Women empowerment in agriculture and human capital investments within the family

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Table of Contents

List of Figures

List of Tables

1 Introduction

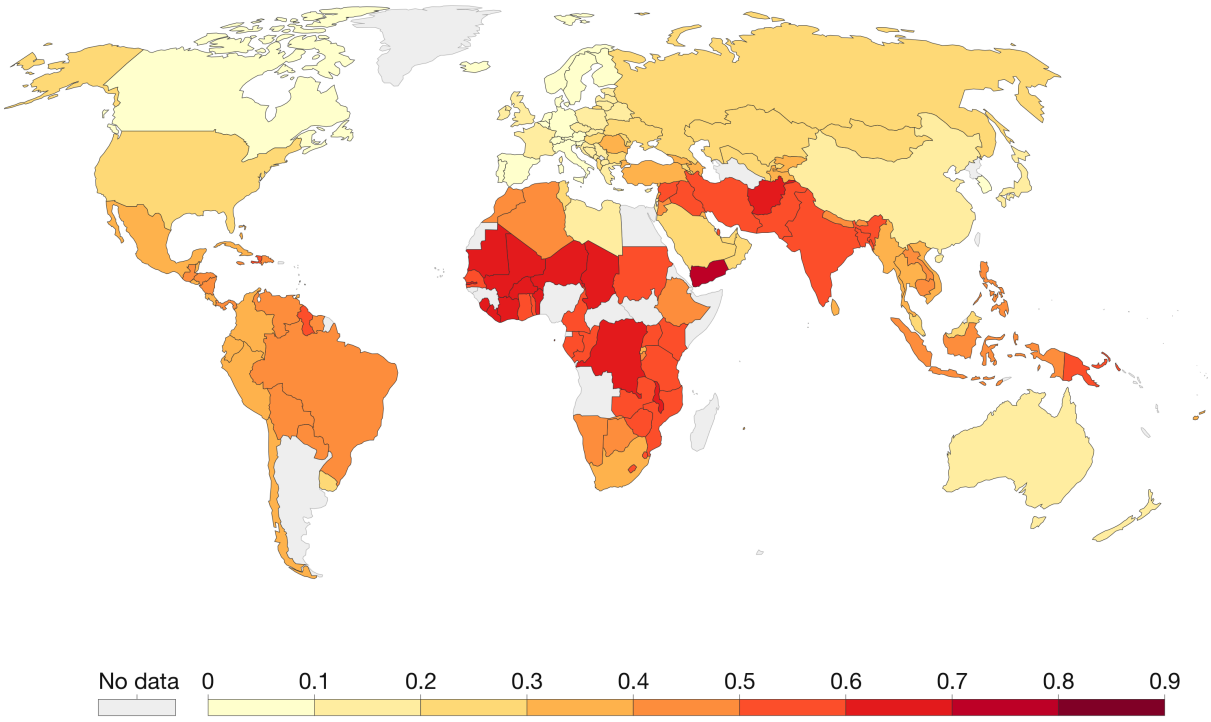
"'All lives have equal value' is not just a principle; it's a strategy. You can create all kinds of new tools, but if you're not moving toward equality, you're not really changing the world. You're just rearranging it." — Bill & Melinda Gates

The world is a better place for women to live in today than it was in the past. Representation of women in national parliaments, on an average, has increased from 19% in 2010 to 24.3% in 2019 (UN 2019), child marriages of girls have reduced by over 40% since 2000 (UN 2019). However, women still remain vulnerable in most arenas. Women are 4% more likely to live in extreme poverty than men and had 10% greater risk of food insecurity than men in 2018 (UN Women 2019). Some of the root causes for not being able to achieve the Gender Equality (Sustainable Development Goal 5) include discrimination in legal, social and decision-making spheres (UN Women 2019).

The main aim of this paper is to study the potential consequences of empowering women in decision-making spheres within households. Data from 51 countries shows that only 57% of the married women (15-49 years) make their own decisions regarding reproductive health and sexual relations (UN Women 2019). There is a need to empower women to be able to make their own decisions. This not only impacts their own well-being by providing basic human rights but also has a ripple effect on their families, communities and economies as a whole.

There is vast literature showing how empowering women leads to their own well being. Households in which women who are empowered are associated to have better health functioning, both physically and mentally (Mabsout 2011; Pennington et al. 2018) and have higher dietary diversity (Amugsi et al. 2016; Khandoker et al. 2021; Quisumbing et al. 2021; Islam et al. 2018). Existing literature also suggests it improves the well-being of their families by improving production diversity of the household (Islam et al. 2018; Sariyev et al. 2021) and household dietary diversity (Islam et al. 2018;

Figure 1.1: Gender Inequality Index from the Human Development Report, 2015



Source: Ortiz-Ospina et al. 2018

Sariyev et al. 2020b; Sraboni et al. 2014).

Figure 1.1 shows the gender inequality across countries (higher score refers to greater inequality). The countries with greater gender inequality also happen to be some of the least developed. Despite the economic growth in South Asian countries, chronic malnutrition among children remains quite high. This phenomenon is attributed as "Asian Enigma" where it is believed "women's low status relative to men in terms of their ability to control decisions about resource allocation, their own bodies, and their children" (Haddad 2015) is having an impact on the nutritional status of the children.

Women stand at the nexus of providing care, generating income and are critical for achieving development goals (Duflo 2012; Mehra 1997). Current literature has found positive association between women empowerment and child well-being outcomes. When women are empowered, their children are more likely to survive (Stiyaningsih et al. 2017), have better nutritional status (Holland et al. 2019; Malapit et al. 2019; Nuhu 2015; Richards et al. 2013), have higher dietary diversity (Sariyev et al. 2020a), have better schooling (Afoakwah et al. 2020; Malapit et al. 2019; Saleemi et al. 2022) and have more financial investments in human capital (Kandpal et al. 2019; Sariyev et al.

2020a).

Human capital requires investment in education, health, nutrition, job opportunities and training (Schultz 1961). This improves the knowledge and skill sets making humans productive assets to the society. This paper deals with the role of women empowerment in human capital investments in Bangladesh. With this regard, I chose to analyze the following outcomes: nutritional status of children (anthropometric measures and dietary diversity of children) and financial investments in human capital (household annual expenditure in education, technology and hobbies). I hypothesize that improvement in the status of women has a positive impact on all of the above mentioned outcomes. The stated associations are examined using the latest cross-sectional data from Bangladesh Integrated Household Survey (2018) which is the national representative survey of rural households of Bangladesh.

There is a vast amount of existing literature on linkage between women empowerment and the household well-being in Bangladesh and most of them use the baseline survey data (2011) of Bangladesh Integrated Household Survey. This paper tries to fill the literature gap by using the latest data from Bangladesh and focusing on children's well-being - not just their nutritional status but also financial investments in human capital. Also, most of the existing literature is associative and does not provide enough evidence of causal links, which this paper tries to establish. The results suggest that women empowerment does have a significant impact on the children's nutritional status as well as the household investments in human capital.

The following sections provide further details about the conceptual framework (section 2), how the empowerment of women is measured (section 3), the empirical specification (section 4), data (section 5) and variables used (section 6) and the findings of this paper (section 7).

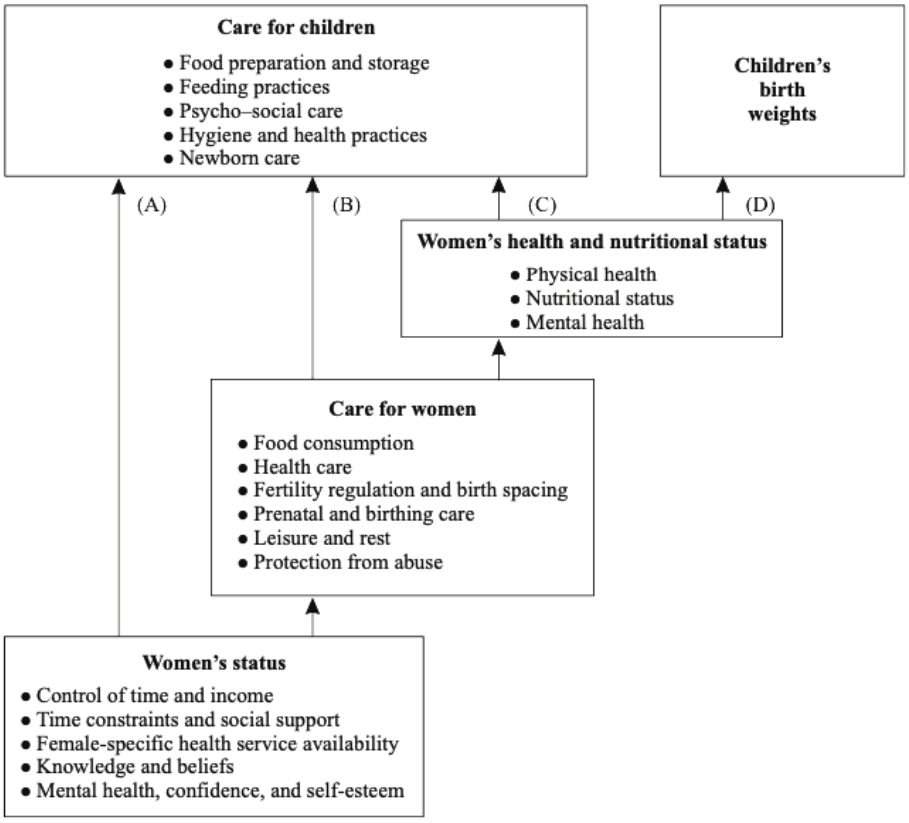
2 Conceptual Framework

Gender relations are defined as "the ways in which a culture or society defines rights, responsibilities, and the identities of men and women in relation to one another" which affect various aspects such as family well-being, planning and production (Bravo-Baumann 2000). Gender relations do not just depend on what the culture or society defines but also on each of our innate qualities such as behavioral patterns and personality traits. Gender relations keep changing from time to time and from place to place making it complex to generalize. Preferences within a household are affected by these gender relations. Hence it would be unfair to assume that all the members of the household have the same set of preferences which the unitary model of household suggests. Assuming that men and women have different preferences, depending on their level of bargaining power within the households, they are able to influence the intra-household allocation of resources (Alderman et al. 1995a; Behrman 1997; Quisumbing et al. 2000). Agarwal 1997, in her paper lists some of the factors that determine a person's bargaining power within the family. This includes control over assets, access to employment, access to communal resources, access to social support systems and social perceptions and norms.

It is evident from the psychological perspective that men and women in the process of evolution have faced different situations that threatened their survival and hence have different thinking mechanisms (Bjorklund et al. 1999). Men and women have differences in the time, effort and resources they put into mating and parenting. Compared to males, female species spend more time in the reproduction process. A study by Geary 1998 has found that men, relative to women, spend less time caring and interacting with their children across different cultures. There are also empirical studies that show that men favour spending money for their personal items while women favour spending money on goods for general consumption in the household (Jan Pahl 1989; Pahl 2000; Goode et al. 1998; Nyman 1999).

Given that there are these differences, I hypothesize that women strive more for the survival and well-being of their children. However, this would only be possible if women have access to "resources (preconditions), agency (autonomy) and achievements (outcomes)" (Kabeer 1999). Kabeer 1999 defined empowerment as "expanding people's ability to make strategic life choices, particularly in contexts in which this ability had been denied to them." Kabeer 1999 states that agency has a direct effect on their empowerment relative to other two channels. Agency is nothing but autonomy in decision-making. When women have autonomy in decision making within a household, they have more bargaining power and their preferences influence the intra-household resource allocation and I hypothesize that this has a positive impact on the child outcomes.

Figure 2.1: Conceptual framework linking women empowerment with child wellbeing



Source: Smith et al. 2003

In many cultures, women are at the nexus of providing care and maintaining the households. Figure 2.1 shows that women's status has a direct effect on the quality of child care received (Arrow A) and indirectly through care for their own selves (Arrow B and C). It not only effects the quality of care received by the child but also the nutritional status (measure by child birth weights) through Arrow D.

3 Measuring Empowerment

Empowerment is multidimensional in nature and there is no direct way of measuring it. So far, there are many proxies used to measure empowerment in the literature such as mobility, household purchases, access to health care, asset ownership, income earned, leadership (Malapit et al. 2015; Deutsch et al. 2017; Jones et al. 2019; Alaofè et al. 2017). Following the definition of Kabeer 1999, a proxy that is developed in recent times that takes into account the agency of women in different arenas is the Women Empowerment in Agriculture Index (WEAI). The index was developed within the Feed the Future project (*WEAI Resource Center* 2012) using five major domains (5DE) to measure empowerment in the agricultural sector.

Table 3.1: Measuring Women Empowerment using 5DE

Domain	**Indicator**	**Weight**
Production	Input in productive decisions	1/10
	Autonomy in production	1/10
Resources	Ownership of assets	1/15
	Purchase, sale or transfer of assets	1/15
	Access to and decisions about credit	1/15
Income	Control over use of income	1/5
Leadership	Group member	1/10
	Speaking in public	1/10
Time	Workload	1/10
	Leisure	1/10

Source: Alkire et al. 2013

Each of the domains have specific indicators to measure them (table 3.1). To calculate the 5DE score of each woman, all the indicators are aggregated using the weights assigned to them (each domain is given equal weight) (Alkire et al. 2013). In this paper, I use the 5DE score as proxy for women empowerment where higher score refers to more empowerment.

4 Empirical Specification

In equation 4.1, child well-being outcomes are expressed as a linear function of 5DE score of the primary woman respondent in a household, individual characteristics, household characteristics and geographic characteristics.

$$C_{ij} = \beta_0 + \beta_1 E_{fj} + \beta_2 I_{ij} + \beta_3 H_j + \beta_4 D_j + \epsilon_{ij} \tag{4.1}$$

C_{ij} is a vector of child well-being outcomes for child i in household j. These include nutritional measurements such as HAZ (height-for-age z score), WAZ (weight-for-age z score) and dietary diversity. E_{fj} stands for the 5DE score of primary female respondent f in household j; I_{ij} is a vector of individual characteristics of child i in household j; H_j is a vector of household level characteristics; D_j stands for the division each household belongs to and enters the equation as division fixed effects; ϵ_{ij} is the error term. Equation 4.1 is estimated by the OLS method. However there is possible bias due to endogeneity. As put forward by Sraboni et al. 2014, empowerment could be affected by similar factors that affect the outcome variables. To overcome this problem, instrumental variables are used.

$$Investment_j = \alpha_0 + \alpha_1 E_{fj} + \alpha_2 H_j + \alpha_3 D_j + \varepsilon_j \tag{4.2}$$

Apart from the nutritional status of children, I also estimate the effect of women empowerment on the annual financial investment at household level in human capital using both OLS and 2SLS methods (equation 4.2). $Investment_j$ stands for annual expenditure in human resources by household j; E_{fj} stands for the 5DE score of primary female respondent f in household j; H_j is a vector of household level characteristics; D_j stands for the division each household belongs to; ε_j is the error term.

5 Data

Bangladesh is a country with a high number of children suffering with malnutrition and has not been on track of meeting the targets of World Health Assembly (Development Initiatives 2018). Bangladesh, like many other South Asian countries, has deeply rooted patriarchal value system in its culture where women are given the subordinate status (Ahmed 1981). Given this context, it is interesting to look at how improving the status of women, in terms of their agency, improves child well-being.

I use the cross-sectional data of Bangladesh Integrated Household Survey (BIHS) conducted between November 2018 and May 2019 for this study. BIHS is a national, rural representative survey with representation from all the main seven administrative divisions of Bangladesh. It is designed and supervised by the International Food Policy Research Institute. BIHS is the most comprehensive survey that has ever been administered in Bangladesh which captures data of various dimensions ranging from poverty, food security to agricultural development. The Women Empowerment in Agriculture Index (WEAI) developed as a part of Feed for Future project was also first piloted in Bangladesh as a part of BIHS in 2011.

The raw data used in this study can be accessed from Harvard Dataverse website (IFPRI 2020). To create the 5DE score, all the instructions are followed using the guides provided in the *WEAI Resource Center* 2012. Data for WEAI module is collected for the primary male and female respondent in each household. For this study I only use the data collected for the primary female respondent to calculate the 5DE score. Data cleaning and analysis was done using Stata 16.1.

As part of BIHS 2018, 6011 households were surveyed. For the first outcome (anthropometric measures) the sample is restricted only to the households with children from 0-59 months while for the second outcome (dietary diversity), the sample is restricted to the households with children from 6-59 months.

6 Variables

6.1 Dependent variables

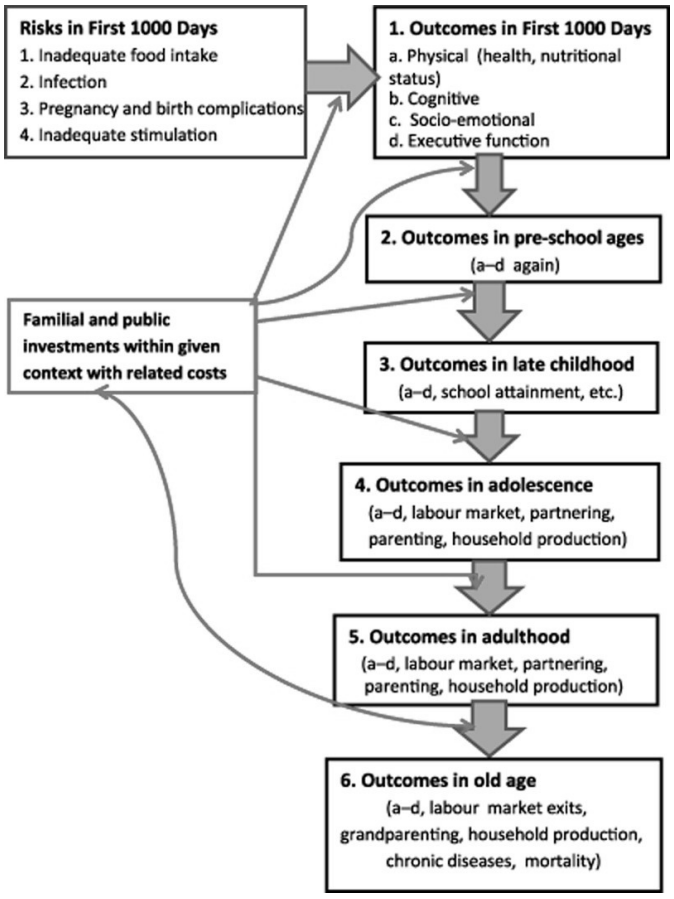
6.1.1 Anthropometric Measures

As of 2013, 42% of the children up to 5 years of age in Bangladesh are malnourished (measured by stunting levels) (BBS and UNICEF 2019). Anthropometric measures are often used as a proxy for understanding the nutritional status of the children. Anthropometric measures employed in this study are HAZ (height-for-age z scores) and WAZ (weight-for-age z scores). HAZ is a measure of stunting; it reflects if the child's height is too short for his/her age. WAZ is a measure of underweight; it reflects if the child is too thin for his/her age. Stunting and underweight not only have an effect on the physical health and cognitive development of the children but in the long run have an impact on their labour market outcomes (Hoddinott et al. 2013). WAZ reflects short-term nutritional status as it depends on the availability and access to food while HAZ reflects long-term nutritional status and is often used as an indicator of malnourishment. For both HAZ and WAZ, z scores less than or equal to -2 are considered as moderate underdevelopment and less than or equal to -3 are considered as high level of underdevelopment. In this analysis, anthropometric measures for children up to 5 years of age (0-59 months) are used as the outcomes. There are 2354 children between 0-59 months of age in the sample of this study and their average age is 29 months. Data on HAZ is available only for 2277 children, out of which 213 children (9.4%) have severe stunting (≤ -3). Data on WAZ is available only for 2281 children, out of which 111 children (4.9%) are severely underweight (≤ -3).

6.1.2 Dietary Diversity

Children after 6 months of age require additional nutrients for both physical and cognitive development. In addition to breast milk, children are recommended to be given complementary feeding to avoid them being vulnerable to malnutrition (WHO and UNICEF 2021). Following the guidelines of WHO and UNICEF 2021, the minimum dietary diversity score (MDDS) for children between 6-59 months of age is calculated. Minimum dietary diversity score is the aggregate of eight food groups: 1. Breast milk, 2. Grains, Roots and Tubers, 3. Pulses and Nuts, 4. Dairy products, 5. Meat, 6. Eggs, 7. Vitamin-A rich Fruits and Vegetables, 8. Other Fruits and Vegetables. The number of food groups consumed in the previous 24-hours of the survey was used to calculate the score for dietary diversity. Undernourishment in the early childhood leads to vitamin deficiencies in children which effects their immune system and makes them susceptible to diseases (UNICEF 2012). There are 2107 children between 6-59 months of age in the sample of this study. Out of this, the data to calculate MDDS is available only for 2047 children. The average MDDS of children in this study is 4.44 food groups.

Figure 6.1: A life-cycle approach to investments in the First 1000 Days



Source: Hoddinott et al. 2013

Hoddinott et al. 2013 in their paper came up with a framework (figure 6.1) that shows how care in the first 1000 days has an impact on child's life. Nutritional status of the child links to the human capital development and effects their labour market outcomes in the later stages of life. The major risks that a child could face are inadequate food intake, infection, complication in mother's health and inadequate stimulation (nurturing). As presented in figure 2.1, the care for children is directly impacted by the status of women and their health. Thus I hypothesize that when a women is empowered, she is able to take better care of herself and her children which will improve children's nutritional status (outcomes discussed in sections 6.1.1 and 6.1.2).

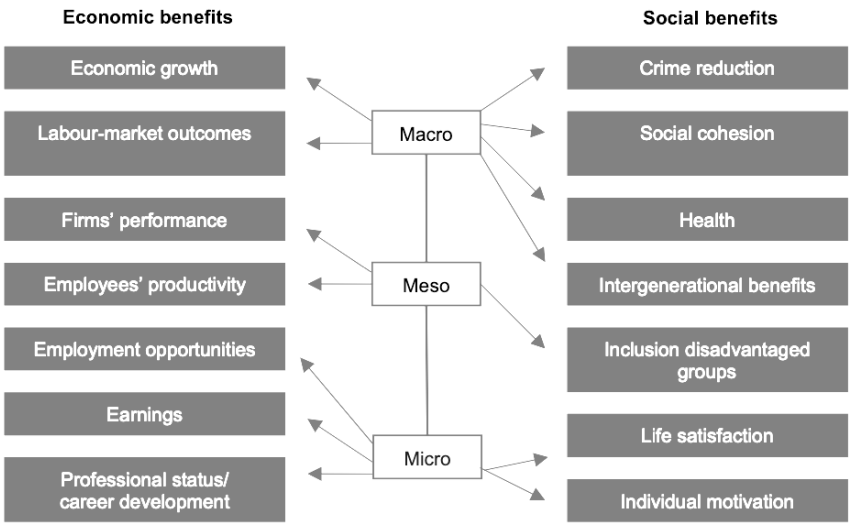
6.1.3 Financial investments in human capital

The final outcome that is investigated in this paper is the annual expenditure incurred by each household in human resources ($Investment_j$), which is decomposed as follows:

$$Investment_j = Education_j + Technology_j + Hobbies_j$$

$Education_j$ is the annual expenditure on school fees, exam fees, hostel expenses, school books and stationery of household j; $Technology_j$ is the annual expenditure on TV, radio and personal computer of household j; $Hobbies_j$ is the annual expenditure on books, newspapers, sporting expenses and club membership fees of household j. A log-linear model is used to look at the effect of women empowerment on investment in human resources of each household.

Figure 6.2: Social Economic benefits of education



Source: CEDEFOP 2011

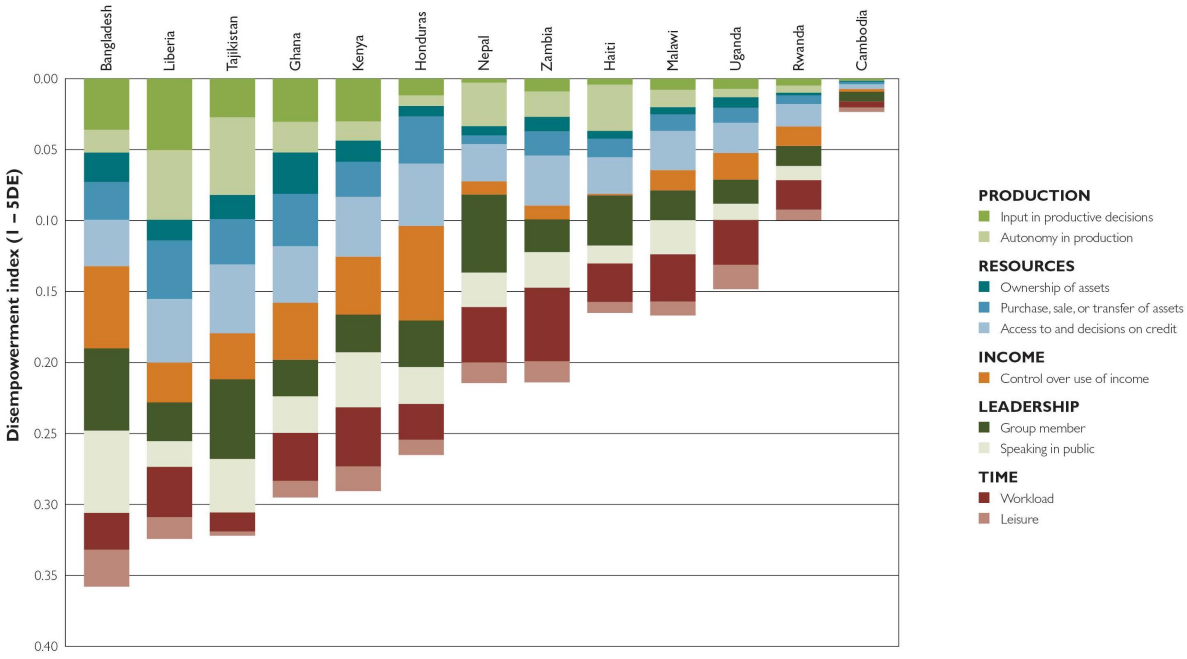
Figure 6.2 is a concise list of benefits that education provides. There has been extensive research done in the field of returns to education. Access to technology also has many socio-economic benefits like easy access to information and a platform for socialising and networking. Danyal et al. 2011 in their paper show that people with computer skills tend to earn higher wages. Technology has helped in changing the social norms regarding son preferences, domestic violence and fertility rates (Jensen et al. 2009; Ferrara et al. 2012). Jensen et al. 2009 also find that introduction of TV has increased the school enrollment rate as well as women's autonomy in decision-making. Jensen 2010 discusses about the perceived returns to education - providing information about the potential benefits of education leads to an increase in the years of education a person receives. In this regard, technology helps in shaping the perceptions of people, especially in rural areas, by disseminating useful information. Investments that are included as part of hobbies in this study provide with information (newspapers, books), help in personality development, maintain physical health (sports) and are also a platform for socialising (club memberships).

Policy makers view household as a single unit and that all its members have the same set of preferences (unitary model). Alderman et al. 1995b in their paper argue how such an assumption of the household behaviour is a peril. Traditionally, men being the bread winners of the family controlled the money while they delegated the task of managing it to the women (Jan Pahl 1989; Vogler et al. 1993). A study by Edgell 1980 showed that the infrequent and strategic financial decisions are taken by men while frequent and less important financial decisions such as spending on food and household items were left to the women in the household. Studies also showed that women spend more on purchasing for the household consumption while men spent more on their personal fancies (Jan Pahl 1989; Pahl 2000; Goode et al. 1998; Nyman 1999). A study by Lawson et al. 2009 shows that in UK, women are responsible for making three-quarters of their household expenditure on child-care, food and education. In a study by Reid 2007 that analysed the expenditure by gender across 35 countries showed that women spend more on food, healthcare, childcare and consumer durables. Assuming that preferences of men and women differ regarding household purchases, I hypothesize that when women have more bargaining power, they are able to influence the household resource allocation by having greater financial investments in human capital.

6.2 Key independent variable

In most South Asian countries, there is a strong preference for male children and daughters are looked upon as a liability. Patriarchal values dominate the social norms and women are given the subordinate status, rather than as an equal, in these countries (Ahmed 1981). One of the studies by the Feed the Future project showed that Bangladesh (using data from 2011-12) (figure 6.3) had the highest proportion of disempowered women among 13 countries where the project was launched.

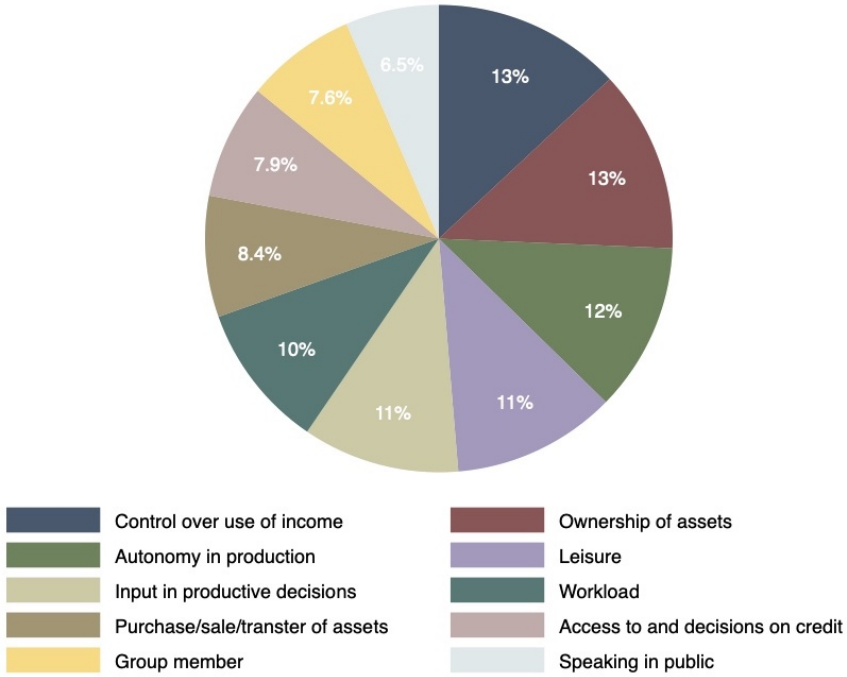
Figure 6.3: Disempowerment of women across 13 countries



Source: Malapit et al. 2014

The key independent variable in this study is the 5DE score which is an aggregate measure of ten indicators across five domains that capture the decision-making power of the primary female respondent in each household. The aim of this study is to find the impact on human capital outcomes when a woman's status in decision-making changes. Figure 6.4 is the decomposition of the 5DE score calculated for this study. The indicators that contribute least in the empowerment are public speaking and group membership, reflecting that women need to be proactive in leadership, which would help them strengthen their social support systems. Other indicators which contribute less towards empowerment are credit decisions and rights over assets.

Figure 6.4: Contribution of each indicator towards 5DE Score



6.3 Other independent variables

Anthropometrics are effected by two major factors: genetic and environmental factors (Silventoinen 2003). With regards to genetics, mother's height is controlled for in this study. Environmental factors that effect anthropometrics include access and usage of health care systems, hygiene and sanitation practices, availability and access to food, education level of the caregivers, income level of the household etc. With regards to environmental factors in which a child grows up, I have a controlled for if the child has a sibling less than six years of age (=1), years of education of the mother, dependency ratio of the household, log transformation of land operated by the household, occupation of the household head (=1 if trader), income tercile of the household and division dummy of the household. Dummy variables that signify the hygiene and sanitary practices that could affect the growth of the child (Chitty 2015) such as spotting of animal feces around the house, piped drinking water, sealed toilet, child seen eating soil and garbage being disposed in open pits are also controlled for. At individual level, child's age (in months), squared age of child, gender of the child (=1 if girl), age of the mother and squared age of mother are also controlled for.

Dietary practices change with place and time and they depends on a mixture of factors such as knowledge, geography, socio-cultural factors, psychology and economic fac-

tors (Powell et al. 2017). The diet a child is receiving largely depends on the knowledge of the primary care giver of the child. For this reason, I have controlled for mother's age, squared age of mother and education of the mother. Economic factors such as log transformation of land operated by the household, occupation of the household head (=1 if trader), income tercile of the household are also controlled for. Diet of the child also depends on the attention and care a child is receiving, in this regard I have controlled for if the child has a sibling less than six years of age (=1) and dependency ratio of the household. Access to food is another factor which effects the diet and in this regard I have controlled for the distance to the nearest shop (in kms) and farm diversity (it is common in rural households to consume a part of their produce). At individual level, child's age (in months), squared age of child and gender of the child (=1 if girl) are also controlled for.

Financial investment in human capital depends on the socio-economic status and perceptions of the households (Tilak 2002). Economic factors such as log transformation of land operated by the household, occupation of the household head (=1 if trader), income tercile of the household are controlled for. Demographic factors such as dependency ratio, number of children between 6-17 years of age, proportion of girl children, proportion of children attending school in the year of survey are also controlled for at household level. Since social perceptions depend on the age and education, both these factors are controlled for the female respondent and household head.

Age and education reflect the experience and knowledge respondents have, hence I expect them to have a positive associations with the outcomes. Log transformed land operated by the households reflects a source of income for the households, hence I expect it to have positive association with all the outcomes variables. Income level of the households are categorised into terciles. For calculating the income of each household, the average annual salaries of the members of the household are summed with annual remittances received by the household and the annual income received from other sources. For all the regressions, dummies that indicate the poorest and richest terciles are included as control variables. I assume that households belonging to poorest terciles behave differently from those that belong to the richest terciles. The main aim of the poorest households could be just to acquire enough calories and not really consume diverse foods. Also as income improves, they could have better access to health care, investment in education and technology and consume more diverse foods.

So I expect the poorest tercile households to have negative association with all the outcome variables and the richest tercile households to have a positive association with all the outcomes. Dependency ratio is calculated as follows:

$$Dependency\ ratio = \frac{Number\ of\ dependents}{Total\ household\ size}$$

where dependents is the number of household members less than 15 and greater than 64 years of age. A higher dependency ratio implies there are more number of people relying on less number of income generating or productive members of the household. As the ratio gets higher, I expect the household to have lesser income to buy the resources or share the existing resources among more number of people. Thus it should have a negative association with all the outcomes. With regards to the sanitary practices followed by the households, I expect spotting of animal feces around the house, child seen eating soil and garbage being disposed in open pits to have a negative association with the anthropometrics while having access to piped drinking water and sealed toilet to have positive association with the anthropometrics. Access to food is measured using both distance to markets and farm diversity. Farm diversity is the number of crop species produced by the household. I expect distance to market to have negative association with the dietary diversity while farm diversity to have a positive association with the dietary diversity. Since the care received by children also depends on if there are other children in the household less than 6 years of age, I expect having a sibling to have negative association with anthropometrics and dietary diversity. All the outcomes variables are estimated with division level fixed effects.

6.4 Instrumental variables

Malapit et al. 2019 and Quisumbing et al. 2021 worked with 5DE score as a proxy of women empowerment. Malapit et al. 2019 studied the impact of women empowerment on child well-being outcomes while Quisumbing et al. 2021 studied the impact of women empowerment of various nutritional outcomes across six countries. Both the studies have not found any valid instruments and their results are associative in nature. As put forward by Sraboni et al. 2014 and Lépine et al. 2013, empowerment could be affected by similar factors that affect the outcome variables. It is important to account for the endogeneity bias and those papers (studying the impact of women em-

powerment on various well-being outcomes) that have accounted for the endogeneity bias in different geographical contexts have found that OLS results were underestimated, relative to 2SLS. In this study I have tried various potential instruments.

Sraboni et al. 2014 have worked on the impact of women empowerment (using 5DE as a proxy) on household nutritional status (per capita calorie availability, household dietary diversity, male BMI, female BMI). To account for the endogeneity bias, they have used instruments such as age difference between the primary male and female respondents, the number of informal credit institutions in the community and the number of community activities women has participated in during the previous year. For some of their models, the instruments proved to be weak.

Similar instruments were later used by Holland et al. 2019 in which they look at the impact of women empowerment (using 5DE as a proxy) on child anthropometric. In their paper, they also include log value of wife's assets brought to marriage as an instrument. Ultimately, the authors dropped the instruments as they proved to be weak. Since Holland et al. 2019 have already tried using age difference and log value of wife's assets brought to marriage as instruments and they were proved to be weak, they were not tested in this study. The number of informal credit institutions in the community and the number of community organisation in the village could not tested as instruments due to the gap in available community level data.

Lépine et al. 2013 studied the impact of women empowerment on child nutritional status but in the context of Senegal. In their paper they have used ethnicity of the mother as an instrument. The reason being that when a woman belonging to ethnicity A lives in a village where most of the women belong to ethnicity B, the woman belonging to ethnicity A is under less social pressure of following the norms and hence would be more empowered. Following this, ethnicity of the women was tried as an instrument in this study but 99.95% of the sample have the same ethnicity (Bengali). Alternatively religion was tried as an instrument. For this Ethnolinguistic Fractionalisation Index (ELF) (Alesina et al. 2003) was calculated using religion as follows:

$$ELF = 1 - \sum_{i=1}^{N} s_{ij}^2$$

where s_{ij} is the population share of group i in community j. Larger the value, more diverse is the community. The reasoning is similar to what Lépine et al. 2013 have speci-

fied, the more diverse the community, the lesser is the social pressure to stick to the cultural norms. However, the index was weakly correlated with women empowerment. Our sample also doesn't have much variation in the religion (89% Muslims).

Afoakwah et al. 2020 have studied the impact of women empowerment on child schooling outcomes in the context of Ghana. They have used age at first marriage of women as an instrument. The argument for this being that early marriages effect the human capital accumulation of women by having lesser years of education. Basing on similar argument, age of the woman when she got married and age of woman when she first got pregnant were tried as instruments. However they were weakly correlated with the empowerment score.

Since 5DE score is used to measure the agency of women (autonomy in decision making), other decision making questions that were asked in the survey but not have been accounted for in the calculation of 5DE score are looked at. Previous literature has used mobility as a proxy for empowerment (Reid 2007; Hashemi et al. 1996; Alaofè et al. 2017). Even if facilities (hospitals, markets, schools) are available, women cannot access them unless they have the freedom of mobility. Thus being mobile helps women to access facilities with ease. Hashemi et al. 1996 in their study show that women's access to credit is positively associated with their mobility. Alaofè et al. 2017 show that women's mobility is positively associated with children's anthropometric measures. Thus I hypothesise that when women have the autonomy to decide where they could go, it has a positive impact on their empowerment, through which the outcome variables in this study would be effected. The survey collected data on who decides for a woman to go to five different locations (table 6.1). For each of these five locations, a score of 1 is given if the woman herself decided to go there, 0.5 if she and her husband together decide if she could go there and 0 if anyone else decides. An average of the scores is used to measure the freedom of mobility (ranges between 0-1).

Another instrument which has not been used before in the literature pertaining to women empowerment using 5DE as a proxy was the decision in choosing the partner. I hypothesize that when woman chooses her partner and gets married with her consensus, she is likely to have a better understanding partner and have more space for bargaining her wishes. Kishor 1997 in his study defines empowerment as "control over key aspects of our own lives" and used choice of partner as one of the dimensions that capture empowerment. He hypothesises having small age difference between the

Table 6.1: Measuring Freedom of Mobility

Place	Who decides if you can go by yourself?	Score
Visit friends and family	Yourself	1
	Yourself and Husband	0.5
	Others	0
Haat/Bazaar	Yourself	1
	Yourself and Husband	0.5
	Others	0
Hospital/Clinic/Doctor	Yourself	1
	Yourself and Husband	0.5
	Others	0
Cinema/Fair/Theatre	Yourself	1
	Yourself and Husband	0.5
	Others	0
Training for NGO/Programs	Yourself	1
	Yourself and Husband	0.5
	Others	0

spouses and choosing their own partners creates a setting for empowerment where women enjoy equality and marital advantages. He also finds in the study that these indicators that provide a setting (environment) for empowerment had more influence on infant survival and immunisation than other direct measures of empowerment such as financial autonomy. The survey collected data for female respondents on who chose their husbands (table 6.2). A score of 1 is given if the woman chose the partner or both chose each other and she agreed for the marriage. A score of 0.5 is given if the husband chose her or her family chose her husband and she agreed for the marriage. A score of 0 is given if the husband chose her or her family chose her husband and she did not agree for the marriage yet she got married to him. The score based on this decision is used to measure the choice of partner (ranges between 0-1).

Table 6.2: Measuring Choice of partner

If you are married, who chose your partner?	Score
We chose each other	1
I chose him and he agreed	1
He chose me and I agreed	0.5
The family chose and I agreed	0.5
He chose me but I did not agree	0
The family chose but I did not agree	0

7 Results

7.1 Descriptive statistics

The characteristics of the cross-sectional sample used in this study are shown in table 7.1. On an average, children in this sample suffer from mild stunting. 9.4% of the children are severely stunted. So is the situation with underweight, the average waz score is on the negative side. 5% of the children are severely underweight. The average 5DE score of women is 0.78 indicating that women on an average are involved in the productive decisions of the households. However, other measures of empowerment used as the instrumental variables reveal that only 5% of the women in this sample had the complete choice in their marriage decision and only 4% of the women have the complete freedom to go anywhere they wish to. The hygiene status of the households in this sample is in a pretty bad shape. 61% of the households in the sample have animal feces around their houses and 69% of the houses dispose of their garbage openly. Only 0.41% of households have access to piped water, while the rest of the households use tube well water for drinking.

The results from the empirical estimations are presented in the following sections. Table 7.2 describes the results from the OLS and 2SLS estimations for children's (0-59 months) haz and waz scores using women's 5DE score as a proxy for empowerment. Table 7.4 displays the results of OLS and 2SLS estimations for children's (6-59 months) dietary diversity score (MDDS) using women's 5DE score as a proxy for empowerment. Table 7.6 presents the results of OLS and 2SLS estimations at household level of financial investment in human capital (log-linear model) using women's 5DE score as a proxy for empowerment.

Table 7.1: Descriptive Statistics

Variable	N	Mean	SD	Min	Max
Dependent Variables					
HAZ	2277	-1.47	1.29	-10.65	4.9
Severe Stunting (≤ -3)	213	-3.7	0.84	-10.65	-3
WAZ	2281	-1.26	1.07	-6.02	2.99
Severe Underweight (≤ -3)	111	-3.51	0.56	-6.02	-3
Dietary Diversity Score	2047	4.44	1.30	1	8
ln(Investment)	4231	8.52	1.30	2.71	12.31
Independent Variables					
5DE score of primary female respondent	5555	0.78	0.15	0.07	1
Age of primary female respondent	5555	41.01	12.65	1	91
Education of primary female respondent	5547	3.71	3.68	0	17
Age of child (months)	2354	29.39	17.29	0	59
Squared age of child (months)	2354	1162.75	1045.04	0	3481
Gender of child (girl=1)	2354	0.48	0.5	0	1
Child has sibling less than 6 years (=1)	2281	0.39	0.49	0	1
Age of mother	2293	27	5.76	14	53
Squared age of mother	2293	761.92	331.25	196	2809
Education of mother	2293	6.4	3.51	0	17
Height of mother (cms)	2230	151.04	5.57	129.1	170.9
Number of children (6-17 years)	5605	1.14	1.03	0	7
Proportion of girls (6-17 years)	5605	0.33	0.42	0	1
Proportion of school going children (6-17 years)	5605	0.6	0.47	0	1
Distance to the nearest shop (kms)	5581	1.86	3.55	0	200
Farm Diversity	5605	3.63	2.87	0	24
Child seen eating soil (=1)	5605	0.32	0.47	0	1
Animal feces found around the house (=1)	5605	0.61	0.49	0	1
Sealed toilet (=1)	5605	0.49	0.5	0	1
Piped drinking water (=1)	5605	0.0041	0.06	0	1
Open garbage disposal (=1)	5605	0.69	0.46	0	1
ln(operated or owned land + 1)	5605	0.5	0.47	0	3
Age of household head	5605	46.59	13.79	18	108
Occupation of household head (trader=1)	5605	0.13	0.33	0	1
Education of household head	5595	3.74	4.07	0	17
Dependency Ratio	5605	0.38	0.24	0	1
Poorest tercile (=1)	5605	0.34	0.47	0	1
Richest tercile (=1)	5605	0.33	0.47	0	1
Division dummy 10 (=Barisal)	6011	0.075	0.26	0	1
Division dummy 20 (=Chittagong)	6011	0.17	0.37	0	1
Division dummy 30 (=Dhaka)	6011	0.31	0.46	0	1
Division dummy 40 (=Khulna)	6011	0.098	0.29	0	1
Division dummy 50 (=Rajshahi)	6011	0.10	0.31	0	1
Division dummy 55 (=Rangpur)	6011	0.10	0.20	0	1
Division dummy 60 (=Sylhet)	6011	0.13	0.34	0	1
Instrumental Variables					
Freedom of mobility	5437	0.41	0.25	0	1
Freedom of mobility (=1)	210	1	0	1	1
Choice of partner	5555	0.52	0.13	0	1
Choice of partner (=1)	269	1	0	1	1

Source: IFPRI 2020

7.2 Women empowerment and Anthropometric Measures

Table 7.2 presents ordinary least squares (OLS) and two-stage least squares (2SLS) regression results of anthropometric scores of children between 0-59 months. The IV post estimation test results are presented in table 7.3.

The OLS results (column (1) of table 7.2) show that HAZ has a positive and statistically significant association with women empowerment. As expected, access to clean and safe drinking water and having a sealed toilet at home have a positive association while presence of animal feces around the house and eating soil have a negative association with HAZ, ceteris paribus. Gelli et al. 2019 also find a negative association with presence of animal feces and lack of access to safe drinking water on the child HAZ scores. Children are exposed to pathogens by not having a clean and safe environment around them which affects their health and physical development. Presence of another child in the household less than 6 years of age (sibling) might play a role in the amount of attention the child is receiving for its nutritional and developmental needs. A negative association with siblings suggests that, those children that do not have a sibling have better HAZ score, ceteris paribus. Children HAZ decreases in age but increases slightly once a certain age is reached which is indicated by the positive association with the child's age squared.

The post estimation test results (column (1) of table 7.3) using 2SLS suggest that our instruments have passed both the weak identification and over identification tests. Weak identification test reports the Kleibergen-Paap rk Wald F statistic with the null hypothesis that the set of instruments is weak (instruments are weakly correlated with endogenous regressor). I reject the null hypothesis at 10% level of significance using the Stock-Yogo critical values. The over identification test reports the chi^2 p-value of Hansen J statistic with the null hypothesis that the set of instruments is valid (instruments are uncorrelated with the error term). I fail to reject the null hypothesis at 10% level of significance. However, it fails the endogeneity test with the null hypothesis that the regressors in question are exogenous. The endogenous test reports the chi2 p-value, which in this case suggests that the null hypothesis cannot be rejected and the female empowerment in this model (with HAZ as outcome) is indeed exogenous.

Table 7.2: Women empowerment and Anthropometric measures of children (0-59 months)

Variable	HAZ		WAZ	
	OLS	2SLS	OLS	2SLS
	(1)	(2)	(3)	(4)
Women Empowerment (5DE)	0.34**	0.68	0.22	2.55***
	(0.17)	(0.99)	(0.15)	(0.89)
Age of child (months)	−0.06***	−0.06***	−0.03***	−0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
Squared age of child (months)	0.00***	0.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Gender of child (girl=1)	−0.03	−0.02	−0.05	−0.07
	(0.05)	(0.05)	(0.04)	(0.05)
Child has sibling less than 6 years (=1)	−0.11*	−0.09	−0.03	0.03
	(0.06)	(0.07)	(0.05)	(0.06)
Age of mother	0.12***	0.12***	0.09***	0.11***
	(0.03)	(0.03)	(0.03)	(0.03)
Squared age of mother	−0.00***	−0.00***	−0.00***	−0.00***
	(0.00)	(0.00)	(0.00)	(0.00)
Education of mother	0.02***	0.02**	0.03***	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)
Height of mother (cms)	0.06***	0.06***	0.03***	0.03***
	(0.01)	(0.01)	(0.00)	(0.00)
Child seen eating soil (=1)	−0.17***	−0.18***	−0.04	−0.01
	(0.06)	(0.06)	(0.04)	(0.05)
Animal feces found around the house (=1)	−0.10*	−0.12*	−0.08*	−0.15***
	(0.05)	(0.06)	(0.05)	(0.05)
Sealed toilet (=1)	0.14***	0.14**	0.11**	0.13***
	(0.05)	(0.06)	(0.05)	(0.05)
Piped drinking water (=1)	0.98**	1.03**	0.98**	0.93**
	(0.41)	(0.44)	(0.39)	(0.43)
Open garbage disposal (=1)	−0.02	−0.02	−0.09**	−0.09*
	(0.06)	(0.06)	(0.05)	(0.05)
ln(operated or owned land + 1)	0.06	0.06	0.09**	0.10**
	(0.05)	(0.05)	(0.04)	(0.05)
Occupation of household head (trader=1)	0.07	0.06	0.12**	0.15**
	(0.08)	(0.08)	(0.06)	(0.07)
Dependency Ratio	−0.33	−0.32	−0.38**	−0.22
	(0.22)	(0.23)	(0.17)	(0.2)
Poorest tercile (=1)	−0.15**	−0.13**	−0.14**	−0.11*
	(0.07)	(0.07)	(0.06)	(0.06)
Richest tercile (=1)	−0.06	−0.05	−0.09*	−0.11**
	(0.06)	(0.06)	(0.05)	(0.06)
Division dummy 20 (=Chittagong)	0.11	0.1	−0.07	0.05
	(0.11)	(0.12)	(0.08)	(0.1)
Division dummy 30 (=Dhaka)	0.12	0.1	0.05	0.12
	(0.1)	(0.11)	(0.08)	(0.09)
Division dummy 40 (=Khulna)	0.06	0.06	−0.05	0.04
	(0.13)	(0.13)	(0.1)	(0.11)
Division dummy 50 (=Rajshahi)	0.21*	0.2	−0.03	0.05
	(0.13)	(0.13)	(0.1)	(0.11)
Division dummy 55 (=Rangpur)	0.08	0.07	−0.11	0.09
	(0.12)	(0.12)	(0.1)	(0.1)
Division dummy 60 (=Sylhet)	−0.13	−0.14	−0.30***	−0.18*
	(0.11)	(0.12)	(0.09)	(0.1)
Constant	−11.13***	−11.30***	−7.19***	−9.11***
	(0.84)	(1.16)	(0.69)	(1.06)
Observations	2214	2143	2218	2147

Note: Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7.3: IV Post Estimation Tests: Anthropometric Measures

Variable	**HAZ**	**WAZ**
	(1)	(2)
Under identification Test; H_0: under identified		
Kleibergen-Paap rk LM statistic Chi^2 p-value	0.00	0.00
Weak identification Test; H_0: weak instruments		
Kleibergen-Paap rk Wald F statistic statistic	28.75	28.69
Stock-Yogo critical value at 10% maximal IV size	19.93	19.93
Over identification Test; H_0: valid instruments		
Hansen J statistic Chi^2 p-value	0.61	0.65
Endogeneity Test; H_0: exogenous		
Chi^2 p-value	0.76	0.01

In spite of women empowerment not being statistically significant (column (2) of table 7.2) using 2SLS estimation, the magnitude and the direction of change are still in line with the OLS results and I consider the OLS estimates in this case to be consistent and efficient compared to the IV estimates. Given that the rest of the regressions in this paper pass all the IV post estimation tests, I assume that the instruments used in this study are still valid and empowerment of women is endogenous.

HAZ is a long term measure of nutritional status and could have other confounding variables affecting both HAZ and women empowerment. Only some of the external factors that effect HAZ could be controlled in this study. Various other factors such as access to health care services, access to and quality of diet received by mother during pregnancy, in-utero growth and development, vitamin deficiencies, diseases and illness have not been controlled for (Black et al. 2013). In many cases these risk factors remain undiagnosed. Though the causality couldn't be established in this case with HAZ, it still has a strong positive association with women empowerment.

On the other hand, the OLS results of WAZ on women empowerment (column (3) of table 7.2) is not statistically significant. However after controlling for the potential endogeneity, the 2SLS results (column (4) of table 7.2) show that women empowerment does have a positive and statistically significant effect on WAZ of the child. The OLS regression, though not statistically significant, has smaller estimates than the IV. Thus, neglecting the endogeneity bias would have underestimated the effect of women em-

powerment on child nutritional status.

WAZ is also affected by the age of the child, age, height and education of the mother, wealth determinants like land operated/owned by the household and the occupation and range of other sanitary practices around the household. As discussed previously, presence of animal feces around the house and disposing garbage openly by the household has a negative impact on the WAZ of the child while having access to clean drinking water and sealed toilet have a positive impact, ceteris paribus. The IV post estimation results also reflect that our instruments are not weak, they are valid and women empowerment is endogenous in this model (column (2) of table 7.3).

Since women empowerment is a proportion (ranging between 0-1), a unit change of it is considered as a 100 percentage point change. Using OLS, a 100 percentage point increase in women empowerment is associated with 0.34 standard deviations increase in HAZ, ceteris paribus. Using 2SLS, a 100 percentage point increase in women empowerment causes WAZ to increase by 2.55 standard deviations, ceteris paribus. Changing by a 100 percentage point means a complete shift, moving from 0 to directly 1, is hard to imagine. Alternatively, a 1 percentage point increase in women empowerment causes WAZ to increase by 0.0255 standard deviations, ceteris paribus.

7.3 Women empowerment and Dietary Diversity

Table 7.4 presents ordinary least squares (OLS) and two-stage least squares (2SLS) regression results of Minimum Dietary Diversity score (MDDS) of children between 6-59 months. The IV post estimation test results are presented in table 7.5.

The post estimation test results (table 7.5) using 2SLS suggest that our instruments have passed the tests for weak identification, over identification and endogeneity. Weak identification test, with the null hypothesis that the set of instruments is weak, is rejected at 10% level of significance using the Stock-Yogo critical values. Over identification test, with the null hypothesis that the set of instruments is valid, fails to be rejected at 10% level of significance. The endogeneity test, with the null hypothesis that the regressor in question is exogenous, is rejected at 10% level of significance.

Table 7.4: Women empowerment and Dietary diversity of children (6-59 months)

Variable	MDDS	
	OLS	2SLS
	(1)	(2)
Women Empowerment (5DE)	0.56***	2.24**
	(0.18)	(1.02)
Age of child (months)	0.14***	0.14***
	(0.01)	(0.01)
Squared age of child (months)	−0.00***	−0.00***
	(0.00)	(0.00)
Gender of child (girl=1)	0.05	0.05
	(0.05)	(0.06)
Child has sibling less than 6 years (=1)	−0.02	0.01
	(0.06)	(0.07)
Age of mother	−0.00	−0.00
	(0.03)	(0.04)
Squared age of mother	0.00	−0.00
	(0.00)	(0.00)
Education of mother	0.03***	0.03***
	(0.01)	(0.01)
Distance to the nearest shop (kms)	−0.01***	−0.01***
	(0.00)	(0.00)
Farm Diversity	0.01	0.01
	(0.01)	(0.01)
ln(operated or owned land + 1)	0.08	0.08
	(0.06)	(0.06)
Occupation of household head (trader=1)	0.29***	0.32***
	(0.08)	(0.08)
Dependency Ratio	0.07	0.19
	(0.22)	(0.24)
Poorest tercile (=1)	0.01	0.03
	(0.07)	(0.07)
Richest tercile (=1)	0.11*	0.10
	(0.06)	(0.07)
Division dummy 20 (=Chittagong)	0.06	0.13
	(0.12)	(0.13)
Division dummy 30 (=Dhaka)	0.00	0.03
	(0.11)	(0.12)
Division dummy 40 (=Khulna)	−0.09	−0.00
	(0.14)	(0.14)
Division dummy 50 (=Rajshahi)	−0.21	−0.17
	(0.13)	(0.14)
Division dummy 55 (=Rangpur)	0.06	0.02
	(0.13)	(0.14)
Division dummy 60 (=Sylhet)	0.00	0.11
	(0.12)	(0.13)
Constant	1.35 ∗ ∗	0.16
	(0.50)	(0.95)
Observations	1980	1916

Note: Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7.5: IV Post Estimation Tests: Dietary Diversity

Variable	**MDDS**
Under identification Test; H_0: under identified	
Kleibergen-Paap rk LM statistic Chi^2 p-value	0.00
Weak identification Test; H_0: weak instruments	
Kleibergen-Paap rk Wald F statistic statistic	28.51
Stock-Yogo critical value at 10% maximal IV size	19.93
Over identification Test; H_0: valid instruments	
Hansen J statistic Chi^2 p-value	0.12
Endogeneity Test; H_0: exogenous	
Chi^2 p-value	0.09

Assuming that the instruments are valid, MDDS is also affected by the age of the child, education of the female respondent, distance to the nearest shop and wealth determinants like the occupation of the household head. A 1 km increase in the distance to the shop reduces the MDDS by 0.01 food groups out of 8, ceteris paribus. This shows that access to market has an effect on the dietary diversity. The household head being a trader increases the MDDS of the child by 0.32 food groups out of 8, ceteris paribus. An additional year of education of the female respondent increases the MDDS by 0.03 food groups out of 8, ceteris paribus. OLS has underestimated the effect of women empowerment on MDDS before controlling for the potential endogeneity bias. A 100 percentage point increase in women empowerment causes MDDS to increase by 2.24 food groups out of 8, ceteris paribus. Alternatively, a 1 percentage point increase in women empowerment causes MDDS to increase by 0.0224 food groups out of 8, ceteris paribus.

7.4 Women empowerment and Financial investments in human capital

Table 7.6 presents ordinary least squares (OLS) and two-stage least squares (2SLS) regression results at household level of annual investment in human capital (annual expenditure on technology, hobbies and education). The IV post estimation test results are presented in table 7.7.

Table 7.6: Women empowerment and Financial investments in human capital

Variable	ln(investments)	
	OLS	2SLS
	(1)	(2)
Women Empowerment (5DE)	0.27^{**}	2.11^{***}
	(0.12)	(0.77)
Age of primary female respondent	0.02^{***}	0.01^{***}
	(0.00)	(0.00)
Education of primary female respondent	0.05^{***}	0.05^{***}
	(0.01)	(0.01)
Number of children (6-17 years)	0.33^{***}	0.30^{***}
	(0.02)	(0.02)
Proportion of girls (6-17 years)	-0.07^{*}	-0.08^{*}
	(0.04)	(0.04)
Proportion of school going children (6-17 years)	0.97^{***}	0.92^{***}
	(0.06)	(0.06)
ln(operated or owned land + 1)	0.11^{***}	0.10^{**}
	(0.04)	(0.04)
Age of household head	0.00	0.01^{**}
	(0.00)	(0.00)
Occupation of household head (trader=1)	0.17^{***}	0.19^{***}
	(0.05)	(0.05)
Education of household head	0.03^{***}	0.03^{***}
	(0.01)	(0.01)
Dependency Ratio	-1.72^{***}	-1.52^{***}
	(0.09)	(0.12)
Poorest tercile (=1)	-0.21^{***}	-0.20^{***}
	(0.04)	(0.05)
Richest tercile (=1)	0.12^{***}	0.10^{***}
	(0.04)	(0.04)
Division dummy 20 (=Chittagong)	0.30^{***}	0.36^{***}
	(0.08)	(0.08)
Division dummy 30 (=Dhaka)	0.19^{***}	0.20^{***}
	(0.07)	(0.07)
Division dummy 40 (=Khulna)	-0.07	-0.06
	(0.08)	(0.08)
Division dummy 50 (=Rajshahi)	-0.03	-0.03
	(0.08)	(0.08)
Division dummy 55 (=Rangpur)	-0.23^{***}	-0.29^{***}
	(0.09)	(0.09)
Division dummy 60 (=Sylhet)	-0.22^{***}	-0.14
	(0.08)	(0.09)
Constant	6.56^{***}	5.14^{***}
	(0.16)	(0.62)
Observations	4463	4379

Note: Robust standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7.7: IV Post Estimation Tests: Financial investments in human capital

Variable	**ln(investments)**
Under identification Test; H_0: under identified	
Kleibergen-Paap rk LM statistic Chi^2 p-value	0.00
Weak identification Test; H_0: weak instruments	
Kleibergen-Paap rk Wald F statistic statistic	50.66
Stock-Yogo critical value at 10% maximal IV size	19.93
Over identification Test; H_0: valid instruments	
Hansen J statistic Chi^2 p-value	0.86
Endogeneity Test; H_0: exogenous	
Chi^2 p-value	0.02

The post estimation test results (table 7.7) using 2SLS suggest that our instruments have passed the weak identification, over identification and endogeneity tests. Weak identification test, with the null hypothesis that the set of instruments is weak, is rejected at 10% level of significance using the Stock-Yogo critical values. Over identification test, with the null hypothesis that the set of instruments is valid, fails to be rejected at 10% level of significance while the endogeneity test, with the null hypothesis that the regressor in question is exogenous, is rejected at 10% level of significance.

Assuming that the instruments are valid, monetary investment in human capital is affected by a number of variables I have controlled for. Having an additional child in the household in the age group of 6-17 years causes the investment to increase by 30%, ceteris paribus. As expected, wealth determinants such as occupation of the household head, land owned/operated by the household and income have a significant effect on the investments made by the household. The financial investment made by the household has a negative association with the proportion of girls in the household between the age of 6-17 years. After controlling for the potential endogeneity bias, the effect of women empowerment on investments made by households in human capital is positive and statistically significant. A 100 percentage point increase in women empowerment causes investment to increase by 211%, ceteris paribus. Alternatively, a 1 percentage point increase in women empowerment causes investment to increase by 2.11%, ceteris paribus.

8 Conclusion

The central concept of this paper is to look at empowerment in terms of agency (autonomy in decision making). The validity of the indicators in the construction of the 5DE score (proxy of women empowerment with focus on agency) can only be tested when empirical studies are able to establish the transformatory potential and significance it has. The main aim of this paper is to establish the consequential significance women empowerment has on human capital investments. Human capital development mainly requires investment in health, nutrition and education. In this regard, I have analysed the effect on nutritional status of the younger children in the households (below 59 months) and on financial investments made in education, technology and hobbies. To estimate the effect, I have made use of instrumental variables to account for the potential endogeneity bias of women empowerment in the context of Bangladesh.

The results show statistically significant association of women empowerment with all the outcomes. Moreover, accounting for the endogeneity, greater empowerment of women leads to better nutritional status of children as well as higher financial investments in the pathways (education, technology and hobbies) that develop human capital. Due to the difference in scales of the dependent variables and women empowerment, it mighty get a little tricky to understand the economic significance. For example, a one standard deviation increase in women empowerment leads to an increase in 0.34[1] food groups on an average, ceteris paribus. This reflects that women empowerment does have economic significance when it comes to child well being. The results corroborate with the findings of other papers in similar context (Malapit et al. 2019; Holland et al. 2019) in showing positive association of women empowerment with child well-being outcomes.

[1]Standardised Regression coefficient: $\beta_1 * (SD_{X1}/SD_Y)$ shows how much a one standard deviation change in X1 leads to one standard deviation change in Y (Siegel 2016)

Despite finding statistically significant results, the following are some of the limitations of this paper, primarily concerning the assumptions in the way 5DE score is constructed. WEAI assumes that primary male and female respondents work in agricultural sectors. Also the index primarily aims at measuring the empowerment in terms of women's involvement in productive activities in agriculture. Since women empowerment is a multi dimensional concept, the proxy used to measure it has to have a more holistic approach. Since the data set used in this paper is the third round of BIHS panel, there could be some amount of response bias as the respondents are familiar with the questionnaire. There is a possibility for women to either underplay or overestimate their involvement in decision making. Ambler et al. 2017 study the BIHS data set from 2011 about the difference in the primary male and female respondents' answers to the same questions. They find that there is indeed some amount of systematic disagreement. For example, men are more likely to report sole male decision making while women are more likely to report joint decision making. Though their study concludes that what women perceive about their involvement in decisions is more important, there is potential for response bias.

The results presented in the paper may vary according to the setting (difference in cultures, gender norms, legal rights, institutions etc.) and depends on the indicators used as a proxy to measure women empowerment. There are also various other alternative measures to check for the nutritional status of children apart from anthropometric measures and dietary diversity (Webb et al. 2005) which could have been tested for robustness if the data was available. Moreover, the paper doesn't address how change in women empowerment over time affects the outcomes in human capital. One of the interesting aspects about WEAI is that the data is collected for both primary male and female respondents of each household. The empowerment gap (inequality) that exists with in each household could also have been used to study its impact on the outcomes. The 5DE score could be decomposed to find out which areas cause the most disempowerment among women that might need policy interventions. In this regard, the effect of the individual indicators on the outcome variables could also have been analysed. In South Asian countries where the status of women still needs to be improved and where there is preference for sons over daughters (Ahmed 1981), women empowerment could have greater effect on girl children well-being outcomes, which is also a topic for further research.

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Statement of authorship

I hereby confirm that the work presented has been performed and interpreted solely by myself except for where I explicitly identified the contrary. I assure that this work has not been presented in any other form for the fulfillment of any other degree or qualification. Ideas taken from other works in letter and in spirit are identified in every single case.

Place, date

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