the other models.

The F-test is again rejected and the level of the adjusted R-squared are even lower than before. Only female empowerment as self-perception has a positive association with male dietary diversity status supporting the result of the previous sub-section that the subjective female empowerment measure appears empirically stronger. However, the control variables seem to be stronger predictors of male nutritional status.

Table 5: OLS-Regression Results of Female Empowerment and Male Dietary Diversity

Female Empowerment and Male Dietary Diversity

	I A-WEAI	II 5DE	III Gender Parity	IV Participa-tion in Agricultur e	V Leader-ship	VI Workload	VII Perceived Self-Determi-nation
A-WEAI empowerment score	-0.014						
	(0.027)						
Empowerment in DE5		-0.011					
		(0.022)					
Gender Parity Gap			-0.001				
			(0.022)				
Dimension 1: Participation in agriculture				-0.001			
				(0.002)			
Dimension 4: Group participation					-0.007		
					(0.010)		
Dimension 5: Time spent working						0.003	
						(0.002)	
Degree of self-reported power over own life							0.013***
							(0.004)
Age	0.003***	0.003***	0.003***	0.003***	0.003***	0.003**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education (in years)	0.007***	0.007***	0.007***	0.007***	0.008***	0.007***	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Dependency Ratio	-0.143***	-0.143***	-0.145***	-0.144***	-0.146***	-0.144***	-0.134***
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)
Log operated cultivable land (in Acre)	0.030***	0.030***	0.030***	0.030***	0.030***	0.030***	0.025***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Poorest Tercile	-0.056***	-0.056***	-0.055***	-0.056***	-0.055***	-0.055***	-0.052***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)

	I A-WEAI	II 5DE	III Gender Parity	IV Participa-tion in Agricultur e	V Leader-ship	VI Workload	VII Perceived Self-Determi-nation
Medium Income Tercile	-0.039***	-0.039***	-0.039***	-0.039***	-0.038***	-0.039***	-0.037***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Distance to the closest market (in kilometers)	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	1.666***	1.665***	1.659***	1.662***	1.677***	1.633***	1.618***
	(0.037)	(0.037)	(0.035)	(0.035)	(0.044)	(0.040)	(0.036)
District Level Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1846	1846	1846	1846	1846	1846	1846
F-statistic	12.881	12.876	12.844	12.880	12.906	13.061	14.588
Adjusted R-squared	0.042	0.042	0.041	0.042	0.042	0.042	0.048

Legend: Standard errors in parentheses; *** p<0.001, ** p<0.05, * p<0.1; Source: 2015/2016 Baseline Survey for ANGeL Evaluation, IFPRI

d) Female Empowerment and Average Household Dietary Diversity

For the third nutritional outcome, the average household dietary diversity, I hypothesize that female empowerment has a positive association on average household dietary diversity. Perceived self-determination retains the same size, significance, and magnitude as for the previous two nutritional outcomes and surpasses A-WEAI related indicators again considering empirical power (Table 6). All A-WEAI related variables are statistically insignificant with similar magnitudes as for the two other dietary diversity outcomes.

All control variables have similar coefficients as for female and male dietary diversity and are significant on the one percent significance level apart from age and distance to markets. Only for A-WEAI related models distance of markets and age are significant at the five percent and at the ten percent significance level respectively. In *Model VII* age is not significantly correlated with the average household dietary diversity. The magnitude of the control variables is also either equal or slightly smaller than in the other reported models.

Regarding the power of the models, the adjusted R-squared has a low level and the F-test could be rejected. Sraboni et al. (2014) also estimated the association between the 5DE and the per capita dietary diversity in Bangladesh. Their F-statistics for the OLS-Model is like the one here, 17.980, however, the reported adjusted R-squared is much higher, 0.168.

Table 6: OLS-Regression Results of Female Empowerment and Average Household Dietary Diversity

Female Empowerment and Average Household Dietary Diversity

	I A-WEAI	II 5DE	III Gender Parity	IV Participa-tion in Agricul-ture	V Leader-ship	VI Workload	VII Perceived Self-Determi-nation
A-WEAI empowerment score	-0.016						
	(0.023)						
Empowerment in DE5		-0.012					
		(0.019)					
Gender Parity Gap			0.005				
			(0.019)				
Dimension 1: Participation in agriculture				-0.001			
				(0.002)			
Dimension 4: Group participation					-0.002		
					(0.009)		
Dimension 5: Time spent working						0.000	
						(0.002)	
Degree of self-reported power over own life							0.013***
							(0.003)
Age	0.002*	0.002*	0.002*	0.002*	0.002*	0.002*	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education (in years)	0.008***	0.008***	0.008***	0.008***	0.008***	0.008***	0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Dependency Ratio	-0.108***	-0.108***	-0.110***	-0.108***	-0.110***	-0.109***	-0.098***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.034)	(0.034)
Log operated cultivable land (in Acre)	0.031***	0.031***	0.032***	0.031***	0.032***	0.032***	0.027***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Poorest Tercile	-0.061***	-0.061***	-0.061***	-0.061***	-0.061***	-0.061***	-0.058***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)

	I A-WEAI	II 5DE	III Gender Parity	IV Participa-tion in Agricul-ture	V Leader-ship	VI Workload	VII Perceived Self-Determi-nation
Medium Income Tercile	-0.039***	-0.039***	-0.038***	-0.039***	-0.038***	-0.038***	-0.037***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Distance to the closest market (in kilometers)	-0.005**	-0.005**	-0.005**	-0.005**	-0.005**	-0.005**	-0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	1.677***	1.675***	1.669***	1.671***	1.673***	1.665***	1.628***
	(0.031)	(0.031)	(0.030)	(0.030)	(0.037)	(0.034)	(0.031)
District Level Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1846	1846	1846	1846	1846	1846	1846
F-statistic	17.448	17.432	17.388	17.432	17.386	17.386	19.734
Adjusted R-squared	0.059	0.059	0.059	0.059	0.059	0.059	0.068

Legend: Standard errors in parentheses; *** p<0.001, ** p<0.05, * p<0.1; Source: 2015/2016 Baseline Survey for ANGeL Evaluation, IFPRI

e) Female Empowerment and Dietary Diversity Ratio

The last outcome I examine in this study is the dietary diversity ratio that indicates the magnitude of the gap between the diet diversity scores of men and women. I hypothesize that female empowerment shifts the dietary diversity ratio in favor of female nutritional status compared to men. Of all independent variables derived from the A-WEAI only workload has a statistically significant association: On average, one hour increase in female work is associated with a five-percentage point gain in nutritional status of men compared to women under ceteris paribus. The female empowerment measure based on self-report is not significant.

The only significant control variable is distance to market, which is negatively associated with the dietary diversity ratio, implying that on average for every additional kilometer a household is farther from the market, women see a 1.1 percentage point gain on diet diversity compared to men, all else equal. This holds for all seven models.

The F-test including the district fixed effects holds and the adjusted R-squared does not suggest any explanatory power of these models. The empirical power of the workload related indicator of the A-WEAI has larger empirical power than the reported self-determination. However, distance to market has an even greater association with the dietary diversity ratio in size and significance.

Table 7: OLS-Regression Results of Female Empowerment and Dietary Diversity Ratio

Female Empowerment and Dietary Diversity Ratio

	I A-WEAI	II 5DE	III Gender Parity	IV Participa-tion in Agricul-ture	V Leader-ship	VI Workload	VII Perceived Self-Determi-nation
A-WEAI empowerment score	-0.012						
	(0.027)						
Empowerment in DE5		-0.010					
		(0.022)					
Gender Parity Gap			-0.015				
			(0.023)				
Dimension 1: Participation in agriculture				-0.000			
				(0.002)			
Dimension 4: Group participation					0.001		
					(0.010)		
Dimension 5: Time spent working						0.005**	
						(0.002)	
Degree of self-reported power over own life							-0.001
							(0.004)
Age	0.002	0.002	0.002	0.001	0.001	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Education (in years)	-0.000	-0.000	-0.000	-0.000	-0.000	-0.001	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Dependency Ratio	-0.049	-0.049	-0.049	-0.050	-0.050	-0.049	-0.051
	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)	(0.041)
Log operated cultivable land (in Acre)	0.002	0.002	0.002	0.002	0.003	0.002	0.003
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Poorest Tercile	0.002	0.002	0.002	0.002	0.002	0.003	0.002
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)

	I A-WEAI	II 5DE	III Gender Parity	IV Participa-tion in Agricul-ture	V Leader-ship	VI Workload	VII Perceived Self-Determi-nation
Medium Income Tercile	-0.000	-0.000	-0.000	-0.000	0.000	-0.001	-0.000
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Distance to the closest market (in kilometers)	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***	-0.011***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	0.007	0.007	-0.002	0.002	-0.000	-0.049	0.005
	(0.038)	(0.037)	(0.035)	(0.035)	(0.044)	(0.040)	(0.037)
District Level Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1846	1846	1846	1846	1846	1846	1846
F-statistic	2.308	2.312	2.342	2.287	2.285	3.063	2.298
Adjusted R-squared	-0.002	-0.002	-0.002	-0.003	-0.003	0.001	-0.003

Legend: Standard errors in parentheses; *** p<0.001, ** p<0.05, * p<0.1; Source: 2015/2016 Baseline Survey for ANGeL Evaluation, IFPRI

5 Discussion

The findings for the four different outcomes are in line with results of previous studies. Sraboni et al. (2014) notice examining the effects of female empowerment on BMI: *"Most of the indicators for women's empowerment do not have any significant impact on adult BMI, suggesting that other factors, such as household wealth, education, and occupation, are more important determinants of adult male and female nutritional status."* The results of my study also show that for the outcomes -women's, men's, and an average household member's nutritional status - variables like education, dependency ratio, operated cultivated land, and income have greater empirical power than the female empowerment variables. These control variables are significant associates across all three nutrition outcomes. Other included control variables like female age and market distance have significant relations only for male and average household member dietary diversity indicating that women's nutritional status does not depend on market distance or age.

Female empowerment is not only beneficial for an increase of nutritional status of different household members but also to increase the relative nutritional status of women to men. As the comparison of means between female and male nutritional status suggests a lower dietary diversity score for women, a relative gain might be a mere catch-up. However, with increasing size the female gain might harm male nutritional status. The female empowerment measures are mostly insignificant indicating no change between male and female nutritional status due to female empowerment. Only the A-WEAI related indicator regarding work burden in hours worked per day is positively associated with male gains in the nutritional status. The only other significant correlate with the dietary diversity ratio is distance to market: further distance is related to a female nutritional gain.

Considering the difference in empirical power between the perceived self-determination and the A-WEAI related variables, the subjective measure has significant association for the dietary diversity of female, male, and average household member whereas the A-WEAI related variables only show a significant correlation with the dietary diversity ratio. This indicates that the self-reported measure appears to possess greater

empirical power even though it does not account for multidimensionality or equity like the A-WEAI. However, the question used for the construction of this variable has not been tested before in this context and could have been easily biased by the earlier questions of the interviewer or by the presence of other household members during the survey.

One major caveat of the A-WEAI results is that the presented models do not account for endogeneity but are pure OLS regressions. Other authors who used the WEAI and related variables achieved significant association with nutritional outcomes after employing instrumental variable techniques. Some of these studies even achieved significant relations with pure OLS regressions. This raises the question whether the modifications of the A-WEAI decrease its empirical power for statistical analysis. For example, Sraboni et al. (2014) estimate an OLS regression with the 5DE based on the WEAI and find a significant association with household level dietary diversity. Unfortunately, this study cannot compare its results to other studies employing the A-WEAI as there are not any available. So, employing instrumental variable techniques are the next steps to identify possible obstacles preventing the A-WEAI to unfold its explanatory power.

Another limitation of the A-WEAI is the restriction of the sample: Only if both woman and man are active in agriculture, this index allows to make comparisons. So, the sample itself might be biased because only people remaining in agriculture without other job opportunities are represented. Often people with low human capital or income are those who are not able to change the carrier paths and stay farmers. Thus, inference for all rural areas in Bangladesh is not possible because only a sub-group is studied.

6 Conclusion

This study wanted to examine in greater detail whether female empowerment is associated with nutritional status within the household. I hypothesized that greater female empowerment would increase female, male, and average household member nutritional status as well as the dietary diversity ratio between female and male household members. To incorporate findings about contradictions between perception and more objective measures of empowerment, I used both the domain specific and multidimensional A-WEAI and

the subjective variable of perceived self-determination of one's life. I expected the A-WEAI related variables to have greater empirical power than *"felt empowerment"*.

For female, male, and average nutritional status female empowerment as perceived self-determination is a positive and significant correlate that remained stable, i.e. an additional step on the self-autonomy ladder is on average related to an increase of 1.3 percentage points in dietary diversity. However, just like Sraboni et al. (2014), control variables seem to have strong correlations. Education, dependency ratio, operated cultivated land, and income are significant associates across all three models. Female age and market distance have significant relations only for male and average household member dietary diversity indicating that women's nutritional status does not depend on market distance or age. For the last considered nutritional outcome, only the A-WEAI related indicator regarding work burden in hours worked per day is positively associated with male gains in the nutritional status. The only other significant correlate with the dietary diversity ratio is distance to market: further distance is related to a female nutritional gain. Consequently, female empowerment is associated with an increase for female, male, and average household member as well as an increase in the dietary diversity ratio in favor of women.

The second objective of this study was to compare two different measures of female empowerment, variables related to the multidimensional and domain specific A-WEAI and *"felt empowerment"*. In the outcomes related to nutritional status of household members, perceived self-determination always provides a significant correlate, whereas the A-WEAI in terms of the indicator workload has one significant association. This indicates that the self-reported measure appears to possess greater empirical power even though it does not account for multidimensionality or equity. This is an issue that should be considered more thoroughly in future. If a short question about self-determination was a better measure of empowerment than a multidimensional index assessed via an intensive questionnaire, there could be significant savings in money and time for future surveys. However, there are some caveats regarding the A-WEAI results because the models do not account for endogeneity via simultaneity and the A-WEAI itself has not been widely used for regression analysis. It might be less suitable when the WEAI.

This study shows that female empowerment as measured by multidimensional indices such as the A-WEAI are less empirically powerful than indicators that assess a woman's "feeling" of empowerment. This has practical policy implications to fight the roots of the Asian Enigma because it stresses that using only one index of female empowerment like the A-WEAI might not be sufficient to capture empowerment. Additionally, the A-WEAI assumes that both household head and spouse are working in agriculture. This assumption should be questioned, given the high number of female participants without a completed male questionnaire (30 percent of the sample) for this study, suggesting different occupation fields. Performance indicators for interventions aiming at increasing female empowerment should consider also measuring *"felt empowerment"* in addition to the multi-dimensional A-WEAI to better reveal the impacts of empowerment on desired outcomes such as intra-household nutritional status.

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