Pathways to well-being: The role of female education and empowerment in Bangladesh

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Abstract

Female education and empowerment are both prerequisites for, and outcomes of, sustainable economic development. This dissertation empirically examines the extent to which women's empowerment results in well-being within the household. To this end, we use a nationally representative cross-sectional household survey dataset viz. Bangladesh Integrated Household Survey (BIHS) 2012. This dataset has unique information on various aspects of well-being for both primary male and female members of the same household along with empowerment data across five domains e.g. agricultural production decisions, access to productive resources, control of income, community leadership, and time allocation.

We begin by exploring mechanisms through which mothers' formal education impacts three health indicators—height, weight, and immunisation—for a sample of 887 children. We consider a range of pathways including mother's participation in the income generating activities, autonomy in spending decisions, exposure to media, access to health information, health knowledge, use of antenatal service, and diversified diet. In addition to including these pathway variables to pick up 'unobservable' variation in the error term, we also include controls for differences in parental health, household income, location, and demographic characteristics of the children. Irrespective of inclusion of the pathway variables, maternal education is found significantly and positively correlated with child health markers; while father's education is found insignificant throughout.

Next we analyse whether mothers' empowerment, measured by a five-domain empowerment index, has any impact on (a) household members' nutrient intake, (b) the household's diet composition, and (c) the intra-household allocation of food. Since these food security indicators and mothers' empowerment may be influenced by common unobservable household-specific gender norms, we instrument the latter using information on the number of community activities in which the mothers had participated in the past 12 months. While greater involvement in community activities is expected to empower the mothers; it is unlikely to have any direct causal impact on individuals' nutrient intake and dietary variation. The regression results, based on a sample of household members from 3,843 agricultural households, show that mothers' empowerment significantly increases not only the household members' calorie and protein intake but also the households' dietary diversity. Mothers' education is also positively correlated with the households' dietary diversity.

Finally we examine whether empowerment influences the subjective well-being (SWB)—measured in terms of life satisfaction scores—of women once again using data from the 3,843 agricultural households. The ordered probit estimates show a positive association between the empowerment index and SWB: notably women appeared significantly happier than their husbands after accounting for the difference in common household, community, and demographic (e.g. religion) characteristics. Education is found to improve the SWB of both, yet its impact is stronger for the women. Given the possibility of reverse causation between empowerment and life satisfaction, we estimate the SWB function using the instrumental variable (IV) method. We use the average number of community activities participated in by women at village level in order to instrument their empowerment index. The IV results suggest that while women's life satisfaction is significantly determined by empowerment; men's life satisfaction is not. The gender gap in well-being partly arises owing to the fact that men and women differ in respect of drawing satisfaction from different domains of the empowerment.

To conclude, our study underscores both the instrumental as well as the intrinsic importance of women's education and empowerment for the well-being of households.

Declaration of original authorship

I confirm that this is my own work and the use of all material from other sources has been properly and fully acknowledged.

Mahbub Hossain

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Dedicated to

My parents, Tofazzal H Miah and Renuara Hossain

My wife Suzana, and daughter Nameera

and

the participants in the Bangladesh Integrated Household Survey whose data are used in this dissertation

Contents

List of tables

List of figures

Abbreviations and acronyms

2SLS	Two-stage least squares
BBS	Bangladesh Bureau of Statistics
BCG	Bacillus Calmette–Guérin
BIHS	Bangladesh Integrated Household Survey
BMI	Body mass index
BRAC	Bangladesh Rural Advancement Committee
BRDB	Bangladesh Rural Development Board
CCT	Conditional cash transfer
DATA	Data Analysis and Technical Assistance Limited
DHS	Demographic and Health Survey
DPT	Diphtheria- Pertussis-Tetanus
EPI	Expanded programme on immunisation
FAO	Food and Agriculture Organisation
FCS	Food consumption scores
FFE	Food for education
GDP	Gross domestic product
HAZ	Height-for-age Z scores
IFPRI	International Food Policy Research Institute
IGAs	Income generating activities
IV	Instrumental variable
kcal	Kilocalorie
LDC	Least Developed Country
LS	Life satisfaction
MDGs	Millennium Development Goals
NGO	Non-Governmental Organisation
OLS	Ordinary least squares
OP	Ordered probit
OPV	Oral polio vaccine
PRSSP	Policy Research and Strategy Support Programme
PSU	Primary sampling unit
SDGs	Sustainable development goals
SWB	Subjective well-being
Tk	Taka (Bangladeshi currency, Tk 1 $\cong$ US Dollar 0.0125)
UN	United Nations
UNICEF	United Nations Children's Fund
US	The United States of America
USAID	United States Agency for International Development
WAZ	Weight-for-age Z scores
WEAI	Women's empowerment in agriculture index
WFP	World Food Programme
WHO	World Health Organisation

Chapter 1

Introduction and outline of the study

1.1 Theme and motivation of this dissertation

This dissertation aims at understanding the role of female education and empowerment on household welfare in Bangladesh. In particular, the dissertation analyses empirically the impact that female education and empowerment are likely to exert on a wide range of development indicators such as child health, household food and nutrition security, and women's subjective well-being in rural Bangladesh. Before proceeding further it may be worth mentioning here that for ease of exposition, this dissertation adopts a direct narrative approach, implying in the rest of the dissertation the term 'we' will be used to denote 'this dissertation' or 'this study'.

The relevance of female education and empowerment to household welfare is centred around the fact that women are the primary caregivers within a household and additionally they play an important role in developing countries' agricultural growth and food security (IFPRI, 2016). The centrality of women in the process of economic development is further recognised in the recently announced Sustainable Development Goals (SDGs) which, in Goal number 5, set women's empowerment and gender equality as development objectives in their own rights (UN, 2015). These goals also see them as a means towards achieving development targets such as poverty reduction and human resource development e.g. nutrition, health, and education (van den Bold, Quisumbing, & Gillespie, 2013; World Bank, 2012; World Economic Forum, 2015). Despite this, throughout the world women are discriminated against and gender inequality is pervasive in most developing countries. This discrimination inhibits women's human capital formation and their economic potential, which ultimately impedes women's capacity to play a role in individual and household welfare as well as in the national economy. More of a concern is that economic growth will not automatically reduce gender inequality, and as a result some kind of policy intervention is required (Duflo, 2012). Hence, the issue of enhancing women's capabilities receives much attention among development experts, which engenders rigorous investigation on the issue.

For evidence-based policy interventions to be adopted by policymakers, there is clearly a need for robust evidence on issues relating to gender equality. Existing literature tends to highlight that women's greater agency or bargaining power is conducive to household welfare,

especially for children's well-being. However, the findings are contested because the relationship between women's empowerment and household welfare indicators may be complicated. Resources that we extensively review in chapters 4 and 5 highlight a number of potential methodological problems that challenge the empirical investigation into the impact of women's education and empowerment on child health and nutrition, and on household food security. Similarly, literature cited in chapter 6 points to the issue of why a relationship between enhanced capabilities and subjective well-being may not be straightforward. The doubt here is that whether the relationship between women's empowerment and welfare indicators is causal if women's enhanced capabilities are correlated with their unobserved innate attributes, or if the relation picks up the effect of unobserved household and even community characteristics.

While attempts have been made by researchers to deal with this concern, it seems that few studies have been able to address the issue across both objective and subjective welfare indicators. In particular, a comprehensive study of this kind is unavailable for Bangladesh—a country which has become a virtual laboratory for various development interventions. The country has made considerable improvements in several aspects of human development despite its low level of per capita income (Asadullah, Savoia, & Mahmud, 2014); nevertheless, it suffers from a high incidence of under-nutrition, low food security, and gender inequality. This provides the context in which we explore the relationship we are interested in. We expect that our findings would shed some light on policy options for the country's overall economic development.

1.2 Contribution of the dissertation

As stated above, the main contribution of this dissertation is that we generate evidence of the impact of women's enhanced capabilities on both objective and subjective welfare indicators after accounting for a number of common methodological issues. We do this in the context of a less developed south Asian country i.e. Bangladesh. Also our study makes a number of other contributions which are discussed below.

First, our study complements the existing evidence of the instrumental role of women's education and empowerment in achieving internationally agreed development goals. In addition to expanding the available body of evidence of the positive and significant impact of maternal education on child health, we find evidence to suggest that mothers' empowerment

in agriculture significantly increases food calorie intake and household dietary diversity. Furthermore, our study provides evidence of the intrinsic importance of women's enhanced capabilities as we find that empowerment is positively and significantly associated with women's life satisfaction. The latter finding is especially notable because it highlights the intrinsic importance of women's empowerment to women's well-being rather than to children's or household welfare.

Second, our research attempts to address some methodological concerns relating to understanding the causal effect of female education and empowerment. In order to account for this issue, we have used several methods including control function approach, fixed effects estimation, and instrumental variables technique. We use these strategies mainly to eliminate any potential bias that is likely to arise from the unobserved attributes of women, from the unobserved characteristics of the household or the community, and from reverse causation. Moreover, our study is based on a countrywide household survey dataset which means the empirical findings of the study are based on a relatively large sample.

Third, our study has several noteworthy features from the perspective of measurement. For child health, we have used two anthropometric indicators namely height-for-age and weight-for-age alongside the immunisation score. For food security analysis, we measure individual-level intake of calories and proteins that enables us to look at the intra-household allocation of food. Additionally our study further measures a household level food security indicator which is measured by a weighted index of household dietary diversity. With regard to measuring the key variable i.e. empowerment, our study makes use of a recently developed multidimensional framework namely: the five domains empowerment index (Alkire et al., 2013b). This index allows us to take account of the multidimensionality of the notion of empowerment by capturing adequacy over 10 indicators across agricultural production, resource control, income, community influence, and time use domains.

Fourth, our study contributes to the literature on Bangladesh development issues. Child malnutrition is a significant public-health issue in Bangladesh (T. Ahmed et al., 2012) and our study finds that the nutritional status of the country's rural children can be improved significantly by educating mothers. In a similar vein, our study generates recent evidence of significant gender discrimination in the intra-household food allocation within agricultural households in rural Bangladesh, which may give valuable insights to the relevant policy planners. Our study identifies whether there is a subgroup of members who are more likely to

be subject of food deprivation within a household as we find that both young and adult daughters are the most nutritionally deprived groups within agricultural households in rural Bangladesh. Another contribution of our study is that it is perhaps the first study in Bangladesh that has explored a relation between empowerment and subjective well-being using country-level data. Thus our finding on the relationship between empowerment and life satisfaction itself is a noteworthy contribution.

In sum, our study contributes to the literature by identifying potential pathways to well-being in a poor less developed country. Our study underscores that even in a poor economy, reducing the barriers to women's capabilities development can lead to household welfare in terms of a reduction in children's undernourishment and an improvement in household food security. Our study stresses that enhancement of women's capabilities can be an important policy tool for reducing poverty and hunger in Bangladesh. Thus the findings of our research may be of particular relevance to the Bangladeshi national policy planners and to the development experts of other countries that share similar socioeconomic conditions.

1.3 Organisation of the dissertation

This dissertation consists of seven chapters. In the next chapter, we discuss the concepts, definition, and measurement of women's empowerment alongside a discussion of women's socioeconomic status in Bangladesh. In chapter 3, we describe the country profile and background and administration of the survey that provides data for this dissertation. We then present three analytical chapters from chapter 4 through 6.

In chapter 4, we explore the impact of mothers' education on children's health markers and the pathways through which the impact operates. In Bangladesh, female education has been improved remarkably on account of the implementation of policy measures such as food for education (FFE) and conditional cash transfers (CCT) since the early 1990s. These have helped to achieve gender parity in both primary and secondary education mainly through increasing the enrolment of girls, especially from poor families. So the chapter sets out to investigate whether such an increase in women's education in Bangladesh could result in an improvement in child health as the literature suggests. While doing so, we have attempted to account for some sources of potential endogeneity of mothers' education by means of identifying pathways through which the effect of mothers' education may translate into children's health. Based on a large sample of young children from rural Bangladesh, the

chapter reaffirms a positive impact of mothers' education on children's long-term and short-term nutritional status, and on immunisation; even after having controls for potential pathways. This evidence thus confirms the importance of girls' education.

This is followed by an exploration of the impact of women's empowerment in agriculture on children's, adults', and households' food security in chapter 5. The concerns that children and women are often discriminated against within the household in terms of food allocation and that women in rural agricultural households tend to have low bargaining power relative to men in terms of decision-making over resource allocation have motivated the investigation. By utilising a multidimensional weighted index of women's empowerment in agriculture and a dataset containing individual-level food consumption information, this chapter contributes to a better understanding of the determinants of individuals' nutrient intake and of whether the intra-household dynamics of food allocation within rural households respond to women's greater decision-making power. In doing so, we have attempted to address the potential endogeneity of women's empowerment by instrumental variables technique. Based on data from 3,843 agricultural households, we find evidence to suggest that women's empowerment can significantly improve children's and adults' calorie and protein intake as well as households' dietary diversity. As far as the intra-household allocation of food is concerned, we find that daughters are the most deprived group but women's greater decision-making power within the household may have a crucial role to play in mitigating such discrimination.

In chapter 6, we examine a relationship between empowerment and subjective well-being with an emphasis on gender. While a considerable number of studies have highlighted the instrumental role of women's empowerment in achieving objective development goals; by contrast, few studies have attempted to understand empirically the intrinsic role of women's empowerment. The inquiry into the intrinsic role of empowerment is important for women's well-being because empowerment may entail an additional burden of responsibilities for them alongside increased freedom, and hence the net impact may not be easy to capture. Whether or not any public policies aimed at altering the intra-household power relation will enhance women's welfare, cannot be unambiguously judged without analysing the nature of the relationship empirically. However the investigation is complicated by the fact that unobservable characteristics of individual, household, or community could potentially affect the relation, and ignoring them may yield a biased result. Also there can be a reverse causation between empowerment and subjective well-being. We attempt to address this potential bias by utilising a variety of methods including fixed effects estimation and

instrumental variables techniques in estimating the relationship. Our analysis reveals that there is, in fact, a positive and highly significant relationship between empowerment and subjective well-being underscoring the intrinsic value of empowerment. We also find that women are significantly happier than their male counterparts once the difference in empowerment and other correlates of subjective well-being are accounted for. This might be a result of the positive changes that have occurred in women's situation in Bangladesh over the past few decades.

Finally, we present the concluding remarks and policy implications of the dissertation in chapter 7.

Chapter 2
Women's empowerment in Bangladesh

2.1 Introduction

In this dissertation, we wish to understand the role that women's enhanced capabilities may have in achieving development outcomes, especially better child health, improved nutrition, and women's own subjective well-being in a less developed South Asian country. Despite a significant rise in per capita income and fall in extreme poverty over the past two decades, gender inequality persists in a wide range of socioeconomic outcomes in South Asia (Asadullah & Wahhaj, 2016b; World Economic Forum, 2015). The majority of women in the region are outside the labour force and primarily responsible for household chores and care of children and elderly (Smith, Ramakrishnan, Ndiaye, Haddad, & Martorell, 2003). An increasing proportion of women also face the double burden of preparing and processing food for household consumption as well as working in the agricultural sector as producers of food and wage earners (Quisumbing, Brown, Feldstein, Haddad, & Pena, 1995). However gender inequalities in decision-making capacity and in the decision-making process are prevalent in the region, which is likely to have a significant impact on food production, intra-household distribution of food, and family well-being (Kishor, 2005).

For the sake of tackling poverty and boosting shared prosperity, the participation of both women and men, girls and boys in all aspects of life is needed (Klugman et al., 2014). The importance of women's contribution to the process of development can be better understood from the World Development Report on gender equality (World Bank, 2012). The report identifies three channels through which gender equality can enhance economic efficiency and improve other development outcomes. First, removing barriers to women's access to education, economic opportunities, and productive inputs can generate broader productivity gains. Second, improving women's absolute and relative status feeds into other development outcomes by giving women greater say in household decision-making. And third, levelling the playing field so as to enable men and women to be equally active in social and political spheres, decision-making, and shaping policies are likely to lead to inclusive and more representative institutions and policy choices and thereby to a more progressive development path.

In this context, concerns remain for developing countries where women are usually subject to discrimination (Amutha, 2017) and have less opportunity for participating in income earning activities. One of the main reasons for the concern is that women in less developed countries generally have very low levels of human capital e.g. education, skill, and health that ultimately inhibit their economic potential and socioeconomic status. Women's low level of human capital is largely attributed to the low investment in them in societies where sons are valued more than daughters owing to cultural norms. Parents usually perceive daughters' human capital development is less important for a variety of reasons. For instance, the low monetary value of women's labour in the labour market gives a negative signal for investing in daughters' human resource development. Also, the fact that a daughter moves to a different family after marriage in line with the cultural tradition leaves little incentive for parents to devote scare financial resource to the development of daughters. The resultant low level of human capital amongst women combined with religious laws and traditions that legalise discriminatory rights to inherit property further worsens women's situation within households and society. In addition, they become the frequent victim of abuse and violence within and beyond the family, and sadly social support is rarely extended to them. Consequently women's position within the family and society tends to be lower than their male counterparts in the developing countries, and ultimately women lack the power to influence any decisions that shape their lives and livelihood choices.

Household decisions in which women are unable to participate are more likely to underestimate household resource allocation related to child health and nutrition (Cunningham, Ruel, Ferguson, & Uauy, 2015). For instance in a household where the primary female household member, who is responsible for nutrition of children and others, has no say over food purchase decisions; the household's purchase of food may not be based on the nutritional requirement of children. In this instance, enabling the woman to influence food purchase decisions may result in the allocation of resources that would better take account of the needs of children. In agriculture women play a key role in the production, processing, and marketing of food (UNDP, 2012); nonetheless, they have less access to and less control over productive resources (FAO, 2011b). Women's lack of rights over resources in the agricultural households makes it less likely that women have any inputs in agricultural resource allocation decisions. If women can take part in resource allocation decisions in these households, then such household decisions may be more efficient for meeting household food security. Thus women's power within households relative to that of men is likely to have welfare

implications for the households' well-being, particularly for children's well-being. Additionally women's greater power to influence decision-making may broaden the sphere of choices and thereby may positively contribute to their own subjective well-being.

Before we proceed to investigate empirically whether women's enhanced capabilities are instrumental to achieving other economic development goals, it would be useful to refer to the literature across various dimensions to understand what governs the gender relations and how such a relationship is influenced. Referring to the existing literature would also help us to comprehend the term 'empowerment' which is often considered to have a lack of concise meaning and definition despite its much presence in inter-disciplinary studies. Indeed, such vagueness of the concept often leads to difficulties in measuring empowerment and in deciding what the measurement should encompass. In subsequent sections, we will survey the literature around empowerment to find a comprehensive framework for our intended empirical analysis. In doing so, we specifically give importance to the context of our analysis: that of rural women in a less developed South Asian country.

In the next section, we synthesise the existing literature on the concepts and meaning of women's empowerment. This follows a section 2.3 on the evidence of the effect of women's empowerment on various development indicators. We also discuss the measurement of empowerment and the factors that are associated with it in section 2.4 and 2.5, respectively. The final section of this chapter discusses women's socioeconomic status in the context of Bangladesh.

2.2 Meaning of women's empowerment

Empowerment means an increase in capabilities to make choices (Sen, 1985). It has multiple meanings relating to power, participation, capability, autonomy, choice, and freedom (Eyben, 2011). Broadly it refers to the expansion of freedom of choice and action to shape one's life (Narayan, 2002). According to Kabeer (1999), "empowerment refers to the process by which those who have been denied the ability to make choices acquire such an ability. In other words, empowerment entails change". Following Kabeer's view, empowerment can be understood with the help of three closely interrelated concepts: agency, resources, and achievement. For the sake of clarity, it may be useful to have a discussion on what Kabeer means by these three terms.

First, 'agency' refers to people's ability to define their goals and act upon them. It has two connotations: in a positive sense, it means the ability of people to make and act on their own life choices, even in the face of others' opposition. Conversely, the negative aspect of it is reflected when one person's agency overrides that of others. For example, a husband can exercise authority over his wife by means of violence. In the absence of exclusive agency, power may operate; therefore the agency should mean exercising choices in a way that challenges existing power relations.

'Resources' are the medium through which agency is exercised. They are distributed through the various institutions and relationships in a society. Resources include not only material assets but also the various human and social resources that enhance choices. Education, which is a crucial aspect of the human resource, provides people with skills to enable them to choose from alternative livelihoods and acquire other resources. Similarly possession of physical resources e.g. land may provide diversified livelihood options. Conversely lack of resources, which is pervasive amongst the poor, compromises freedom of choice. Resources are distributed through the various institutions and relationships in society. In the distribution process, there may be some actors who occupy privileged positions over others e.g. heads of households, chiefs of tribes, elites within communities, and managerial personnel in organisations. Distribution of assets is also often discriminated along gender lines (Agarwal, 1994b), and in South Asia the gender gap in ownership and control over property is the single most critical determinant of gender differences in economic well-being, social status, and empowerment.

Gender discrimination in resource possession and control often stems from religious laws on inheritance that allows men to have the larger share of the property. Even if women receive a share of the property, they still may not have control of the property (Cain, Khanam, & Nahar, 1979). In this way, women disproportionately represent the most disadvantaged group in respect of resource possession in poor communities (Cagatay, 1998). Referring to Sen (1985), Kabeer (1999) argues that resources and agency form people's capabilities i.e. their potential for living the lives they want.

The third term 'achievements' refers to the extent to which people's potential is realised or fails to be realised. In relation to empowerment, achievements are viewed in terms of both the agency exercised and its consequences. Women's engagement in paid work would be

regarded as empowering if such engagement raises women's sense of independence as opposed to meeting survival needs (Kabeer, 1999, 2005).

Kabeer's framework of agency, resources, and achievement aside, there are other competing concepts and frameworks to study women's empowerment. For instance, according to Alsop, Bertelsen, and Holland (2005), "empowerment is a process of enhancing an individual's or group's capacity to make purposive choices and to transform those choices into desired actions and outcomes". This definition points to the fact that empowerment can be described as having two components. First, empowerment can be thought of as an expansion of **agency**—the ability to act on behalf of what one values and has reason to value. The second component is an **institutional environment** that offers people opportunities to exert agency fruitfully. Acquisition of assets—including human, physical, financial or social—increases individuals' or group's agency; but such an acquisition would not automatically result in empowerment if opportunities for exercising agency are not conferred upon them. This usually happens when formal or informal institutions confine opportunities to a specific group of individuals. To give an example, a person may increase their human capital by completing secondary or higher education; but in order to be empowered, there must be opportunities available to him or her to shape their livelihood. Formal institutions e.g. the legal framework often restrict women's employment in certain sectors in the form of protective measures. Informal institutions e.g. rigid socio-cultural norms (patriarchy, *purdah*[1]) constrain the realm of women's lives in poor developing societies through restrictions on mobility and public appearance. Thus to be empowered, one has to have a choice making ability which is to be acquired through acquiring assets and to have an enabling institutional environment to exercise choice making abilities.

The term empowerment bears multiple meanings as it has been used differently in the literature depending on the underlying socio-cultural context. With reference to Solava and Alkire (2007), who have extensively reviewed several definitions of 'empowerment', it can be said that empowerment connotes various terms such as agency, self-direction, self-determination, liberation, participation, mobilisation, and self-confidence. In the literature, the terms empowerment, agency, and autonomy often coincide or have been used interchangeably to refer to the ability to make an authentic choice and to have resources to exercise these choices in pursuit of the desired goals. However they can substantially differ from each other

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[1] *purdah* implies the broader set of norms and regulation that promote the seclusion of women: exclusion from public spaces and give specific gender identities to labour (S. Amin, 1995)

and one cannot reflect on the other; although they are very positively related (Mishra & Tripathi, 2011). Their subtle difference lies in the fact that agency is a constituent of empowerment which is a process; whereas autonomy can be regarded as an outcome of such a process and does not encompass progression (Alfano, Arulampalam, & Kambhampati, 2011; Mishra & Tripathi, 2011).

Mishra and Tripathi (2011) suggested that there is a certain disjunction between empowerment and autonomy and that it cannot be assumed that one would automatically lead to another. By analysing the National Health and Family Survey-3 data, they have indicated that women in South India enjoyed apparent constituents of empowerment (higher education, jobs for cash, and access to resources); nevertheless they have very low levels of autonomy in household decision-making, freedom of movement, and complaints with domestic violence. On the other hand, the north-eastern women in India are less empowered in terms of the above constituents but enjoy a higher degree of autonomy. Thus it becomes apparent that autonomy and empowerment are not interchangeable, which signifies the need for identification of cultural factors that have a bearing on empowerment and autonomy.

Empowerment is not just related to access and control over resources and to the ability to exercise agency, it also means to have self-worth, control over one's life, and influence over the direction of social change. Empowerment may mean an increase in one's level of confidence. In order to acquire human assets, one needs to believe in oneself. In the case of women, the lack of self-confidence regarding their potential as an agent for bringing about desirable changes may impoverish their sense of empowerment. By empowerment, one should acquire an ability to make choices even if this ability is challenged. Attitudes to intimate partner violence, sexual health and reproductive rights, and freedom of movement can have an important bearing in regard to women's empowerment as they are all likely to affect women's opportunities for self-development and opportunities to exercise their ability.

It is to be noted from the above discussion that women's empowerment is a multidimensional concept, and as such empowerment in one aspect does not necessarily mean empowerment in another aspect. A woman may have ownership of productive resources (e.g. land) but this may not translate into her empowerment if she cannot utilise the resource for her own interests. Acceptance of women's voice in household affairs does not necessarily mean that they are empowered overall, because they may still need to seek permission from others to go outside their home for engaging in any social activities. On the other hand, a woman with a

burden of workload might be regarded as empowered if she can refuse the workload wholly or partly. We also need to take into account the context, for example, if we are looking at women in agricultural households, we need to evaluate their agency, control over resources, and achievements, alongside the institutional opportunities that are specifically applicable to agriculture. Examples are: whether women in those households have any access to production resource e.g. land or capital; whether they have any control over assets; whether or not they have any input in choosing what crop to plant; or whether women can raise issues and express concerns in agricultural input management groups.

Based on the above discussions, it becomes clear that empowerment entails changes in one's ability to choose and to act upon the choices; and that its constituent parts are resource, agency and achievement. Not only is empowerment a multidimensional phenomenon but also its understanding requires taking account of the specific context in which the phenomenon is being examined. Accordingly in this dissertation, we adopt a multidimensional framework of empowerment which we discuss in detail in section 2.4. Having discussed the meaning of empowerment, in the next section we review the evidence of the effect of women's empowerment.

2.3 Benefit of women's empowerment

The proposition that women's empowerment is crucial for achieving development goals relies on the notion that women's empowerment is likely to be associated with increased bargaining power that may enable them to influence household decision-making in favour of increased welfare spending (Thomas, 1990). With the greater power of decision-making, women are likely to be able to allocate household resources e.g. household income in a way that would benefit the welfare of household, especially of children (Quisumbing et al., 1995; Todaro & Smith, 2015). In this section, we primarily discuss the benefits that are likely to accrue from women's empowerment in terms of greater decision-making power within the household.

Prior to discussing the benefits that women's greater decision-making power may have, it may be useful to understand the underlying mechanism of the household decision-making process. Initially models that intended to describe how decisions are made within households tended to view households as single production and consumption units (Doss, 2013). The unitary structure implies that there is conformity in household decision-making and that the household decision-making process is not affected by the distribution of and access to

resources within a household. Furthermore, there are no conflicting dynamics between household members in the decision-making process. Under the unitary model, the household's utility is thought to be the same for all household members. However, these assumptions do not hold if household members have unequal access to resources or if there are disparities in preferences. Importantly studies have documented evidence of differential preferences. For a comprehensive technical illustration on the matter, refer to Alderman, Chiappori, Haddad, Hoddinott, and Kanbur (1995); Browning and Chiappori (1998), and for a non-technical illustration, refer to Houston and Huguley (2014); Smith et al. (2003); and Doss (1996).

Contrary to the unitary approach, collective models treat households as a collection of decision-making units (Doss, 2013). One such model—the cooperative bargaining model—assumes that the decision-making power of the agents depends on their power to exert influence on other household members. Such a power is termed as the bargaining power of the agent. Thus women's bargaining power corresponds to their ability to exercise their right to make decisions regarding household affairs and therefore any increase in women's bargaining power will provide them greater agency to influence the household decision-making process. Importantly women's achievement of the bargaining power to influence household decisions depends on the constituents of their empowerment i.e. agency as well as resources. In the followings, we consider the literature surrounding whether or not women's empowerment in the form of bargaining power is positively associated with welfare outcomes, especially to those relating to children's health and nutrition.

There is a substantial amount of literature that has examined whether or not women's bargaining power or decision-making power leads to better outcomes. These studies have broadly documented the beneficial effect of women's bargaining power on a variety of indicators including fertility control, contraceptive use, health care utilisation, infant mortality, child health and nutrition, consumption and expenditure patterns, agricultural productivity, and food security. We will discuss each of them in turn.

A large number of studies underscore that women's empowerment or greater decision-making power within the household is beneficial for child health-related outcomes (Arulampalam, Bhaskar, & Srivastava, 2012; Bhagowalia, Menon, Quisumbing, & Soundararajan, 2012; Cunningham, Ruel, et al., 2015; Imai, Annim, Kulkarni, & Gaiha, 2014; Lépine & Strobl, 2013; Malapit, Kadiyala, Quisumbing, Cunningham, & Tyagi, 2015; Malapit, Sraboni,

Quisumbing, & Ahmed, 2015; M. M. Rahman, Saima, & Goni, 2015; Schmidt, 2012; Smith et al., 2003; Zereyesus, Amanor-Boadu, Ross, & Shanoyan, 2016). The positive effect of women's decision-making power on child health indicators is not surprising because women are the primary caregivers to children and often know more about the needs of their children than other family members. Therefore if they have a greater bargaining power to make decisions then it is more likely that they can think, express, decide, and act independently to diverting time and resources towards children's well-being. Indeed women tend to allocate more resources towards expenditures that improve the nutrition of family, especially of children (Thomas, 1990). Additionally, women's empowerment is likely to be associated with better maternal health care because women who have education, decision-making power and access to economic resources may be better able to cope effectively with challenges (S. Ahmed, Creanga, Gillespie, & Tsui, 2010). For instance, a mother with the freedom of mobility may go to antenatal care or may choose to give attended birth. Thus mothers' empowerment may correspond to the better use of maternal care services as well. Empowered mothers are likely to go outside and thus are more likely to interact and exchange information with people outside the home and thereby they are more likely to acquire knowledge and advice pertaining to children's care, food, and nutrition. Women's freedom of movement can also let them utilise health care for their children and conversely a barrier to it may hinder mothers' access to children's basic health protection. In India, children of mothers with low freedom of movement have 20 percent higher odds of being incompletely immunised (Malhotra, Malhotra, Ostbye, & Subramanian, 2012). Women's empowerment in terms of control over assets is likely to influence child well-being significantly. For example, in Nepal women who own land seem to have a final say in household decision-making and children of such mothers tend to be healthy (Allendorf, 2007).

Another beneficial aspect of women's decision-making power is that it helps to reduce fertility because empowered women can negotiate with spouse about the adoption of family planning, contraceptive use or reproductive health care (Abadian, 1996; M. M. Rahman, Mostofa, & Hoque, 2014; Schuler & Hashemi, 1994). Reducing fertility may also contribute to freeing women's time from traditional household chores and care work, and thereby may enable women to lift their households out of poverty by devoting the saved time to economic activities (Gribble & Voss, 2009). There is evidence that women who contribute to family support are more likely to use contraceptives than women who do not contribute (Schuler & Hashemi, 1994). Thus in addition to its role in counteracting the pressure of increasing

population, women's control over fertility regulation may increase their participation in the economic activities that are likely to contribute in a country's economic development process.

Women's empowerment has implications for agriculture as well because women are performing an important role in agriculture throughout the world. Hence reduction of the gender gap in agriculture is likely to promote agricultural growth and rural development (FAO, 2011a). Women's empowerment can benefit agriculture by more effectively utilising women's human, social, and physical capital. Women's involvement in forums may increase their knowledge of new technologies, crops or technical know-how. Women's engagement in social networks may enable them to learn about utilising resources more efficiently. It may also provide women with means to easily access credit which they can use for productivity enhancing techniques. This is especially true in rural areas of less developed countries where small-scale farming is the main source of livelihoods. Seymour (2017) showed that closing the empowerment gap between husband and wife in farm households in rural Bangladesh would imply a 2.2 percent increase in farm technical efficiency. This is because when agricultural decisions are made jointly, they are more efficient and the outcome of joint decisions is often less risky. Productivity gains in agriculture from women's empowerment are likely to increase household incomes that can be used by the household for improved food and nutrition (Balagamwala, Gazdar, & Mallah, 2015).

Not surprisingly women's empowerment has been found to improve household food security (Sharaunga, Mudhara, & Bogale, 2015, 2016; Sraboni, Malapit, Quisumbing, & Ahmed, 2014; Yimer & Tadesse, 2016). This is so because empowered women are self-motivated (Kabeer, 1999) and their inner drive prompts them to pursue control over resources so as to achieve household food security (Sharaunga et al., 2016). Such characteristics of empowered women also persuade them to adopt diversified livelihoods for their households in order to be more resilient to shocks and eventually to reduce the chances of being food insecure. Mothers' empowerment may also help reduce intra-household food bias. For instance, Malapit, Kadiyala, et al. (2015) showed that children's diet improves significantly in households where the empowerment gap between father and mother is less in contrast to households where such a gap is high.

In addition to the above evidence, the literature has also documented that women's empowerment is important for improving their own subjective well-being (de Hoop, van Kempen, Linssen, & van Eerdewijk, 2014). This is why women's empowerment has intrinsic

value. The realisation of social justice in the form of equality between women and men is an important aspect of human welfare. The attainment of such welfare can be influenced significantly by women's empowerment because having greater decision-making power enables them to make effective choices and exercise control over their lives (Arulampalam et al., 2012). Although it may appear that greater agency entails additional burdens for women and therefore reduces women's subjective well-being; there is some evidence that this is not necessarily the case (Fernandez, Della Giusta, & Kambhampati, 2015). Women's empowerment is likely to be associated with fewer experiences of domestic violence (Koenig, Ahmed, Hossain, & Mozumder, 2003). Women's empowerment paves a way for realising their fundamental human right–to live a life free from deprivation.

In sum, there is substantial evidence of the benefit of women's enhanced capabilities, be it agency or decision-making power or bargaining power. The above-mentioned discussion signifies why empowering women is needed for achieving development goals. Evidently women's empowerment plays an instrumental role in achieving broad economic development goals, in addition to its being an end in itself. Moreover gender equality and women's empowerment are preconditions for effective and sustainable development and for the enjoyment of universal human rights (WFP, 2009). Thus removing barriers to improving women's capacity enhancement may be conducive to accelerating economic development.

2.4 Measurement of empowerment

The existing concepts and frameworks of women's empowerment do not readily lend itself to direct measurement (Pitt, Khandker, & Cartwright, 2006). At the individual and the household levels, a woman's empowerment may be determined by the extent to which she can participate in decision-making, share domestic work, can control reproductive functions to decide family size, can prevent violence, and uphold self-esteem (Medel-Anonuevo, 1993). Thus there are difficulties in deciding how to measure empowerment. In this section, we explore what measures of empowerment have been used in the literature, and then provide a discussion on how we measure it in this dissertation.

Literature suggests that women's autonomy has been quantified by a wide variety of indicators that include the level of education, women's age at marriage, age difference with spouse (Abadian, 1996), and economic activity level e.g. engagement in cash earning job (Jeejebhoy & Sathar, 2001). Indeed these indicators are a proximate measure of women's

decision-making power because they capture a difference in the human capital endowment that supposedly has a bearing to some extent on determining women's bargaining power within the household. Nevertheless such differences in human capital—relative or absolute—can be regarded at most as an indirect measure of decision-making power. Notably they just capture a partial aspect of empowerment i.e. agency. Therefore those indicators may be inadequate in quantifying empowerment as far as the 'agency, resource, and achievement' framework is concerned. Likewise possession of any asset or ownership of land—another commonly used indicator in the literature—would only account for a partial aspect of empowerment and may be regarded as a proximate measure.

Agency itself is difficult to measure because we do not observe what choices are available and also because the agency is exercised at multiple levels: personal and collective (Hanmer & Klugman, 2016). Women's agency may increase as a result of enhanced knowledge but her influence in the household may remain unchanged. In order to capture women's status and empowerment in different domains of their lives, the Demographic and Health Surveys (DHS) has been collecting information from women of different countries since 1984 (ibid).

The DHS usually collects information from women of reproductive age (15-49 years) on such topics as attitudes to intimate partner violence, control over financial resources, freedom from violence, sexual and reproductive rights, and control over movement (Afridi, 2005; Durrant & Sathar, 2000; Kishor, 2005). With the availability of such information, studies have tended to use them as a more direct measure of agency. However, these measures clearly lack the capacity to reflect multidimensionality of women's empowerment which is essentially a process. In addition, such indicators may not particularly fit into the context of women of rural agricultural households.

Women constitute a significant proportion (about 40 percent) of the agricultural labour force all over the world and do the bulk of unpaid agricultural work (FAO, 2011a). Nevertheless, they face obstacles and economic constraints which limit their further inclusion in agriculture (USAID, IFPRI, & OPHI, 2012). In order to measure women's empowerment in rural societies in which women are generally engaged in agriculture, it is important to take into account their position in agriculture relative to men. Hence women's empowerment in agricultural households needs to be assessed in the context of resources used in agriculture, the agency in resource utilisation and enterprise selection, and contextual achievements. For the agricultural households, resources imply cultivable land, fishponds, large agricultural

tools, and machinery. Generally these resources are owned and operated by men, and consequently women have little or no influence on decisions concerning the utilisation of these resources. Women may not have been involved in decisions such as which crops to plant, whether or not sell the crop, where or when to sell. Thus women have little influence on the agricultural households' achievements that are the outcomes of decisions made without women's participation. In the case of small-scale farming, which is commonly found in developing countries, there may be a need for forming a group of farmers to utilise some agricultural services or inputs like credit, irrigation, combine harvester, and power tiller. Membership in such groups, ability to provide input into group discussions and negotiation with service providers feature important aspects of empowerment: thus whether or not women in agricultural households can participate in these reflects their empowerment. On the other hand, time constraints and workloads often narrow the realm of possible alternatives for the individual and accordingly abilities to choose. Thus the conventional indicators of autonomy mentioned previously seem inadequate and inappropriate to account for the multidimensionality of the concept of women's empowerment, especially of women in agricultural households.

The Women's Empowerment in Agriculture Index (WEAI) has been developed to comply with the need for a multidimensional measure of empowerment (Alkire et al., 2013a). The WEAI is based on national level surveys of households and is computed from the responses of the primary male and primary female decision makers in agricultural households. The WEAI has two components namely (i) a five-domain empowerment index which is computed at the individual level and (ii) a gender parity index measured at the household level. The first component of the index i.e. the five domains empowerment index is computed for both the primary male and primary female decision makers in a household. The five domains are:

1. **Production decision making**: Sole or joint decision-making power over food or cash crop farming, livestock, and fisheries, as well as autonomy in agricultural production.

2. **Access to productive resources**: Ownership of, access to, and decision-making power over productive resources such as land, livestock, agricultural equipment, consumer durables, and credit.

3. **Control over the use of income**: Sole or joint control over income and expenditures.

4. **Leadership in the community**: Membership in economic or social groups, and is comfortable speaking in public.

5. **Time allocation**: Allocation of time to productive and domestic tasks, and satisfaction with the time available for leisure activities.

The five domain empowerment index measures adequacy over the above five domains using 10 indicators with their corresponding weights. Each indicator is designed to measure whether an individual reaches a certain threshold i.e. has an adequate achievement (Alkire et al., 2012). Table 2.1 shows the 10 indicators along with their adequacy criteria and corresponding weights. All the five domains are equally weighted i.e. each domain has a weight of 1/5 which is further equally divided among domain-specific indicators. For instance we can see the production domain has two indicators and accordingly the domain weight i.e. 1/5 becomes 1/10 for each indicator. For each of these 10 indicators a value of 1 is given if the adequacy criterion is met; otherwise, the indicator takes a value of 0. In general the adequacy threshold is set at the middle of the answer scale because setting a high threshold would be too strict while the opposite would be too flexible in considering as having adequate achievements (Alkire et al., 2012, 2013b). Refer to the appendix 1 at the end of this chapter for the details of adequacy criteria. For a complete discussion on the adequacy threshold of all indicators along with the historical background of the WEAI, and test and validation of the component indicators: refer to Alkire et al. (2012, 2013b). Additionally a comprehensive instruction guide on how to calculate the WEAI can be found[2] at the IFPRI website. The weighted sum of the 10 indicators yields the five domains empowerment index of an individual. According to Alkire et al. (2013a) if an individual has adequacy in four domains (in other words if the index value is 0.80 or more) the person will be regarded as empowered.

The final score of the WEAI, which is a weighted value of the two components, involves a few more arithmetic steps. The details of the measurement are not reported here, for it is comprehensively described in Alkire et al. (Alkire et al., 2012, 2013b), USAID, IFPRI, & OPHI (2012; 2014). Additionally the details of the computation of the WEAI—an index value that is reported at country level—is beyond the scope of this dissertation as we focus on the individual level measure of empowerment i.e. five domains empowerment index.

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[2] https://www.ifpri.org/sites/default/files/Basic%20Page/weai_instructionalguide_1.pdf

Table 2.1 Definition and weight of the indicators of five domains empowerment index

Domains	Indicators		Adequacy criteria	Weight
Production decision making	I1	Input in production decisions	A woman is adequate if she participates or feels she has input in at least two types of decisions over food and cash-crop farming, livestock, and fisheries	1/10
	I2	Autonomy in production	A woman has adequate achievement if her actions are motivated more by her values as opposed to her fear of disproval or feelings of coercion	1/10
Access to productive resources	I3	Ownership of assets	A woman is adequate if she has joint or sole ownership of at least one major asset	1/15
	I4	Purchase, sales or transfer of assets	On assets owned by a household, a woman is adequate if she is involved in the decisions to buy, sell, or transfer assets	1/15
	I5	Access to decision on credit (i5)	An adequate woman belongs to a household that has access to credit and when decisions on credit are made, she has input in at least one decision regarding at least one source credit	1/15
Income	I6	Control over use of income	A woman is adequate if she has some input (or perceived input) on income decisions provided that she participated in the income generating activity	1/5
Community leadership	I7	Group membership	A woman is considered adequate if she is a member of at least one group from a wide range of economic and social groups	1/10
	I8	Speaking in public	A woman is considered adequate if she is comfortable speaking in public in at least one context	1/10
Time allocation	I9	Workload	A woman is considered to have an excessive workload and thus, inadequate if she worked more than 10.5 h in the previous 24 hours	1/10
	I10	Leisure	A woman has adequate leisure time if she does not express any level of dissatisfaction with the amount of leisure time available	1/10

Adapted from Alkire et al. (2013b) and Zereyesus et al. (2016)

This five domain empowerment index has several key strengths (Cunningham, Ploubidis, et al., 2015). First, it is a survey-based tool specifically designed to measure women's empowerment in agriculture. Second, it recognises the multidimensionality of empowerment. And third, it includes a composite index as well as disaggregated indicators that allow for a deeper understanding of the relative contribution of different dimensions of empowerment in a particular context.

2.5 Factors influencing women's empowerment

Not only is women's empowerment a multidimensional phenomenon, but also the factors affecting it as well as the process of empowerment are complex to understand. In this section, we discuss the factors that may have an influence on women's empowerment.

Among the factors that influence women's empowerment, education is thought of first and foremost because it is seen as an agent to expand women's knowledge and skills (Jayaweera, 1997). Also education is considered to improve women's ability to resist subjugation (Hogan, Berhanu, & Hailemariam, 1999) and it increases women's capacity to deal with the outside world (Kabeer, 2005). One of the crucial roles that education plays in human capital development is that it enhances one's potential for employment and income. By providing women with the necessary and adequate knowledge and skills, education paves the way for overcoming the barriers towards materialising their economic potential.

Employment and equal opportunities for employment are crucial for women's empowerment. When women work for pay outside their husband's farm or outside the home, then their socioeconomic status within the household and society tends to improve because their earning supplements household resources. When women earn, societies and households begin to recognise women's economic contribution and thereby women achieve respect and command. Also employment reduces women's economic dependence on men. In this way, participation in the labour market and earnings are crucial in influencing women's empowerment. It has been found in Bangladesh, India, and Nepal that women who are working and earning are more likely to have a voice and perhaps have a strong say in household decision-making than women who do not work and earn (Senarath & Gunawardena, 2009). More importantly, formal employment or semi-formal employment that provides women with earnings at regular intervals influences their agency, voice, and relationship within the household (Kabeer, Mahmud, & Tasneem, 2011). Women who are engaged in this type of employment tend to have some control over their income and investment decisions. When women work in different sectors, it builds confidence among other women as well as among employers and thus broadens employment opportunities for other women. Many people tend to approach the women who are engaged in formal jobs for opinions and information, which also amplifies the social value of women.

Access to and control over resources are not only one of the constituents of the process of empowerment but also a lack of them seriously affects women's well-being, socioeconomic status, and empowerment (Agarwal, 1994b). The most important resource for agricultural households is arable land, in which usually women have little or no control, especially in South Asia (ibid). Women generally lack the right to hold property, owing to religious and cultural practices. A prime example is the law of inheritance which legalises discriminatory right to inherit property for women (Agarwal, 1994a). As social norms further limit women's work in the agricultural fields, women lose their direct access to land. Moreover, legal property rights are also found to be discriminatory against women. There is evidence in Bangladesh that even if women own land, men (her husband or elder son) mainly controls its operation and that women often forgo their share of inheritance for their brothers (Cain et al., 1979). In the events of widowhood, abandonment or divorce, it is generally women who form the deprived group in relation to assets. All these factors lead to the women's lack of ownership of properties. As a result, they generally have too little or no power to participate in decision-making concerning the use of resources. By contrast, there is evidence in the literature that women who own land are more likely to have the final say on household decisions in Nepal (Allendorf, 2007).

Access to financial resources can also be vital for women's empowerment because it can potentially eliminate the effect of other limiting factors. It may help women to break the vicious circle of poverty and thereby can lift them from a poverty trap. In particular, access to credit may facilitate women to cope with the deprivation of land resources, property inheritance, and employment. However since women generally lack resources and constitute the most disadvantaged group in the poor rural areas, they often remain outside the reach of collateral loans. For poor rural women, a lack of skills combined with inaccessibility to credit limits their livelihood options. Micro-credit, which is a particular intervention mainly implemented by various NGOs to make credit available to resource-poor rural women, found to have a positive influence on women's socioeconomic status and empowerment. Numerous studies have documented such evidence of the significant effect of microcredit on women's empowerment (R. Amin, Becker, & Bayes, 1998; Chowdhury & Chowdhury, 2011; N. Islam, Ahmed, Chew, & Netto, 2012; Pitt et al., 2006; M. M. Rahman et al., 2014; Schuler, Hashemi, Riley, & Akhter, 1996). Micro-credit programmes require the participant women to meet in peer groups meeting usually on weekly basis, which enables women to establish control over their mobility. Apart from this, micro-credit acts as an additional income source

for women and thus reduces women's socioeconomic dependence on their husband. Women's participation in group-based micro-credit programmes exposes them to new ideas, values, and social support, which eventually leads to greater assertiveness. They become aware of their legal rights and about the source of potential legal support in case of any conflict or violence. All these provide women with control over material resources, thus they secure increased domestic prestige and importance in the eyes of their husbands who then seek wife's consultation in household matters (R. Amin et al., 1998).

Institutions—both formal and informal—have a considerable effect on women's empowerment (World Bank, 2012). Examples would be when law and regulations segregate men and women in ownership rights, prohibition of women's work in some sectors, or restrictions on hours of work. Institutions tend to reflect those who wield more power and influence, which are difficult to change. Thus institutions can constrain women's agency and opportunities more than those of men.

Along with institutions social norms shape women's empowerment (ibid). Social perceptions and attitudes towards women may determine the endowments and opportunities that women have and thus can negatively influence women's empowerment. When women do not work outside the home, their daughters are also less likely to work as adults, and their sons are less likely to marry women who work outside the home. In this way, discriminatory attitudes may be propagated across generations, which may reproduce over time through social norms.

In sum, women's empowerment is likely to be influenced not only by a single factor instead a wide variety of factors may have an effect. Education, employment opportunities, access to and control over productive resources, access to credit, institutional constraints, and social norms all may have an important bearing on empowerment.

2.6 Women's socioeconomic status in Bangladesh

Women's socioeconomic status varies across different regions of the world, with the Nordic countries leading the league of countries having gender equality; and South Asian countries listing towards the bottom (World Economic Forum, 2015). Although Bangladesh is located in the latter region, it is considerably different from its neighbouring countries in respect of gender equality, which is clearly manifested in its relatively higher rank in the global gender gap index. While none of the South Asian countries ranks within the top 50 countries on the list, Bangladesh is the only country to secure a rank within top 65 (64th to be exact) (ibid).

This is quite a remarkable feature of the country despite its widespread poverty. Notwithstanding this, the country's women still share similar features that are common in South Asia. The most notable such features are: they are largely excluded from family decision-making, they have limited access to, and control over resources, they lack freedom of movement, and they are frequently subject to threat and violence (Jejeebhoy & Sathar, 2001).

The discriminated status of women relative to men in Bangladesh features harmful and discriminatory practices such as child marriage, abandonment, dowry, and gender-based violence (F. S. Begum, 2014). Violence against women takes place at home, in the workplace, and in public spaces, and women looking to migrate to work easily fall victim of trafficking. In Bangladesh among the ever-married women, 72.60 percent report having experienced psychological and physical violence (BBS, 2016a). Beating, burning or even murdering a wife for dowry is becoming an everyday phenomenon in Bangladesh. The discriminatory practice against women in Bangladesh is deeply rooted in the country's age-old socio-cultural norms that favour boys over girls.

The country is characterised by a patrilineal and patriarchal kinship system which enforces the social and economic dependence of women on men. "Family and kinship relations in Bangladesh are organised along patriarchal lines, with authority vested in the senior male household head. Descent and property are transmitted through the male line, leaving women effectively without property and genealogically irrelevant" (Kabeer et al., 2011). Women in Bangladesh have little control over productive resources such as land and money because the inheritance practice in the country is strongly biased towards sons whereas wife and daughters are disadvantaged (Patalagsa, Schreinemachers, Begum, & Begum, 2015). In rural Bangladesh, women are commonly expected to be in *purdah* (seclusion) and not encouraged to work outside their *bari* (homestead) (Jahan, 2015). In poor families daughters are seen as economic liabilities and are socially undervalued because of the patrilocal marriage system which removes a newly married bride from her natal family and place to the husband's locality. Such practices towards girl prompt parents to undervalue the importance of their daughter's education and to prefer their daughters get married at an early age. Early marriage of girls is highly prevalent among rural communities of the country, which then leads to early motherhood. Because of these interplaying factors, the school dropout rate is high among girls and fewer women than men have completed post-secondary education in Bangladesh. This particularly affects women's economic potential and prospects for empowerment. Women's

concentration remains high in low-paid jobs and their earnings are usually lower than that of men because of the country's prevailing gender wage gap: women's wages are about 58 percent of those of men in Bangladesh (UNDP, 2010). Gender inequality in core human capital endowment persists in the country and thereby constrains the integration of women in economic development activities in order to achieve the sustainable development goals.

Table 2.2 compares the gender differential over time regarding socioeconomic and health indicators in the case of Bangladesh. It is evident from the indicators presented in the table that while gender disparity is still prevalent in the country but much improvement has also been taken place over past three decades.

Table 2.2 Gender differentials in economic and social indicators in Bangladesh

Indicators	1980		2010	
	Male	Female	Male	Female
1. Economically active population in labour force (%)	86.80	29.17	82.50	36.00
2. Unemployment rate (%)	2.50	3.60	4.00	5.70
3. Unpaid household work (%)	15.60	86.60	13.90	81.70
4. Literacy rate of population aged over 5 years (%)	38.90	25.50	57.60	52.50
5. Labour force having no education (%)	49.20	66.90	39.90	40.60
6. Labour force in Agriculture (%)	74.03	47.61	40.10	64.80
7. Infant mortality per 1000 live births (numbers)	102.30	97.40	36.00	33.00
8. Mean age at marriage (years)	23.90	16.70	24.90	18.70
9. Life expectancy (years)	57.00	57.10	68.90	70.30
10. Net school enrolment at the age group 6-10	40.00	30.00	82.61	86.99

Sources: Indicators 1 to 6 are obtained from the reports on labour force surveys of Bangladesh (BBS, 1992, 1996, 2011b); indicators 6 to 10 are obtained from the statistical yearbook of Bangladesh (BBS, 1983, 2016b).

Referring to the literacy rate, it can be seen that men's literacy rate in 2010 is about 58 percent which is higher than women's literacy rate of 53 percent. The difference is, however, lower in comparison with the difference in 1980 when the literacy rate was about 39 percent for men and 25.50 percent for women. Over the last few decades, the literacy rate has increased markedly for both genders in 2010. The Government of Bangladesh played an important role in improving female education through a variety of policies over the past few decades. The country's success in educating its female population follows from the introduction of Food for Education (FFE) in 1993 and a cash transfer scheme—the Female Secondary Stipend programme (FSS)—in 1994 (A. U. Ahmed & Del Ninno, 2002; Shamsuddin, 2015). These initiatives were primarily taken with a view to motivating parents of poor families to send their children to school for education as opposed to engaging children for earnings. Subsequently, the government offered free primary education for boys and girls, and

secondary and higher secondary education was made free for female students. The impact of these policies is reflected in the net school enrolment, in particular girls' school enrolment which rose approximately three-fold over the past three decades. Furthermore, the gap between male literacy and female literacy fell from 13 percent in 1980 to 5 percent in 2010 owing to the national policy actions. Apart from initiatives of the government, different NGOs also played a supporting role by providing opportunities for basic education to a target group who could not be at formal schools. *Madrashas*—Muslim ideology based learning centres—have been playing a vital role in reaching extremely poor female students who would otherwise not get any kind of education (A. U. Ahmed & Del Ninno, 2002; Asadullah & Chaudhury, 2009; M. S. Islam & Dogra, 2011).

The education policy interventions also brought about some other favourable changes for girls. There were specific eligibility criteria for girls to receive a conditional cash transfer from the government. One of the criteria to get such cash support was that the female student must be unmarried (A. U. Ahmed & Del Ninno, 2002). This discouraged parents from getting their daughters married early and led to a change in their perceptions about daughters' education. Perhaps this has led to the rise of women's mean age at first marriage in recent decades. Age at first marriage[3] has increased notably for women from around 16.70 to 18.70 years (BBS, 2016b).

Although very impressive gains have been achieved in respect of educational attainment, still around 40 percent of the labour force of both genders has no education. Moreover the increase in female literacy has not been well reflected in the labour market participation, as indicated by the substantial gender gap in participation in the labour force. In 2010, 83 percent of men of economic active age were participants in the labour force; whereas the rate for females was only 36 percent. In addition, the increase in women's labour force participation has been very slow. As can be seen in Table 2.2, the proportion of women in the labour force[4] was about 29 percent in 1980 and it went up only around 7 percent over a period of 30 years. This possibly reflects two aspects. First, women's participation in the labour market is poverty-driven (Asadullah & Wahhaj, 2016b; S. Begum & Sen, 2009), and second, creating employment opportunities for women remains a challenge as the larger share (81.70 percent) of the

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[3] Minimum legal age for girl's marriage in Bangladesh is 18 years. Nonetheless, there are instances of early girls' marriage in Bangladesh. For example, between 2008 and 2014, 18 percent of the country's women aged between 20 and 24 years got married by 15 years and 52 percent got married 18 years (UNICEF, 2016). The Bangladesh Health and Demographic Survey also reported that mean age at first marriage of women in the age group 20-49 years was less than 18 years (NIPORT et al., 2016).
[4] Labour force comprises individuals who are aged between 15 and 64 years

economically active women have to engage in unpaid household work. The gender disparity in unpaid workload puts women in a disadvantageous position with regard to time and employability. In such ways, women remain dependent on their male counterparts for livelihoods; this ultimately undermines their social status and recognition owing to strong patriarchal socio-cultural norms e.g. *purdah*.

The rise of microfinance and the rapid expansion of the readymade garments industry have helped Bangladeshi women enormously in terms of their employment and other economic opportunities. While the garments industry provided direct employment in cities, microfinance helped to create self-employment for millions of women especially in rural areas (M. S. Islam & Dogra, 2011). In Bangladesh, microfinance institutes—both state-run and NGOs based—adopted strategies to provide loans to poor borrowers, especially to women borrowers. Grameen Bank, BRAC, Proshika, and Bangladesh Rural Development Board (BRDB) are only a few to mention among hundreds of microfinance providers in the country. Generally microfinance institutes provide collateral-free and low-cost credit to a small group of like-minded individuals (Alam, 2012), and such a group of like-minded individuals remains responsible for the repayment of each individual's loan. With such credit becoming available to poor rural Bangladeshi women, they began to invest in home-based small-scale income generating activities (IGAs). Thus micro-credit has given poor women opportunities to earn income which is likely to improve woman's situation within households.

With the rise in educational attainment and the spread of microfinance institutes, the opportunity cost of time for women has risen and they now tend to engage in various economic activities to complement livelihoods. With the reduction in infant mortality owing to improvement in child and maternal health care facilities throughout the country, a notable reduction in fertility rate has also occurred in Bangladesh (from 6.3 in 1975 to 2.3 in 2014) (data not shown in Table 2.2) (NIPORT, Mitra and Associates, & ICF International, 2016). This reduction in fertility rate has enabled women to free up time from household responsibilities for earning activities. Reduction in fertility has been accompanied by a reduction in infant and child mortality and improvement in sex ratio (sex ratio in infant mortality is better in Bangladesh compared with India and Pakistan) (World Bank, 2013).

Over the past three decades, all these factors have exerted positive effects towards reducing gender inequality and improving the socioeconomic status of women in Bangladesh in spite of the country's patriarchal culture. In line with this, the country's phenomenal progress in

female education and basic health care facilities draws the attention of experts around the world. Nevertheless, progress has been slow and disparities persist in the attainment of higher education, labour force participation and employment, and relative position within household and society. Consequently, it has not yet been possible to remove fully the barriers to women's inclusion in the country's economic development process. The failure to increase women's engagement in the process of economic development would also hinder the country's other initiatives to reduce poverty and achieve well-being.

In the subsequent three analytical chapters (chapter 4 to 6), we will analyse empirically the role of women's schooling on child health, food and nutrition security, and women's own subjective well-being. If women's enhanced capabilities are conducive to economic development, then we expect to see a positive impact of women's education and empowerment across those indicators of well-being. Thus our findings would reinstate the instrumental and intrinsic value of women's enhanced capabilities, which may become particularly relevant and useful for the concerned policymakers in designing and implementing appropriate policy actions for the country's economic growth and development. Before we present the analytical chapters, we will have a discussion on the source of data, description of data collection, and computation of five domains empowerment index in the next chapter. We will also present information on the sample women's socioeconomic status and their participation in household's expenditure decision.

Appendix 1 Adequacy criteria of the empowerment index

Domain 1: Production

Indicator	Questions	Answer scale	Method	Adequacy criteria
Indicator 1: Input in production decision	1. If an individual had participated in any activity, how much input did the individual have in making decisions about a) food crop farming, b) cash crop farming, c) livestock raising d) fish culture	1 = no input 2 = input into very few decisions 3 = input into some decisions 4 = input into most decisions 5 = input into all decisions	For each activity, a sub-indicator is created, which considers the individual is adequate if he or she participates in the activity and has **at least input into some decisions related** to that activity.	Sub-indicators from questions 1 and 2 form the indicator "input in production decisions". An individual is considered adequate on this indicator if he or she is adequate in at least two of the sub-indicators of question 1 and 2. In other words, an individual is considered adequate if there are at least two types of decisions in which he or she has some input in decisions, makes the decision, or feels he or she could make it to a medium extent if he or she wanted to.
	2. To what extent does the individual feel he or she can make his or her own personal decisions regarding the following aspects of household life if he or she wanted to? a) agricultural production, b) which inputs to buy c) which types of crops to grow for agricultural production, d) when to take or who should take crops to market, and e) whether to engage in livestock raising	1 = not at all 2 = small extent 3 = medium extent 4 = to a high extent	For each aspect, a sub-indicator is created, which considers the individual as adequate if the individual feels that he or she could participate in the decision making to at least a medium extent.	
Indicator 2: Relative autonomy in production decision	1. My actions in [activity area] are partly because I will get in trouble with someone if I act differently 2. Regarding [activity area] I do what I do so others don't think poorly of me 3. Regarding [activity area] I do what I do because I personally think it is the right thing to do. The activity areas refer to: i. Agricultural production, ii. Which inputs to buy, iii. Which types of crops to grow, iv. When to take or who should take crops to market v. Livestock production	1 = never true 2 = not very true 3 = somewhat true 4 = always true	Relative Autonomy Index (RAI) is computed. This index corresponds to the weighted sum of the different types of regulations' subscales. The conventional weights are ⁻2 for external regulation (coercion), ⁻1 for introjected regulation (trying to please), and 3 for identified regulation (own values). The index varies between ⁻9 and 9. See an example on next page.	An individual is considered to have adequate autonomy in production if his or her RAI is greater than 1 in at least one of the five areas of decision-making.

30

A hypothetical example of computation of the RAI in the case of one of the activities e.g. input purchase.

Activity area	(1) My actions in [activity area] are partly because I will get in trouble with someone if I act differently.	(2) Regarding [activity area] I do what I do so others don't think poorly of me.	(3) Regarding [activity area] I do what I do because I personally think it is the right thing to do.	RAI
	Weight = -2	Weight = -1	Weight = 3	
Input purchase	1 = never true 2 = not very true 3 = somewhat true 4 = always true	1 = never true 2 = not very true 3 = somewhat true 4 = always true	1 = never true 2 = not very true 3 = somewhat true 4 = always true	$(-2)(1)+(-1)(2)+(3)(3)=$ $-2-2+9 =5$

Domain 2: Resource

Indicator	Aspect	Response code	Method	Adequacy criteria
Indicator 3: Ownership of land and assets	List of assets i. Agricultural land, ii. Large and small livestock, fishponds, iii. Farm equipment, iv. House, v. Large and small household durables, vi. Cell phone, vii. Non-agricultural land, and viii. Means of transportation	Self =1 Spouse =2 Self and spouse jointly =3 Other household member =4 Self and other household member = 5 Spouse and other household member =6 Self and other outside people =7 Spouse and other outside people =8 Self, spouse and other outside people =9 Someone (or group of people) outside the household =10	Check if the individual, alone or jointly, owns any of the eight assets.	An individual is adequate on ownership of asset if he or she owns at least one asset, as long as it is not chickens, ducks, turkeys, pigeons, non-mechanised farm equipment, or small consumer durables. An individual from a household that does not own any type of asset is considered inadequate.
Indicator 4: Decisions regarding the purchase, sale, or transfer of land and assets	Who is the person who can decide regarding the purchase, sale, or transfer of land and assets? Assets: same as above.	Same as above	Check if the individual, alone or jointly, has right to sell, to give, to rent or to buy the asset.	An individual has adequacy if he or she has at least one type of right over at least one of the eight assets. An individual who lives in a household that does not own any type of agricultural asset is considered inadequate and, hence, are assigned the value 0 for this indicator.

31

Indicator	Aspect	Response code	Method	Adequacy criteria
Indicator 5: Access to and decisions about credit	Whether to obtain credit from various sources i. NGO, ii. formal and informal lenders, friends or relatives, iii. rotating savings, and iv. credit associations	Same as above	Check if the individual lives in a household that has taken a loan in the past 12 months from at least one of the potential sources of credit. For each source of credit, check if the individual, alone or jointly, makes decisions on borrowing or how to use the credit.	An individual is classified as adequate if he or she makes at least one decision relating to credit from at least one source. An individual who lives in a household that does not use any source of credit is considered inadequate.
	and how to use the credit obtained from various sources stated above	Same as above		

Domain 3: Income

Indicator	Aspect	Answer scale	Method	Adequacy criteria
Indicator 6: Control over use of income	If an individual participated in the activity, how much input did the individual have in decisions about the use of income generated from i. food crop farming, ii. cash crop farming, iii. livestock raising, and iv. fish culture	1 = no input, 2 = input into very few decisions, 3 = input into some decisions, 4 = input into most decisions, 5 = input into all decisions	For each activity, a sub-indicator is created, which considers the individual as adequate if he or she participates in the activity and has at least some input into decisions related to the particular activity.	The two sub-indicators are aggregated into an indicator for control over income. An individual is considered as adequate if he or she is considered adequate in at least one of the sub-indicators. Household's minor expenditures are not taken into account.
	To what extent does the individual feel he or she can make his or her own personal decisions regarding the following aspects of household life if he or she wanted to i. his or her wage or salary employment, and ii. major and minor household expenditures	1 = not at all, 2 = small extent, 3 = medium extent, 4 = to a high extent.	For each type of decision, a sub-indicator is created, which considers the respondent as adequate if he or she makes the decisions himself or herself or if the respondent feels that he or she could participate in the decision-making at least to a medium extent.	

Domain 4: Leadership and community influence

Indicator	Aspect	Answer scale	Method	Adequacy criteria
Indicator 7: Group membership	Whether or not the individual is an active member of at least one group including: (1) agriculture producers' or marketing groups, (2) water users' groups, (3) forest users' groups, (4) credit or microfinance groups; (5) mutual help or insurance groups (including burial societies), (6) trade and business associations, (7) civic or charitable groups, (8) local government groups, (9) religious groups, and (10) other women's groups.			An individual is considered as adequate if he or she is a member in at least one of the groups.
Indicator 8: Speaking in the public	Whether or not the individual is comfortable in speaking in public for three reasons: (1) to help decide on infrastructure (e.g small wells, roads) to be built (2) to ensure proper payment of wages for public work or other similar programs, and (3) to protest the misbehaviour of authorities or elected officials.	1 = no, not at all comfortable 2 = yes, but with a great deal of difficulty 3 = yes, but with a little difficulty 4 = yes, fairly comfortable 5 = yes, very comfortable	For each of the three reasons, a sub-indicator of the individual's comfort in speaking for that specific reason was created. The answer code 2, 'yes, but with a great deal of difficulty', is the cut-off.	The three reason-specific sub-indicators are aggregated into an indicator 'speaking in public'. An individual is considered as adequate if he or she is comfortable speaking in public for at least one of the three reasons.

Domain 5: Time use

Indicator	Aspect	Response	Method	Adequacy criteria
Indicator 9: Workload	It refers to the allocation of time to productive and domestic tasks	The productive and domestic workload is derived from a detailed 24-hour time allocation module in which respondents are asked to recall the time spent on primary and secondary activities in the 24 hours prior to the interview, starting at 4:00 am on the day before the interview.	The number of hours worked is defined as the sum of the time that the individual spent on the primary activities plus 50 percent of the time he or she spent on the secondary activities. The primary work-related tasks includes (i) wage and salary employment, (ii) own business work, (iii) farming, (iv) construction, (v) fishing, (vi) shopping/getting service, (vii) weaving/sewing, textile care, (viii) cooking, (ix) domestic work, (x) caring for children/adults/elderly, (xi) commuting, and (xii) travelling	An individual is defined as adequate if the number of hours he or she worked is less than the time poverty line of 10.5 hours in the 24 hours.
Indicator 10: Leisure	An individual's satisfaction with the time available for leisure activities.	1 = not satisfied . 5 = indifferent . 10 = very satisfied		The respondent is considered as adequate if he or she ranks his or her level of satisfaction equal to or higher than 5.

Chapter 3

Study background and data

3.1 Introduction

In this chapter, we provide background information on Bangladesh and a description of the source of our data. In addition we discuss the sample selection process, household characteristics of the sample, and women's status within the sample households. We discuss them in the following separate subsections in turn.

3.2 A brief overview of Bangladesh

Bangladesh emerged as an independent country on 16 December 1971. Geographically it is located in the northeastern part of South Asia covering an area of 147,570 square kilometres. Since 1991 the country has been ruled by a parliamentary form of government, headed by a Prime Minister; while the President remains the head of the State. The country has an estimated population of 164.7 million (PRB, 2017) which implies more than 1,100 people live per square kilometres, and thus it becomes one the most densely populated countries in the world. The country's population has a slightly higher proportion of male as revealed in its sex ratio which is 100.25 men per 100 women. The fertility rate is 2.3 meaning that, on an average, a woman gives birth to more than two children through her reproductive ages in Bangladesh. The country's civilian labour force is estimated to be 57.1 million of which women account for approximately 30 percent (BBS, 2015).

Bangladesh is generally a low-lying flat region with some hilly areas in the northeast and the southeast. Land is the most scarce and vital natural resource in the country. Fertile soils together with the sub-tropical monsoon climatic condition make the country especially adaptive to agriculture. The agriculture sector forms the backbone of the country's economy and by contributing 17.22 percent to the Gross Domestic Product (GDP) (BBS, 2016b) the sector stands out to be the single largest producing sector in Bangladesh. This sector accommodates around 46 percent of the country's labour force (ibid), and in the rural areas it provides livelihood to majorities. In addition to providing employment to the largest share of the country's labour force, the agriculture sector also strongly supports several other subsectors in the service sector such as wholesale and retail trade, and transport. In this way, the national economy of the country predominantly depends on the performance of agriculture

sector (BBS, 2010). Among the non-agricultural sectors, the ready-made garment industry makes a very substantial contribution to the national GDP.

The headcount rate of the incidence of poverty based on the costs of basic needs is 24.30 percent in the country, which is even higher (about 26 percent) in the rural areas (BBS, 2017). Although the incidence of poverty has fallen at a rate of 1.74 percent over the first decade of the new millennium (World Bank, 2013), the issue of poverty reduction and food insecurity are still central to the country's development concerns as about a quarter of the population is unable to meet the costs of basic needs. Moreover, child under-nutrition is highly prevalent in the country as 36 percent of the country's children aged below 5 are chronically malnourished (stunted) and about 33 percent children weigh less than the recommended weight of children of same gender and age (NIPORT et al., 2016). The higher incidence of under-nutrition and poverty poses a major development challenge for the country. Also alarming is that about 22 percent babies born with low birth weight in the country (UNICEF, 2016).

As regards the situation of women, Bangladesh has made great strides in reducing gender discrepancy in comparison with other South Asian countries (UNDP, 2011). The country's constitution has granted equal rights for women with men in all spheres of state and public life (GoB, 2011). In the national parliament, 50 seats amounting to one-sixth of the total constituencies are reserved for female members. Not only are several ministries led by women, most importantly the country has been ruled by a female Prime Minister since 1991. Women's noticeable presence in the political arena, a rise in educational attainment, opportunities for employment in the export-oriented garment industries, and access to microfinance have been leading to an improvement in women's socioeconomic status in the country (discussed in section 2.6). This is also bringing about changes in people's perception about women. Notwithstanding the progress, girls and women still face challenges in realising their human potential. The country has the third highest incidence of child marriage in the world (Asadullah & Wahhaj, 2016a). Child marriage usually precedes early pregnancy which consequently may bring about various health complications among the young married girls. About 8 percent of women's deaths are caused by pregnancy-related complication and as many as 90 percent women give birth of a baby at home in rural Bangladesh (BBS, 2016b). The concern here is that not only does early marriage lead to a higher risk of death, but it also seriously curtails girls' opportunities for higher education and ultimately employability. Although girls outnumber boys in primary and secondary education, it reverses at tertiary education as women account for only about one-third of the current university students

(BANBIES, 2016). This perhaps attributes to women's less representation in highly paid jobs as well as to the substantial gender wage gap that prevails in the country. Women's unique responsibilities for childbearing and care often cause the withdrawal of their participation from the labour market, leaving them dependent on men. In Bangladesh violence against women is also very common. About two-thirds of ever-married women in Bangladesh experience some kind of violence from the intimate partners (BBS, 2016a). They rarely have any access to productive resources, especially arable land. Their low status relative to men within the household and in society gives them little or no power to participate in household decision-making concerning resource allocation. Indeed, rights and liberty are a dream to many women in Bangladesh (BBS, 2016b).

3.3 Source of data and background information about the survey

The Government of Bangladesh considers agricultural development a major priority alongside food and nutrition security. With a view to investigating issues concerning food security and agricultural development, the Bangladesh Policy Research and Strategy Support Programme (PRSSP) was launched in October 2010. It is funded by the United States Agency for International Development (USAID) and implemented by the International Food Policy Research Institute (IFPRI). For the purpose of meeting the data requirements of the IFPRI-PRSSP's research, the IFPRI researchers designed the Bangladesh Integrated Household Survey (BIHS). This survey also serves as a baseline for the United States (US) Government's global initiative to address the root causes of poverty, hunger, and under-nutrition (A. U. Ahmed et al., 2013). The IFPRI-PRSSP research plan includes three rounds of the BIHS. The first round of the BIHS, which was conducted in 2011-2012, is used as a reference point to measure progress through repeat surveys. The second round was carried out from January to June in 2015, and the third round is planned to be conducted from November 2017 to March 2018 (A. U. Ahmed, 2016). Since the second round of the BIHS became available for non-IFPRI researchers in December 2016 (Nilam, 2017), by when the majority of this dissertation's analysis was completed, we are unable to utilise the panel nature of the BIHS.

We obtain our data from the first round of the Bangladesh Integrated Household Survey (BIHS) 2012 (A. U. Ahmed, 2013). It is worth mentioning that the BIHS is the most comprehensive household survey dataset available for Bangladesh to date (A. U. Ahmed et al., 2013), and it has some notable strengths over the other datasets available for Bangladesh.

Two potential alternative datasets include the Bangladesh Demographic and Health Survey (BDHS) and the Household Income and Expenditure Survey (HIES). The former is a particularly rich dataset for health-related information of children e.g. immunisation and anthropometric indicators. Also, it has data on women's participation in household decision-making relating to domestic affairs. However this dataset has no information on food security and subjective well-being. Thus the BDHS has not been used in our dissertation.

The other available national household survey is the Bangladesh Household Income and Expenditure Survey implemented by the State agency—Bangladesh Bureau of Statistics (BBS)—which collects food consumption data but at household rather than individual level. Moreover it has no information on anthropometric indicators and subjective well-being measures. Most importantly, none of the aforementioned datasets would enable us to measure the empowerment of women engaged in agriculture in a multidimensional framework.

The BIHS, which is used in this thesis, is the only nationwide household survey that has collected data on (i) individual-level dietary intake of all household members; (ii) anthropometric measurement of all household members; (iii) a wide range of empowerment measures from the primary male and primary female member of the same household; and (iv) life satisfaction. In addition, the BIHS carried out a community survey to complement information on area-specific contextual factors. Given its richness, the BIHS stands out to be the most appropriate dataset for this dissertation. However utilising the dataset essentially confines the scope of our analysis to rural households, as the BIHS has covered rural households only.

3.3.1 Sampling

The BIHS sample is statistically representative of rural areas of each of the seven administrative divisions of Bangladesh: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet. The survey followed stratified sampling in two stages: first, selecting the primary sampling unit (PSU) i.e. villages; and second, selecting households within each PSU using the sampling frame developed from the community series of the 2001 population census of Bangladesh. The sampling technique required the BIHS to survey 6,503 households from 325 primary sampling units (PSU) across Bangladesh. Figure 3.1 shows the country map of Bangladesh in which each black dot represents a survey area.
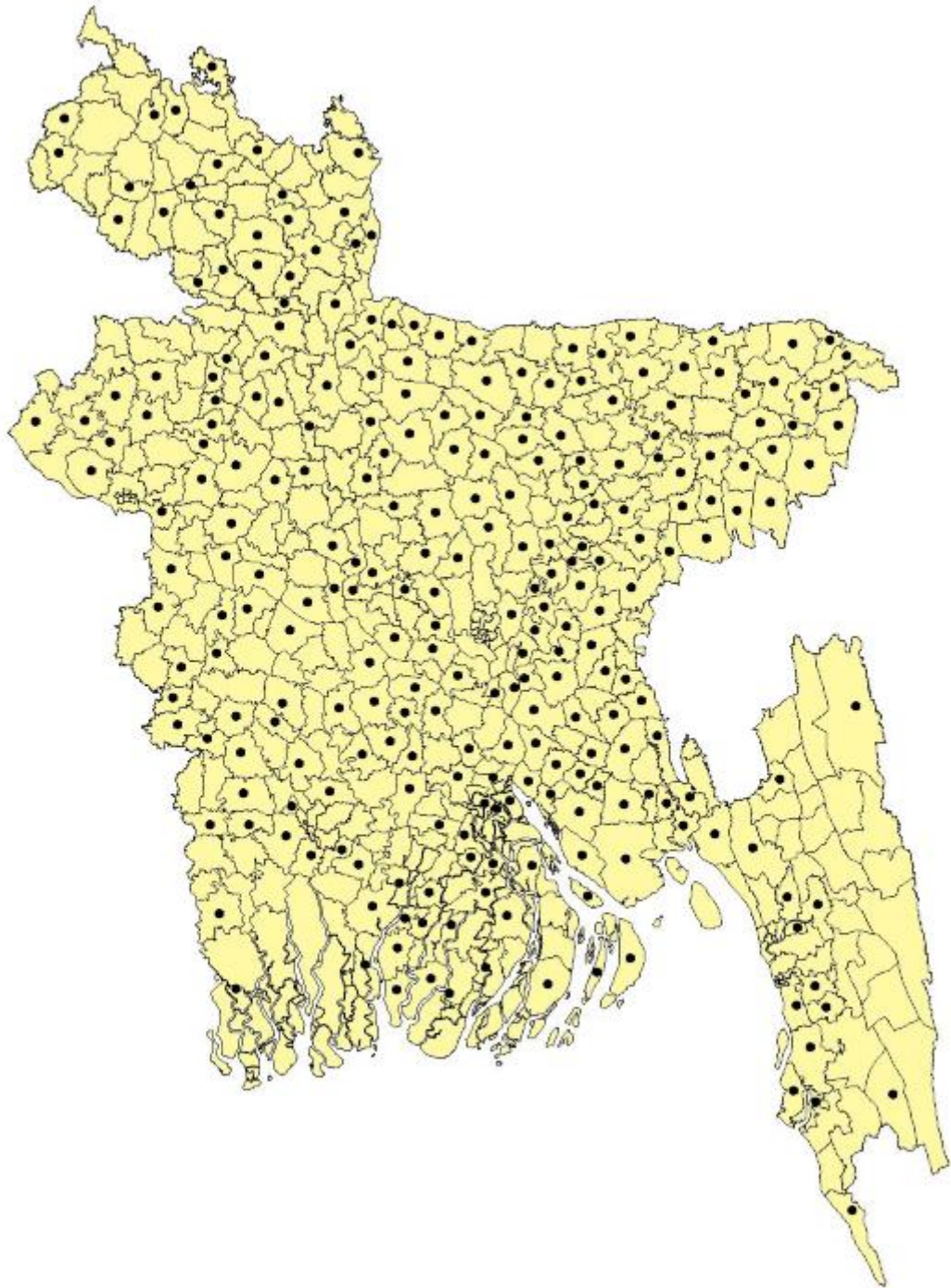
Figure 3.1 Distribution of the primary sampling units across Bangladesh

Source: A. U. Ahmed et al. (2013)

3.3.2 Survey instrument

The BIHS used a two-part questionnaire – one part for female respondents and the other for male respondents. For implementing the survey the IFPRI contracted Data Analysis and Technical Assistance (DATA) Limited— a consulting firm in Bangladesh. The firm trained 60 female and 60 male enumerators as well as 3 female and 17 male supervisors to conduct

the survey. In addition, there were 4 female and 6 male editors to edit the completed questionnaire in the field during the survey.

3.3.3 Survey administration

The female enumerators interviewed an adult female household member (generally wife of the head of the household) of a household, and the male enumerator interviewed an adult male member of the household who is generally the household head. It took about four hours for an enumerator to complete the questionnaire i.e. eight hours to survey a household. The surveyed household received some financial gift in appreciation of the time given for the survey. The first round of the BIHS survey started on October 26, 2011 and ended on March 15, 2012. On completion of the data entry and cleaning, the DATA delivered the complete dataset to the IFPRI-PRSSP at the end of June 2012 (A. U. Ahmed et al., 2013).

The IFPRI and DATA took extensive care to ensure the quality of the survey data. For instance, at the place of the survey the supervisors oversaw the interviews conducted by the enumerators routinely on a daily basis and verified whether enumerators had completed all the questionnaires. If the supervisors detected any inconsistent responses in the completed questionnaires, they visited the concerned respondents to find out the reasons and corrected the responses as needed. In addition, the supervisors made random checks of about 10 percent of the completed questionnaires by revisiting the sample households. The IFPRI researchers also made frequent field visits to supervise the fieldwork (ibid.).

3.4 Selection of the sample for this dissertation

It is important to illustrate how we select the sample for this dissertation from the BIHS households. The selection process can be understood with the aid of Figure 3.2. Altogether the BIHS has surveyed 6,503 rural households across Bangladesh; however, the specific information relating to immunisation, mother's nutrition and health knowledge, and feeding and hygiene practices has been collected only in the case of a household that has a child up to the age of 24 months. It may be worth noting that the information has been collected for only one child from each eligible household. In the BIHS, there are 1,136[5] such households hence the relevant information is available for 1,136 children up to two years and their mothers. From these 1,136 children, we have selected a sample of children for chapter 4 on the basis of the child's relation to the household head. We retain only those children in our working

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[5] Of these households, 331 households are non-agricultural households.

sample who are household head's own child. In other words, if the surveyed child is household head's niece, nephew, grandchild or any other relation then we exclude them from our working sample. This exclusion criterion along with unavailability of information on relevant variables has reduced the sample to 887 children of which 280 children are from non-agricultural households.
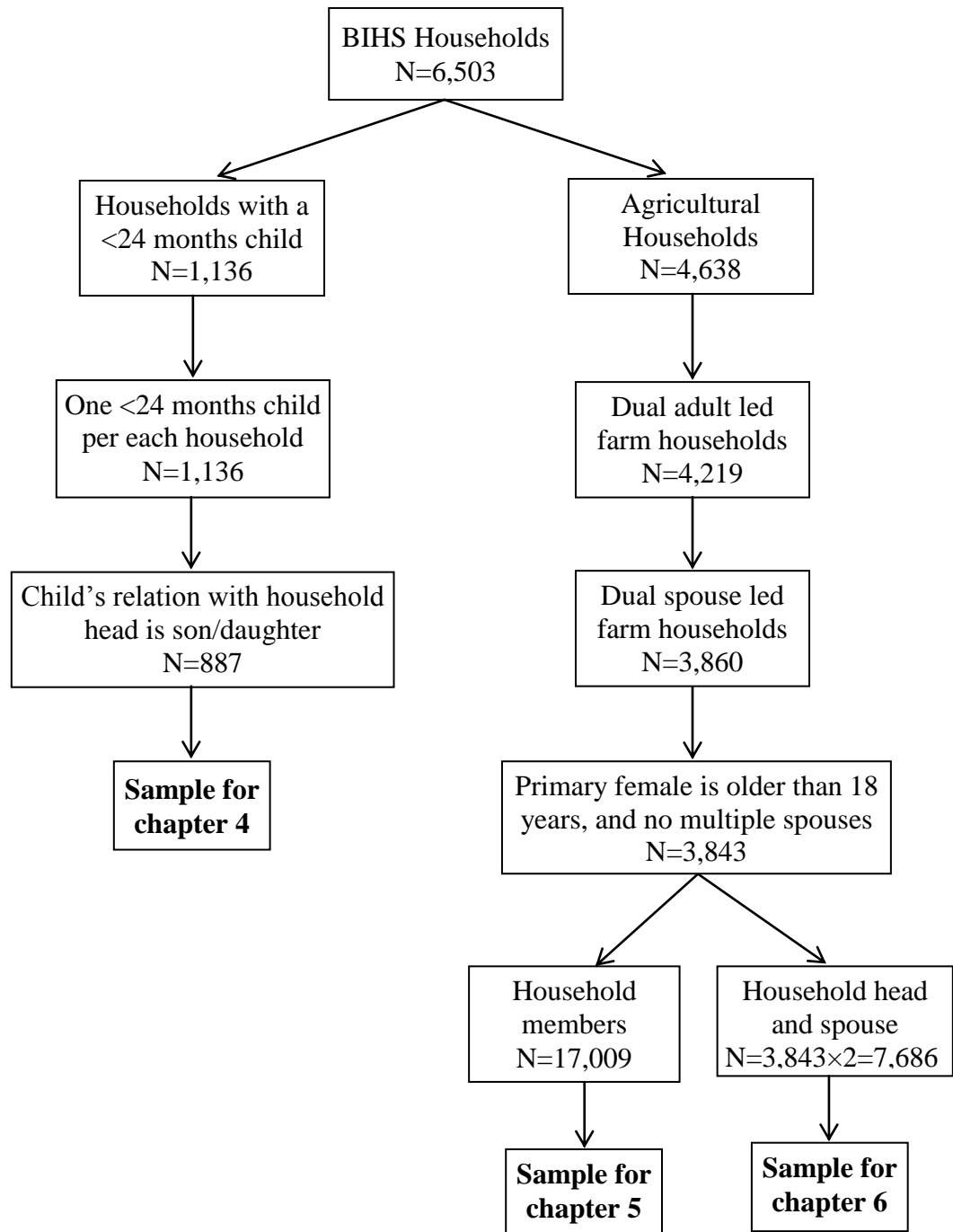
Figure 3.2 Diagrammatic presentation of the sample selection process

Note: N means number

As we have already mentioned, the BIHS is a particularly rich dataset in regard to information on empowerment measures. The survey has collected extensive information on various aspects of empowerment from both the primary male and primary female household members. This is so because one of the purposes of the survey was to assess empowerment of women in rural agricultural households in Bangladesh through the Women's Empowerment in Agriculture Index (WEAI).

We explicitly focus on women's empowerment in chapters 5 and 6, where we examine the impact of women's empowerment on food security and subjective well-being, respectively. Since the weighted multidimensional index is appropriate for quantifying the empowerment of women who belong to agricultural households, we exclude any non-agricultural households from our working sample that we use in chapter 5 and 6. Additionally we exclude some households from our sample on the basis of the following three criteria: (i) the primary female member is not the spouse of the household head; (ii) the household head has more than one wife[6]; and (iii) the primary female respondent is the spouse of the household head but not an adult i.e. aged below 18 years. Furthermore households without an adult primary male member or an adult primary female member are also excluded from the working sample because non-spousal intra-household bargaining power is beyond the interest of this dissertation. In this way, we eventually found 3,843 households that are dual spouse-led households and are engaged in agriculture. The household members of those 3,843 agricultural households form the working sample for chapter 5, and the household heads as well as their spouses from those households compose the working sample for chapter 6 (see Figure 3.2).

It is worth pointing out that in those 3,843 households, the primary female member is a wife of the household head and is the mother of the household head's children. Therefore in chapter 5 she is regarded as the mother and is regarded as the primary female member of the household in chapter 6.

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[6] It may be very interesting to see what happens to women's empowerment if the male household head has more than one wife in a household; however, we opted for excluding those households that have more than one wife because of too little representation in the overall sample. We are aware of only 13 agricultural households wherein the household head had more than one wife.

3.5 Demographic, socioeconomic, and household characteristics of the sample

This subsection accompanied by Tables 3.1 and 3.2 presents an overview of the characteristics of the sample 3,843 agricultural households. Household characteristics of the young children's sample are not presented here instead we present them in chapter 4.

To define household, we have adopted the same definition that has been followed in the BIHS. To clarify, the term household defines a group of people who live together and take food from the 'same pot'. A household member is someone who has lived in the household at least 6 months and at least half of the week in each week in those months. Persons who are not blood relations (e.g. servants, lodgers or agricultural labourers) will be regarded as members of a household if they have stayed in the household at least 3 months of the past 6 months and have taken food from the same pot. If someone stays in a household but does not take food from the same pot, he or she will not be considered as a member of the household.

Table 3.1 shows demographic and socioeconomic characteristics of the household members of the 3,843 agricultural households. It can be seen from the table (row 1) that the overall proportion of males is slightly higher than that of females in the sample. The majority of the household members belong to the economically active age groups i.e. between 15 and 64 years (row 2).

Table 3.1 Characteristics of the household members of 3,843 agricultural households (percent)

Indicators	Male	Female
1. Gender	50.20	49.80
2. Demographic		
0-14 years	35.65	35.12
15-64 years	57.78	60.88
65 years or more	6.57	4.00
3. Marital status		
Unmarried	49.27	41.86
Married	50.17	52.75
Widow, widower	0.51	4.67
Divorced	0.04	0.72
4. Education		
No schooling	40.19	40.56
Pre-primary (1-4 years)	22.58	21.67
Primary (5-7 years)	18.59	21.54
Secondary (8-12 years)	17.52	15.96
Tertiary (more than 12 years)	1.12	0.27
5. Economic activity		
Work for pay	86.70	58.58
Work without pay	3.91	11.86
Unemployed	0.64	0.04
Unpaid household work	0.28	20.73
Other	8.47	8.79

Indicators	Male	Female
6. Labour force participation		
Wage labour	19.74	1.83
Salaried worker	3.08	0.88
Self-employed	9.70	0.71
Trader	9.06	0.64
Farming	47.67	51.10
Non-earning occupation	10.75	44.84

Source: Author's own calculation

More than half of the members of the sample households are married across both genders (row 3). Except for the unmarried category, the proportion of females is greater than that of males. Notably, the incidence of widowhood is higher among the females as a total of 5.3 percent women are either widowed or divorced or separated. Thus a gender gap can be seen in respect of marital status possibly because remarriage is less common among women than men.

The BIHS collected information on completed years of schooling for all household members. From row 4 in Table 3.1, it can be seen that around 40 percent of both male and female have not completed a single year of formal education and the proportion is slightly higher for females. Similar numbers have completed some primary education which almost certainly reflects the government initiatives that were adopted in the early 1990s to promote girls' education. But the predominance of men in secondary education is clear and in tertiary education it is striking. The gender gap in higher education may be indicative of the fact that investment in women's higher education is largely neglected. The policy interventions that have been taken so far to increase girls' education may have been successful in increasing the proportion of girls having completed primary education, but wide gender gap in higher education thrusts a concern for the policy planners.

Economic activity (row 5 in Table 3.1) of the household members aged above 15 years was recorded by questioning which has been their main activity in the previous week of the survey. About 90 percent of the male household members are engaged in works for pay, while for women the figure is less than 60 percent with the remainder working in the household and farm, implying no access to cash income. This clearly exemplifies gender inequality in employment in rural Bangladesh.

Table 3.1 also presents information on the labour force participation of the household members who are 15 years old or more (row 6). As our sample comprises agricultural households, it is not surprising to see that the majority of the members across gender are

engaged in farming that comprises a range of independent enterprises such as sharecropping, livestock and poultry rearing, fish culture, and homestead farming. Although the proportion of female in farming is higher than that of men; female members' participation is notably low in wage labour, salaried work, self-employed work (i.e. artisanal, semi-professional, professional work), and trading. Striking is the role of women in 'non-earning occupation' (largely household works) alongside their contribution to farming. This clearly depicts a contrasting scenario of women's labour force participation in the case of rural Bangladesh. Overall Table 3.1 underpins gender disparity among the sample household members with respect to key socioeconomic indicators such as education, economic activity, and labour force participation.

Table 3.2 represents the distribution of the sample 3,843 agricultural households with respect to some key household characteristics. As can be seen from the table, the majority of the households have 4 and 5 members, and the average household size is over 4.43 persons (data not reported in the table).

Table 3.2 Characteristics of the 3,843 agricultural households

Indicators		Percent
1. Household size (persons)		
	2	3.44
	3	13.83
	4	27.58
	5	24.30
	6 or more	30.85
2. Dwelling type		
	Concrete	14.13
	Tin	44.53
	Other (wood, bamboo, jute stick, straw, mud)	41.33
3. Tenure of dwelling		
	Owned	94.27
	Rented	0.31
	Rent-free	5.41
4. Lighting energy		
	Kerosene	52.28
	Electricity	41.50
	Other	6.22
5. Source of drinking water		
	Tube-well	65.87
	Canal, river, pond	27.18
	Supply or tap water	1.71
	Other	5.24
6. Defecation method		
	Sanitary (water unsealed)	49.07
	Sanitary (water sealed)	26.40
	Non-sanitary	21.42
	Open space or other	3.11

Source: Author's own calculation

In respect of dwelling type, it can be seen that only about 14 percent households have concrete dwellings; whereas the majority of the households either live in tin sheds or in non-permanent dwellings made of bamboo, jute stick, straw or mud. Nevertheless about 94 percent households own the dwelling in which they live.

Table 3.2 also shows the distribution of the 3,843 households on the basis of sources of lighting fuel, sources of drinking water, and the method of defecation used. The majority of the sample households use kerosene as the main fuel for lighting. In the case of drinking water, we can see the majority of the households have access (about 66 percent) to tube-well water, and less than two percent have access to supply or tap water. Importantly more than a quarter of the households (27 percent) still use unclean water sources like pond or river. With regard to defecation method, it can be seen that the majority of the households use a sanitary toilet; nonetheless roughly 22 percent households do not have any sanitary toilet and 3.11 percent households do not have any toilet at all.

3.6 Gender difference in decision-making within the household

The gender gap in intra-household decision-making is considered in light of the statistics presented in Table 3.3 which summarises information on decision makers within the household across different aspects. Data presented in this table are based on information provided by the 3,843 primary female household member who is the wife of the primary male household member.

Table 3.3 Intra-household decision-making in 3,843 agricultural households (percent)

Decision on	Wife	Husband	Couple	Other	NA
1. Wife's participation in the IGAs	18.34	1.19	44.51	0.05	35.91
2. Expenditures relating to					
Food	2.15	33.99	61.71	2.15	-
Cloths	2.10	31.74	63.78	2.39	-
Housing	1.48	34.17	61.61	2.07	-
Healthcare	1.58	32.33	63.70	2.23	-
Education	1.37	26.84	50.83	1.79	19.17
3. Wife's mobility outside household to					
Outside community	10.26	21.42	51.74	0.52	15.06
Market	4.51	21.17	28.76	0.44	45.13
Hospital, clinic	7.44	19.38	55.70	0.54	16.94
Training at NGOs	2.82	5.91	14.56	0.23	76.48
4. Contraceptive use	5.73	2.90	68.89	-	22.48

Note: NA means not applicable
Source: Author's own calculations

Women's participation in income generating activities (IGAs) is a vital indicator to denote their employment and earning. Women's participation in economic activities is believed to lead to economic and social progress as well as to the realisation of the potential of women (R. I. Rahman, 1993). The BIHS asked the primary female respondent whether she is involved in any IGAs to supplement household income. In the case of some 64 percent[7] households, the primary female member reported that she is engaged in the IGAs. As to who decides whether or not the primary female member would engage in the IGAs, it can be seen from the table that in the majority (44.51 percent) of the households, the decision is made jointly by the husband and the wife. About 18 percent of the women can take such a decision for themselves without consulting their husband or any other household members. Although employment is likely to be positively associated with women's empowerment, the five domains empowerment index does not take such information into account. In other words, the index does not differential whether women are engaged in the IGAs and the decider of such decision.

The BIHS also collected information on decision-making relating to expenditure on basic needs such as food, clothes, shelter, treatment, and education, which has also been summarised in Table 3.3. It is evident from the table that in the majority of the households most decisions are taken jointly by the husband and the wife. The proportion of households wherein joint decision-making is followed concerning expenditures varies from about 51 percent to about 64 percent. Combining the proportion of households where the husbands solely make expenditure decisions with the proportion of households where decisions are jointly made, it appears that the husbands' representation in decision-making is as high as about 96 percent. In around 2 percent households, the wife has sole decision-making power in the case of expenditures on basic needs. Evidently women clearly lack the power to make expenditure decisions alone in the rural agricultural households of Bangladesh.

The figures relating to decisions on the mobility of women indicate that women's mobility is very much restricted in rural Bangladesh. The BIHS asked the primary female respondent (wife of household head) to report who decides whether she can go outside the house for meeting friends or relatives outside the community, marketplace, hospital or clinic or training at NGOs. From Table 3.3 we can see that women's mobility decisions are mostly taken by husbands, either alone or in consultation with the wife. In less than five percent of

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[7] Of these, the majority (53.86 percent) reported that they work inside the house, 3.50 percent reported they work outside the house, and 6.74 percent work in both inside and outside the house.

households, women can solely decide to go to the marketplace. Traditions and family-imposed restrictions forbid women from leaving the home compound or regulate when, where, and with whom they can travel. Additionally issues of safety often prevent women from travelling alone for even short distances (Pitt et al., 2006). Women's mobility outside the household reflects their freedom in households, and it helps to create a gender equitable cultural norm by normalising women's public mobility and access to public institutions (N. Hossain, 2011).

Fertility control in terms of family planning is another important household decision where gender difference might operate. The BIHS asked the surveyed woman whether or not she has used any contraceptive method and who had made the decision. Among the sample households, as many as 78 percent of wives reported usage of contraceptives and in the majority (about 69 percent) of the households, the decision is made together by both the husband and the wife.

Based on the data presented in Table 3.3 it becomes evident that among the majority of the households, decisions concerning wife's participation in income generating activities, household expenditures, wife's mobility, and birth regulation are made jointly by wife and husband. Nonetheless husband's representation in the decision-making is greater than that of the wife across all the aspects.

Table 3.4 compares the adequacy of the primary male (husband) and the primary female (wife) of the 3,843 agricultural households in terms of the component indicators of the five domain empowerment index. The comparison also restates the sharp gender discrepancy in regard to empowerment.

In the case of eight out of the 10 component indicators, the husband has greater adequacy in comparison with his wife. In regard to indicators relating to resource domains, especially in asset ownership (I3) and buying, selling or transferring of assets (I4), the contrast is most prominent. In community influence (leadership domain) more women than men have membership in groups, perhaps because of the operation of numerous microfinance NGOs in the rural areas. Usually these NGOs exclusively target women and provide microloans to a group of women with joint responsibilities for repayment. Thus it is not very surprising that wife surpasses husband in the membership in groups. Although more women have membership in groups, this does not seem to give most of them enough confidence to speak in public. About two-thirds of the women reported that they were not comfortable in public

speaking, which indicates a distinct lack of confidence amongst the women in communicating and negotiating at a society level. It may mean that rural women are not sufficiently capable of raising their voices to bargain against issues affecting their lives and livelihood. In relation to time use and workload indicator, it can be seen that more women than men reported that they had worked less than 10.5 hours in a day; this may be reflective of the fact that fewer women than men participated in the labour market. However if women's unpaid housekeeping and family work hours are accounted for, the total hours of women's work would be greater than 10.5 hours in a day. In fact, this is revealed in the indicator relating to happiness with leisure as fewer women than men express satisfaction with available time for leisure (I10). A clear gender inequality is evident in time use as more women than men in rural agricultural households are in time poverty.

Table 3.4 Proportion of husband and wife having adequacy in empowerment indicators

Components of empowerment index	Wife	Husband
1 Production domain		
I1 Input in production decision=1, otherwise 0	51.34	77.56
I2 Able to act on own values=1, otherwise 0	66.90	71.40
2 Resources domain		
I3 Own asset=1, otherwise 0	46.50	97.00
I4 Input in buy, sell, transfer of asset=1, otherwise 0	69.42	98.36
I5 Input in borrowed money usage=1, otherwise 0	47.62	62.19
3 Income domain		
I6 Input in decision on use of income=1, otherwise 0	85.29	88.52
4 Leadership domain		
I7 Member in a group=1, otherwise 0	29.82	14.10
I8 Comfortable in public speaking=1, otherwise 0	32.89	74.18
5 Time use domain		
I9 Works less than 10.5 hours in a day=1, otherwise 0	17.95	11.31
I10 Satisfied with leisure=1, otherwise 0	69.94	74.21
Observations	3,483	3,843

Source: Author's own calculations

As far as we have discussed the multidimensional index seems to capture varied aspects of power relations between husbands and wives, which are not well reflected in the traditional measures such as who takes decisions with regard to expenditures, mobility or birth regulation. Hence in chapters 5 and 6 where we explicitly deal with the impact of women's empowerment, we use the five domains empowerment index.

Having described the objectives, study context, and characteristics of the sample, in the next three chapters we will present the three main analytical studies. In the following chapter, we will discuss the linkage between mothers' education and children's health in rural Bangladesh, and the pathways via which education impact on health.

Chapter 4

Pathways to children's health: does mothers' education matter?

Abstract

Using a sample of 887 children up to the age of two years from the BIHS, in this chapter we explore the impact of mothers' formal education on their children's nutritional status as well as on their health-seeking behaviour (measured by the children's immunisation status). We use regression analysis to examine the direct impact of mothers' education on children's anthropometric indicators i.e. height and weight, and immunisation. The OLS estimates confirm that mothers' education is a positive and statistically significant determinant of children's anthropometric indicators and immunisation; while fathers' education does not have any significant association. We then address the potential endogeneity of mothers' education by controlling for several confounders that may have helped to transmit the impact. We consider seven potential pathways viz. mother's engagement in income generating activities, autonomy regarding expenditure decisions, access to health information sources, exposure to media, health knowledge, use of antenatal service, and household dietary diversity. Even after controlling for those potential pathways in the OLS regression model, mothers' education still exerts a statistically significant and positive effect on children's health markers. Our findings therefore reinforce the importance of women's education in improving child health.

4.1 Introduction

Mothers' education is likely to be strongly associated with child welfare in terms of survival, health, and nutrition (Fafchamps & Shilpi, 2014; Sandifordt & Rica, 1995; Wolfe & Behrman, 1987) which are also the key indicators of a country's economic well-being (Y. Chen & Li, 2009). Mothers' education is the single most important factor explaining differential in child health outcomes (Vikram, Vanneman, & Desai, 2012). Nevertheless girls and women, especially in the poorer societies, are often deprived of opportunities for accessing education owing to poverty and gender discriminating socio-cultural norms. Typical of this, Bangladesh featured a substantially lower educational attainment among girls and women until the early 1990s when some pioneering policy interventions were launched in the country. Bangladesh is the first country in the world to launch a Conditional Cash Transfer (CCT) programme (Shamsuddin, 2015), which aimed at creating effective demand for children's education, especially that of girls in the poor households. Two particularly mentionable interventions include: Food for Education (FFE) launched in 1993 (A. U. Ahmed & Del Ninno, 2002), followed by the Female Secondary Education Stipend Programme (FESP) in 1994 (Shamsuddin, 2015). These interventions[8] effectively helped to overcome barriers to children's access to education imposed by poverty and gender discriminating attitude towards daughters. Eventually, poor children increasingly enrolled in schools and gender parity was achieved at primary and secondary levels by the end of the century (N. Hossain, 2004). This along with an expansion of education system in the country led to a substantial improvement in female education in Bangladesh, especially of the young cohort. On the other hand, barriers continue to persist against post-secondary female education in the country. These arise from parents' unwillingness to invest in daughters' human capital development, which is reinforced by the low monetary value of women's labour in the labour market.

In the context of such changes in women's education, it is interesting to revisit the impact of maternal education on child health. We extend our analysis by identifying potential pathways or channels through which mothers' education may impact on child health.

The questions asked here are important because whether or not policies aimed at improving child health should emphasise women's education, requires empirically verifiable results on

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[8] The CCT provided food grain assistance for school attendance of children from poor families, and the FFE provided girls, who were attending grades from 6 to 10, with stipends, free tuition, books and exam allowances (Shamsuddin, 2015).

the causal impact of maternal education on child health. Keeping Bangladesh in view, the question is particularly relevant as under-nutrition among young children is still unacceptably high, and little progress seems to have taken place over the past years. The higher incidence of child undernourishment and low progress in mitigating the situation pose a greater public health concern in the country particularly because of the impact they have on the quality of human capital in the country. According to the most recent Demographic and Health Survey, more than one-third of Bangladeshi children under age of five years suffer from acute malnutrition (NIPORT et al., 2016).

For the purpose of our empirical investigation, we have carried out an econometric analysis using data on 887 children aged up to two years, from the first wave of the BIHS. In our study, we look at children's nutritional status— measured by anthropometric indicators such as height and weight—in accordance with the World Health Organisation (WHO) guideline. Additionally, we consider the number of vaccines given to children i.e. immunisation score in order to connote parental health-seeking behaviour following Desai and Alva (1998).

Our empirical investigation involves a two-fold strategy. First, through Ordinary Least Squared (OLS) regression, we explore whether or not children's anthropometric indicators and immunisation score are significantly associated with their mothers' education, after controlling for child, parental, household, and regional level factors. We test the hypothesis that mothers' education is a statistically significant and positive determinant of the child health indicators. Since the association between them may also include the effect of unobserved factors relating to mothers' personal characteristics for reasons illustrated in the literature review, there is a possibility that the coefficient on mothers' education is biased. To address this concern, in our second strategy, we identify several variables that may reasonably proxy for the unobservable factors so as to help to reduce the bias in the regression model. We hypothesise that mothers' education might influence child health through seven potential pathways, namely (i) mother's participation in income generating activities, (ii) mother's autonomy, (iii) mother's ability to access sources of health information, (iv) mother's exposure to media, (v) mother's health knowledge, (vi) mother's use of antenatal service, and (vii) household dietary diversity. Unsurprisingly each of these variables is likely to be influenced by how educated the mother is and we, therefore, regard these variables as potential pathways through which mother's education may influence child health. Our results indicate that maternal education continues to have an independent positive and significant association with nutritional status, even after these pathway variables are included; while

fathers' education is not significant at all. Thus we identify as closely as possible the way by which mothers' education might impact on child health. Overall our finding suggests that mothers' education tends to raise mothers' ability to interact with various information sources, to comprehend health and nutrition information, to adopt better maternal and child care practices, and to choose optimal nutritional input. In brief formal schooling enhances mothers' skill and knowledge about child care and nutrition, which ultimately results in their children's improved nutritional and immunisation status.

By focusing on pathways, our study intends to contribute to the literature on understanding how the relationship between maternal education and child health indicators works out in the specific context of rural Bangladesh. Notably, our study contributes from the methodological perspective as we have attempted to address the issue of endogeneity of mothers' education arising from the unobserved heterogeneity of the mothers. To this end, we have used a rich dataset containing detailed information on various aspects of maternal and child health care, which are practised by the mothers as well as are likely to be reinforced by education. Thus in the health regression models, we are able to account for factors that may serve as potential proxies for unobservable characteristics of mothers—a strategy adopted from Aslam and Kingdon (2012). Second, in this chapter we examine an extended list of potential pathways, following on from the work of Aslam and Kingdon (2012); Frost, Forste, and Haas (2005); and Glewwe (1999). It is worth mentioning here that these researchers did not consider any nutrient intake related pathway even though it is clear that child growth failure can result from poor nutrition. The literature argues that more educated parents, in particular, mothers, are more likely to use a better mix of health-inputs; hence children of educated mothers may have better health. Thus ignoring a diet-related pathway may not adequately isolate the effect of confounding variables on the estimated return to mothers' education in child health regression models. This is one area where our study makes a substantial contribution because we have been able to address it by incorporating household's dietary diversity as a potential pathway in addition to those considered in previous studies. Third, our study corroborates the literature on the social return of women's education by generating recent evidence on the intergenerational effect of women's education on child health in a poor developing country. In addition, our study sheds some light on the long-run return to increased women's schooling, which is revealed in the improvement in mothers' nutrition knowledge for selecting optimal food combination. We hope the empirical findings of this chapter will provide insight for policies in relation to both child health and nutrition as well as women's education. Above all,

our study is an addition to the literature that rationalises integrating women's development policies into broad national development plans for achieving SDGs.

The remainder of this chapter is structured as follows. The next section discusses the literature on pathways through which mother's education might influence child health. Section three describes the sample, measurement and econometric techniques we have used, and section four describes summary statistics, empirical results and findings. Finally, section five summarises the study and makes concluding remarks.

4.2 Literature review

In almost all societies, the primary task of childbearing, feeding, and nursing is done by mothers who are the main caregivers, and hence the survival, health, and nutrition of children are integrally related with mothers' service delivery (Smith et al., 2003). How well a mother—the most important health worker—performs this task may depend on her schooling which equips her with general and specific knowledge (Barrera, 1990). There is a relatively large cross-country empirical literature in both social science and medical studies, which has documented a significant association between maternal education and a range of child health variables including survival[9] (Akter et al., 2015; J. G. Cleland & van Ginneken, 1988; Gakidou, Cowling, Lozano, & Murray, 2010; Grépin & Bharadwaj, 2015; Sandifordt & Rica, 1995; Smith-Greenaway, 2013; Tulasidhar, 1993), nutritional status (anthropometric indicators) (Abuya, Ciera, & Kimani-Murage, 2012; Aslam & Kingdon, 2012; Barrera, 1990; Burchi, 2012; Y. Chen & Li, 2009; Frost et al., 2005; Glewwe, 1999; Güneş, 2015; Handa, 1999; Thomas, Strauss, & Henriques, 1991), micronutrient status (Block, 2007), immunisation (Govindasamy & Ramesh, 1997; Vikram et al., 2012), cognitive performance (Araújo, Giatti, Chor, Passos, & Barreto, 2014).

The rationale behind why mothers' education would result in improvements in child health is perhaps that education increases mothers' knowledge (Vikram et al., 2012) and makes mothers more receptive of health information (Glewwe, 1999). As a result, mothers who are educated are likely to have a better understanding of disease causation, prevention, and cure (J. Cleland, 2010). Accordingly, they may adopt better domestic hygiene, interact with their children intensively, and use of modern preventive services (J. Cleland, 2010). Education may also enhance their confidence level and skills to access health service for seeking medical

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[9] For an extensive review, refer to Hobcraft (1993)

advice and to comply with the advice (Semba et al., 2008). Overall education improves the use of health services, provides economic advantages, and empower women (Gakidou et al., 2010), all of which are likely to influence child health positively.

Despite its significant positive influence on a range of child health indicators in different counties, concern remains regarding whether this influence of mothers' education is causal. The issue is mainly centred around the endogeneity of maternal education for a variety of reasons. Women's education may simply reflect natal family background characteristics. Progressive parents may want to provide education to their daughters in contrast to conservative parents. It is possible that women from such a family background possess distinctive social and psychological characteristics, which are reinforced by formal education, which also accounts for their performance as mothers (J. G. Cleland & van Ginneken, 1988). Hence mothers' education can indicate the intergenerational transfer of values. Berhman and Wolfe (1987) found that controlling for the background endowment resulted in the elimination of the significant impact of mothers education on child health. J. G. Cleland and van Ginneken (1988) further pointed out that educated women generally marry a similar advantaged man (or marry into an affluent family) and enjoy a relatively high standard of living. So the positive strong association between maternal education and child health indicators may reflect the impact of economic advantage. Another reason why mothers' education may be endogenous is that it possibly accounts for unobservable maternal characteristics such as attitudes towards hygiene and preventive care, willingness to adhere medical advice, intelligence which all are likely to be correlated with education and child health.

To overcome the endogeneity of maternal education, it is necessary to find some exogenous variation in mothers' education. In recent years, the use of schooling reform as a source of exogenous variation has become popular in labour and health economics (Agüero & Bharadwaj, 2014; Grépin & Bharadwaj, 2015; Güneş, 2015; Makate & Makate, 2016; Silles, 2009). Exposure to certain schooling reform gives a natural experiment to find a causal impact of mothers' education. Exploiting exogenous variability in women's educational attainment prompted by schooling reform as an instrument, Grépin and Bharadwaj (2015) have found a positive significant causal impact on several child health-related outcomes in Zimbabwe; and likewise Güneş (2015) has found a causal impact on children's anthropometric indicators in Turkey. More recently Makate and Makate (2016) also found a causal impact of mothers' education on infant and child survival in Malawi.

However finding exogenous variation in mothers' education is really difficult, and in a situation when no suitable instrument can be found one way to get around the issue will be to identify a direction of impact, in other words to find channels or pathways via which mothers' education translate into children's health. In fact, this strategy has drawn considerable attention among the researchers across disciplines.

Beginning with Caldwell (1979) there have been a number of studies that have considered the pathways through which mother's education impacts on markers of child health (Aslam & Kingdon, 2012; Burchi, 2012; J. G. Cleland & van Ginneken, 1988; Glewwe, 1999; Hopewell et al., 2008; Vikram et al., 2012). According to these studies, the impact of mothers' education operates through different potential pathways. The impact can be transmitted by increasing mothers' literacy skills which enable them to understand and comprehend health information from different sources, for instance, social network, health workers, newspapers, radio or television. The impact may be transmitted by increasing women's participation in the labour market. Education increases women's job opportunities, which may lead to better child health through an income effect. Women's participation in the labour market increases their social status enabling them to play a more assertive role in family and community decision-making. In case of medical emergency, greater decision-making power and mobility may enable the mother to visit a health care centre to save her child without needing to rely on others. Education may impact child health by increasing mothers' knowledge which helps them to make better decisions and to choose better health inputs in the face of resources constraints. Education helps women to break traditional approach of childbearing and seek for modern preventive and curative services (e.g. immunisation).

While education may translate into child health by changing mothers' attitude and by enhancing skills and knowledge, it may also translate through providing balance diets to children. Inappropriate and unbalanced diets can result in the poor nutritional status of children. Education may improve knowledge about appropriate diet composition and the nutritional value of different foods for children of different age. Since household food preparation is the primary task of mothers, she may be able to influence the choice of food to be served in the household. If a mother knows what type of food her child needs given the age, this would influence the household's food purchase. However, this potential pathway has largely been ignored in the previous studies. Failure to account for households' dietary composition in children's health production function may not adequately purge the residuals.

Impact of mothers' education may also transmit into better child health markers by enabling mothers to adopt good practices during pregnancy. It is now recognised from nutrition strategies that children's survival and post-natal health depends on intervention in the first 1000 days of a child's life i.e. from conception to two years, which would provide children with the best chance to avoid being stunted and cognitively impaired (Black et al., 2013; Modibo, Thompson, & Thomas, 2012; Thompson & Amoroso, 2014; WFP, 2012). Thus mothers' may adopt good practice during pregnancy including the use of antenatal care. Since the adoption of good practice during pregnancy is associated with children's health and mothers' education, neglecting this potential pathway may not effectively purge the residuals in the child health model, too.

In sum, a large body of literature has confirmed the positive significant effect that mothers' education has on children's health, yet there is a lack of clear understanding of how the former impact the latter. Researchers have been trying to identify causality by various approaches: finding an exogenous source of variation in mothers' education because of the implementation of policy reform or controlling for unobservable maternal characteristics given the availability of data. The above discussion clearly highlights that studies that focused on the latter approach have ignored two important confounders: household's dietary diversity and mothers' use of antenatal service. This is the gap that our study is going to address with the aid of the data from a South Asian country where child under-nutrition has always been a key development concern despite much improvement in female education.

4.3 Sample, measurement of key variables, and empirical strategy

This section discusses the sample, measurement of key variables, and the empirical strategies followed in this chapter.

4.3.1 The sample

As stated in chapter 3, we obtain the children sample from the BIHS surveyed in 2012. It may be useful to restate that the BIHS collected extensive information on maternal and child health care practices from mothers of those households having a child aged up to two years. Since this particular information is used to identify the potential pathways, we are able to identify potential pathway variables specifically for those mothers only. This also means that our child sample is composed of only those young children for whom the relevant data were collected in the BIHS. To recap, 1,136 households out of the surveyed 6,503 households of the BIHS

have a child under age of two from which we obtain 887 children who are children of the household head.

4.3.2 Measurement of the key variables

In this chapter we consider three markers of child health: two indicators of nutritional status and another indicator to reflect immunisation status, which are regarded as dependent variables in three separate models. In the followings, we illustrate how these dependent variables are measured.

(A) Nutritional status

In order to measure children's nutritional status, we consider standardised anthropometric indicators i.e. height-for-age and weight-for-age, which are generally used to indicate children's physical growth. The standardisation, which is termed as Z transformation, is done by comparing the sample children's anthropometric indicators with the World Health Organization (WHO) reference children's growth standards. The WHO actually provides a Stata macro for computing the Z score transformation, which we have used in our analysis. Height-for-age Z-score (HAZ) and weight-for-age Z (WAZ) score are defined by the following expressions: $HAZ_i = \dfrac{h_{ij} - \bar{h}_j}{\sigma_j^h}$ and $WAZ_i = \dfrac{w_{ij} - \bar{w}_j}{\sigma_j^w}$, respectively. Where, h_{ij} is the observed height of the child- i in group- j, w_{ij} is the observed weight of the child- i in group- j; where group j is defined according to child's gender, and the age in days. The terms $\bar{h}_j$, $\bar{w}_j$, σ_j^h and σ_j^w are the median height, weight, and standard deviation, respectively in group j, based on the WHO reference children. The WHO reference children are based on an international sample of ethnically, culturally, and genetically diverse healthy children living under optimum conditions that are conducive to achieving a child's full genetic growth potential. The rationale behind comparing against the WHO child growth standards is that well-nourished children of all population groups follow very similar growth patterns before puberty. These growth standards can, therefore, be used to assess the nutritional status of children all over the world, regardless of ethnicity, social and economic influences, and feeding practices (WHO, 2006). The Governments in many countries including Bangladesh and the United Nations (UN) agencies, therefore, rely on the WHO growth standards to

measure the general well-being of populations, formulate health and related policies, and plan interventions and monitor their effectiveness (NIPORT et al., 2016; WHO, 2006).

A child who is more than two standard deviations below the median (-2 SD) of the WHO reference population in terms of height-for-age, is considered short for his or her age i.e. stunted. This condition reflects the cumulative effect of chronic malnutrition. If a child is below three standard deviations (-3 SD) from the reference median, then he or she is considered to be severely stunted. Generally, stunting reflects a failure to receive adequate nutrition over a long period and is worsened by recurrent and chronic illness. Height-for-age, therefore, reflects the long-term effects of malnutrition in a population and does not vary appreciably according to recent dietary intake (NIPORT et al., 2016). Among the sample children, about 41 percent children are stunted and 18 percent are severely stunted.

Weight-for-age (WAZ) is a composite index of weight-for-height and height-for-age. A child can be underweight for his age either because he is stunted or is wasted (too thin), or both. Children whose weight-for-age is below two standard deviations (-2 SD) from the median of the WHO reference population are classified as underweight. Children whose weight-for-age is below three standard deviations (-3 SD) from the median of the reference population are considered severely underweight. Thus WAZ is an overall indicator of a population's nutritional health (ibid). Child wasting has been well recognised as an important underlying cause of young child death (UNICEF, 2003). The WAZ can also be regarded as an indicator of children's short-term nutritional status because body weight loss is the most immediate consequence of under-nutrition. Among the sample children, 21 percent were underweight and 10 percent were severely underweight.

(B) Immunisation status

Immunisation is a globally recognised factor for reducing infant and child morbidity and mortality, hence immunisation status captures the parents' attitude towards using preventive health care service. The BIHS collected immunisation information from the mothers of all children under the age of two years. During the survey, the enumerator confirmed the vaccination status from the respective child's immunisation card. The vaccines for which information was collected are BCG, 3 doses of DPT, 3 doses of Hepatitis B, 3 doses of Penta, 3 doses of OPV, Measles, and Vitamin A. Counting the number of vaccines given to a child yields the variable 'immunisation status'.

(C) Education[10]

In this chapter, our key independent variable is education. We measure education in terms of the number of completed years of schooling. The BIHS has collected information on the completed years of education. We consider both mothers' education as well as fathers' education. The range of the education variable is 0 to 17 years.

(D) Pathway variables

As it has already been stated, we consider a range of pathway variables in our analysis. We will describe below how the seven potential pathways are defined in our study.

1. Engagement in Income Generating Activities (IGAs): A mother is considered engaged in IGAs if she works or runs a business that brings in cash, food, or allows accumulation of assets for the household. The BIHS has collected this information from the mothers, which we use to generate an indicator such that 1 means the mother is engaged in IGAs, and otherwise 0. Mothers' engagement in IGAs may contribute to child health both positively and negatively. It may be related positively because mothers' involvement in IGAs is likely to supplement household income and thereby it may enable parents to choose better health and nutrition inputs. By contrast, it can adversely affect child health, if mothers' time for providing care is compromised by such engagement. Since women's participation in the labour market in Bangladesh is not a correlate of educational attainment rather poverty-driven, mothers' engagement in IGAs may also pick up the negative effect of a poor socioeconomic condition of a household. Thus the relation between mothers' participation in IGAs and child health could be either positive or negative.

2. Autonomy: We construct an index of autonomy of expenditure decision-making based on the responses to question regarding who decides how to spend on food, housing, health, education, and clothing. All expenditure categories are equally weighted. If the mother alone or jointly with a spouse or other household member takes decisions on how to spend money in those five categories, a value 1 is assigned otherwise 0. Thus the autonomy index of expenditure decision-making ranges between 0 and 5. The

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[10]The education system in Bangladesh is divided into three levels (i) primary (grades 1 to 8), (ii) secondary (grades 9 to 12), and (iii) tertiary (3 or 4 years bachelor, and 1 or 2 years masters, 5 years MBBS).Secondary education is further divided into two categories: secondary (grades 9 to 10) and higher secondary (grades 11 to 12) (BBS, 2016b).

higher the number, the more autonomous the mother is. There is considerable evidence that women with discretionary power tend to allocate resources in such a way that benefits their children. A priory we expect to see a positive relation between autonomy and child health.

3. <u>Exposure to media</u>: A mother is considered to have exposure to media if she listens to the radio, or watches television, or does both. We measure this as a dummy variable, 1 indicating mother watches TV or listens to radio or both, and 0 otherwise. In Bangladesh, important health information especially child vaccination, date of a public campaign for free vitamin A and polio capsule, information on hygiene practice, child nutrition, the nearest point of contact for child emergency and so on are regularly being transmitted on mass media. We expect that rural women who are educated are more likely to have exposure to mass media than their uneducated counterparts and that educated mothers are better able to reap information from the media. The effect of exposure to media on child health may, therefore, be positive.

4. <u>Access to health information sources</u>: The BIHS asked the respondent mother whether she had learnt about sentinel practices from health workers, nurses, medicine shops, BRAC (NGO) or health centres. We use this information to create an indicator of mothers' access to health information sources, 1 indicating yes and otherwise 0. Educated mothers are more likely to be confident in accessing such sources than non-educated women. Moreover educated mothers are more likely to be better able to deal with the health advice from those sources. Thus it may positively transmit the effect of education on child health.

5. <u>Health knowledge</u>: Health knowledge score is based on the following 10 questions related to infant feeding, hygiene practices, and nutritional knowledge of respondent mother. A score of 1 is assigned for each correct answer and 0 otherwise. Thus it ranges between 0 and 10.

   i. What should a mother do with the 'first milk' or colostrums?
   ii. Can you mention one that can happen to children if they do not get enough iron?
   iii. What seasoning (food item) is often fortified with iodine (a nutrient important for brain development)?
   iv. What should you do when your child has diarrhoea?

v. When should you wash your hands?

vi. What food does a young child (<24 months) need in order to grow and develop their brain?

vii. Do you know breastfeeding should be started immediately after delivery within 1 hour?

viii. Do you know a baby should be exclusively breastfed (give only breast milk) up to six months?

ix. Do you know a child should be fed adequate quantity of family foods in addition to breastmilk from 7-24 months?

x. Do you know a child older than 6 months should be fed animal foods (fish, egg, liver, meat) at least once in a day?

Mothers' education may raise women's general knowledge and exposure to different networks, which may ultimately improve her health knowledge. Thus it would be reasonable to gauge mothers' health knowledge has a positive effect on child health.

6. <u>Use of antenatal service</u>: Use of antenatal service not only helps to monitor proper foetus development in the womb, but it may also make pregnant mothers aware of special dietary requirements (e.g. eating iron-rich food) and the consequence of bad lifestyle and habit (e.g. smoke, alcohol, narcotics). Since education may bring about change in perception, educated mothers may better understand the importance of having specialists' advice and the advantage of being monitored during pregnancy in order to ensure normal foetal development. This can be crucial for a baby's birth weight which is an important determinant of children's survival and postnatal growth. By regularly visiting antenatal care mothers may become aware of these. In this study, we define mothers' use of antenatal service as whether they attended antenatal care at least 4 times during pregnancy either in the hospital, health care centre or private clinic.

7. <u>Dietary diversity</u>: Education may increase mothers' knowledge about nutrition as well as nutritional values of different food. This knowledge may persuade mothers, who are generally responsible for meal preparation and nutrition, to prepare meals that are as diverse and balanced as possible so that it meets the nutritional requirements of children. Thus household diets composition may serve as a pathway through which

mothers' education impacts children's health. We have measured dietary diversity through food consumption score which is a weighted score based on the frequency of a household's consumption of nine food groups over past seven days. The food groups along with their corresponding weights in parenthesis are as follows: staples (2), legumes/pulses (3), vegetables (1), fruits (1), meat/fish/eggs (4), milk/dairy (4), oil (0.5), sugar (0.5), and condiments (0). The choice of food groups and its corresponding weights are derived from the guidelines of the World Food Programmes (WFP, 2008). One of the underlying causes of under-nutrition is the lack of dietary intake from diversified food. A greater variation in households' diet composition would mean a greater extent of food security, and children in food secure households are more likely to get balanced diets.

In the above, we have illustrated how we measure the key variables of interest in this chapter. Having done this, we have also pointed out a probable direction of operation of the potential pathways. Given the wide range of information used to define those potential pathways, we expect that controlling for them in the child health regression model will effectively separate out any potential bias from the unobserved maternal characteristics.

4.3.3 Conceptual framework

For the purpose of illustration, we have adopted a conceptual framework from Block (2007). The framework is based on the standard model of household decision making widely used in the literature on demand for the child, and given its most detailed exposition by Berhman and Deolalikar (1988) cited in (Block, 2007).

In this model, the determinants of child micronutrient status are a function of household characteristics (including maternal human capital) X_h, child characteristics (gender, age) X_i, and total family income Y. Assume the household maximises its utility over health status H, leisure L, and consumption of goods G, given household X_h and community X_c characteristics:

$$\max_{H,L,G} U = U\left(H,L,G; X_h, X_c, \psi\right), \ U^{'} > 0, U^{''} < 0 \qquad \text{Equation 4.1}$$

Where ψ represents the unobserved heterogeneity of preference. Households maximise this utility function subject to two constraints: a budget constraint and a biological health production function for anthropometric status. This production function takes the form:

$$H_i = H\left(N_i, M_i, X_h, X_c, X_i, \eta_i\right) \qquad \text{Equation 4.2}$$

Where N_i are nutrients consumed by member i, M_i are non-food health inputs, and η_i are unobserved individual health endowments. CH is taken to represent H_i.

This maximisation problem leads to a reduced-form demand function for child's health status:
$$CH_i = h^*\left(X_h, X_c, X_i, \upsilon_i\right) \qquad \text{Equation 4.3}$$

υ_i represents a child's unique health endowment which is unobserved.

4.3.4 Empirical strategies

To estimate the child health model 4.3, we have used Ordinary Least Squares (OLS) method as specified in Equation 4.4.

$$CH_i = \beta_0 + \beta_1 medu_i + X_i\beta_2 + X_{h,i}\beta_3 + X_{c,i}\beta_4 + u_i \qquad \text{Equation 4.4}$$

Here, the subscript i indicates child-i. CH_i denotes height-for-age Z score (HAZ), weight-for-age Z-score (WAZ), and immunisation score in three separate models, henceforth will be termed HAZ model, WAZ model, and Immunisation model, respectively. $medu_i$ is completed years of schooling of the i-th child's mother; X_i stands for the vector of child-i's characteristics (gender, age), $X_{h,i}$ stands for the vector of child-i's household characteristics (father's education, household income, number of household members); $X_{c,i}$ is the vector of characteristics of the community in which child-i lives (healthcare facilities, quality of healthcare services and so on); and u_i represents disturbance term in the relationship . Apart from the observable characteristics that are controlled for in the regression, child health is also dependent on health endowment (υ_i); therefore, a failure to control this would bias the estimates of child health regression. Unobserved heterogeneity in child's health endowment or genetic influence (υ_i) is indeed very difficult to control for in the health regression; notwithstanding it will be accounted for in the model by including parent's height (Glewwe, 1999).

An alternative to incorporating specific community characteristics (in order to avoid the need for detailed information about community services and their qualities) is to estimate the model with community fixed effect. This is what we adopt in our estimation strategy.

$$CH_i = \beta_0 + \beta_1 medu_i + X_i\beta_2 + X_{h,i}\beta_3 + D_i\beta_4 + u_i \qquad \text{Equation 4.5}$$

Instead of $X_{c,i}$, we estimate division level fixed effects model by controlling for divisions D_i. The division is the largest administrative unit in Bangladesh. β_1 is the coefficient on mother's education, and we want to test the null hypothesis that β_1 is statistically significant and different from zero. In other words, mother's education has a positive and statistically significant effect on child health status. However we may not claim β_1 represents the causal effect of maternal education on child health markers because it may pick up some of the effects of confounding factors such as unobserved maternal characteristics (motivation, ability, or values) embedded in u_i. In which case the covariance between $medu_i$ and u_i will not be zero implying a violation of one of the assumptions of the OLS, and our model would suffer from standard endogeneity because of omitted variable bias.

A popular methodological approach to studying the causal impact of parental education on child health is the instrumental variable technique, but the application of this approach is conditional on the availability of indicators that predict schooling without directly influencing the child outcome. Some researchers have used exposure to schooling reform to model exogenous variation in educational attainment, which we have discussed in the literature review. In the Bangladesh context, one such policy intervention is the secondary school scholarship scheme which was introduced nationwide in 1994. Evidence indicates that women exposed to the scheme completed extra years in school compared to those who attended school before the introduction of the scheme (Shamsuddin, 2015). Therefore, we began by constructing an instrument based on mothers' age in a way that captures exposure to the stipend scheme. In Bangladesh, pupils start secondary school at around 13 years of age, so those mothers who were less than 13 years old in 1994 were likely to be exposed to the scheme and are likely to have completed more years of schoolings than those who were older than 13 years in 1994. This has been shown in Figure 4.2 in appendix 2. On an average there is a difference of about 2.2 years in the educational attainment between the mothers who were exposed to the programme and those who were not, which is statistically significant as well. However while we attempt to use this policy exposure indicator to model mothers' years of schooling, it did not appear significant. Thus the approach of using policy exposure indicator as an instrument for mothers' completed years of schooling in the children's health regression model did not yield a statistically significant instrument (the F-stat was even less than 1 in all three child health models) in our analysis. One plausible reason may be that our sample over presents younger mothers i.e. women who were younger than 13 years in 1994. In our sample

about 84 percent of the mothers were less than 13 years in 1994 implying there is a lack of representation of untreated mothers (about 16 percent) in the sample.

Given the difficulty in finding a credible instrument in our survey data set, we adopt an alternative methodological approach to isolate the true impact of mothers' education on child health following Aslam and Kingdon (2012). This involves accounting for the potential endogeneity of mothers' education by controlling for a wide range of factors that might affect the coefficient on mothers' education if they are left out of the model. By accounting for such factors, termed as the potential pathways, we may be able to identify how education influence child health in addition to explicitly identifying the effect of proxies for mother-related unobserved characteristics from the error term in Equation 4.5. Finally the model takes the form of the following Equation 4.6.

$$CH_i = \beta_0 + \beta_1 medu_i + X_i\beta_2 + X_{h,i}\beta_3 + D_i\beta_4 + P_i\beta_5 + e_i \qquad \text{Equation 4.6}$$

In Equation 4.6, P_i stands for the vector of pathways, and e_i represents partially purged disturbance term. After controlling for the potential pathways, we expect the $\text{cov}(medu, e)$ would tend to be zero. If the inclusion of potential pathways in Equation 4.6 happens to attenuate the size or significance of the coefficient on mother's education compared to the one estimated in Equation 4.5, then it would mean that the impact is transmitted via the so introduced pathway.

Two points are to be noted here: whether (1) potential pathway variables are significant, and (2) they happen to decrease the size or significance of the coefficient on mother's education. If both (1) and (2) hold, then it can be concluded that mothers' education works through those potential pathways. If (1) holds but not (2), then it implies that the pathway variable is significant but is not influenced by mother's education.

We draw the Figure 4.1 for ease of understanding the channel of impact.
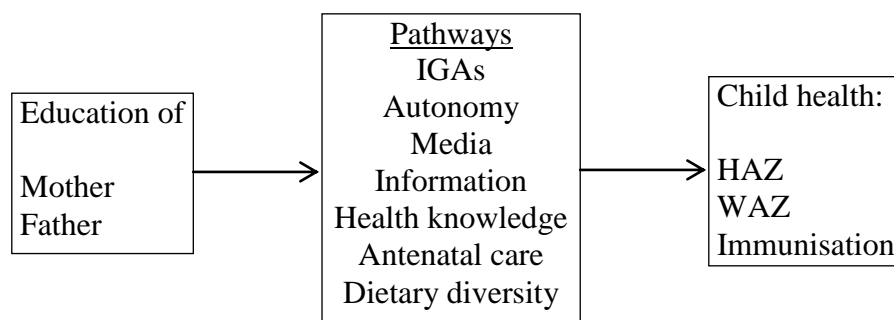
Figure 4.1 Diagrammatic presentation of potential pathways of impact

4.3.5 Sample characteristics

Table 4.1 presents the definition and summary statistics of the variables of interests. The negative mean values of HAZ and WAZ being less than -1 indicate that the sample children are moderately malnourished. The average immunisation score is above 7 indicating the sample children have received more than 7 vaccines. As can be seen, while immunisation data are available for all children, height and weight data are missing for 15 and 6 children, respectively. Our sample consists of an almost equal proportion of boys and girls and the sample mean age of the children is just over 11 months.

Table 4.1 Definition and summary statistics of the variables of interest

Variables and definition	N	Mean or proportion	SD
Dependent variables			
Height-for-age Z score (HAZ)	872	-1.636	1.607
Weight-for-age Z score (WAZ)	881	-1.445	1.200
Immunisation score	887	7.272	2.761
Independent variables			
Child characteristics			
Female child=1, otherwise 0	887	50.40%	0.500
Age of child (months)	887	11.278	6.605
Age squared	887	170.791	157.457
Parent's characteristics			
Father is missing=1, otherwise 0	887	11.72%	0.321
Father's height in centimetre	887	161.730	5.510
Father's completed years of schooling	887	3.153	3.903
Mother's completed years of schooling	887	4.494	3.597
Mother's height in centimetre	887	150.405	6.219
Household characteristics			
Log of per capita monthly expenditures	887	7.075	0.541
Household size (persons)	887	4.547	1.429
Agricultural household=1, otherwise 0	887	68.43%	0.465
Pathway variables			
Mother is engaged in IGA=1, otherwise 0	887	49.49%	0.500
Autonomy in expenditure decisions	887	2.907	2.220
Mother's exposure to media=1, otherwise 0	887	40.69%	0.492
Access to health information sources=1, otherwise 0	887	48.82%	0.500
Mother's health knowledge score	887	7.249	3.072
Visited antenatal care=1, otherwise 0	887	25.02%	0.433
Household's food consumption score	887	51.908	17.777
Administrative divisions			
Barisal		8.13%	
Chittagong		15.33%	
Dhaka		31.91%	
Khulna		12.74%	
Rajshahi		8.68%	
Rangpur		8.00%	
Sylhet		15.22%	

Source: Author's own calculation

We can see both mothers' and fathers' average educational attainment is less than primary level, more striking here is that mothers' average completed schooling is greater than that of fathers'. On an average, mothers have completed 4.5 years of schooling; whereas fathers mean completed years of schooling is just above 3 years. The higher number of completed years of schooling by mothers in contrast to fathers may be attributed to the strides Bangladesh has made in improving female literacy and education since the early 1990s. Additionally, the majority of the sample mothers are younger who have completed more years of education owing to their exposure to policy interventions.

The average height of father is 161.7 cm, while it is 150.4 cm for the mothers. In the case of 11.6 percent children, their father is missing either because he is no longer a member of the household or he is a migrant. Therefore information on paternal characteristics (height and education) is also missing. In order to avoid dropping those children from our estimation, father's missing height was replaced by the sample mean height of fathers' following Glewwe (1999). In the case of father's education, the missing value has been replaced by zero. Finally we account for this in the regression by introducing a dummy indicating 1 if the father is missing, otherwise 0.

We consider the household's per capita monthly expenditure as a proxy for income[11]. Monthly expenditures include a household's food and non-food expenditures. The average log of per capita monthly expenditure is 7.08. (US\$ $1 \cong$ Taka 80.700) (Bangladesh Bank, 2017). The average household size is 4.5 persons, which is consistent with the national rural average (BBS, 2011a). In the sample, some 31 percent children are from non-agricultural households.

Let us move on to the summary statistics of the pathway variables. We can see from Table 4.1, almost half of the sample mothers are engaged in income-generating activities. With regard to the autonomy of expenditure decisions, we can see on an average, mothers have participated in roughly three expenditure decisions. Greater autonomy regarding household expenditure may help mothers to allocate more resources towards the care and nutrition of children. More educated women not only are likely to have exposure to mass media (TV or radio) than non-educated women but also they are more likely to able to take advantage of health information provided in the mass media. We can see that about 41 percent mothers have exposure to television or radio. Access to health information may better enable mothers to look after their child, especially if a child becomes sick. About 49 percent mothers seem to

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[11] Household income data are missing for some households.

have access to various health-related information sources. Mothers' health knowledge which in this study is meant to indicate their awareness regarding infant feeding, hygiene, and sentinel practices – may also be one of the important, potential pathways of impact transmission. On a scale of 10, the sample mothers' average health knowledge score is 7.25, which indicates good awareness amongst the rural mothers.

We can see from Table 4.1 that only about a quarter of the sample mothers visited antenatal care at least four times during pregnancy.

The mean food consumption score—a measure of household's diet diversity indicating consumption of 9 food groups over the past week (WFP, 2008)—is about 52, which means the sample households' diet is acceptably diverse in content.

In order to see whether there is any systematic relationship between the potential pathways and mothers' education in our data, we construct the following cross tabulation (Table 4.2). We present the sample mean of child health indicators and pathway variables across mothers' education categories.

Table 4.2 Mean values of the health markers and pathways across level of mothers' education

| Variables | Mother's education level | | | | |
	No education	Pre-primary (1-4 years)	Primary and pre-secondary (5-8 years)	Secondary or above (>8 years)	All
Dependent variables					
HAZ	-1.846	-1.767	-1.619	-1.170	-1.636
WAZ	-1.693	-1.616	-1.378	-0.999	-1.445
Immunisation score	6.881	7.175	7.311	7.986	7.272
Pathway variables					
Mother is engaged in IGA	0.438	0.554	0.521	0.475	0.494
Autonomy in expenditure decisions	2.734	2.773	2.977	3.181	2.907
Mother's exposure to media	0.246	0.321	0.498	0.559	0.407
Access to health information	0.362	0.380	0.539	0.699	0.488
Health knowledge score	6.742	7.102	7.516	7.664	7.249
Visited antenatal care	0.138	0.168	0.293	0.427	0.251
Food consumption scores	46.117	50.880	53.361	59.899	51.908

Source: Author's own calculation

It is evident from Table 4.2 that children of more educated mothers enjoy better health. The extent of under-nutrition is less among children of more educated mothers, which is revealed by the mean values of both HAZ and WAZ. The negative mean value of the anthropometric indicators falls as mothers' education increases. Similarly immunisation score rises with the

level of mothers' education. The mean values of the child health variables across mothers' education give an approximate indication that child health improves as mothers' education increases. In regard to potential pathway variables, we also see a positive pattern of relationship indicated by the respective mean values which become greater at a higher level of education, with the exception of mothers' participation in IGAs. If more educated women are married to affluent households then they may not need to work to supplement household income. A commitment to childbearing responsibilities may also refrain mothers from engaging in IGAs.

In brief, except for mothers' participation in income generating activities, all other pathway variables exhibit a systematic pattern i.e. mean value of those pathway variables rises as education level increases. Such a positive causation in our raw data gives us some clue that impact of mothers education may operate through the potential pathways, which lead us to our econometric results in the next section.

4.4 Empirical results and discussion

4.4.1 Results

In this section we will first focus on the empirical results, afterwards we will provide discussion on our findings in section 4.4.2. As stated in the methodology, we first estimate Equation 4.5 by the OLS across three indicators – HAZ, WAZ, and immunisation – to obtain the estimated effect of maternal education on those child health variables. The regression results of these three models are presented in Table 4.3. Column 1 shows the regression result of the HAZ model, and column 2 and 3 show the regression results of WAZ and immunisation models, respectively.

Table 4.3 OLS estimates of the HAZ, WAZ, and immunisation model

Variables	(1) HAZ	(2) WAZ	(3) Immunisation
Female child=1, otherwise 0	0.168	0.037	0.007
	(0.103)	(0.078)	(0.146)
Age of child (months)	-0.099***	0.002	0.691***
	(0.033)	(0.024)	(0.044)
Age squared	0.001	-0.001	-0.020***
	(0.001)	(0.001)	(0.002)
Father is missing=1, otherwise 0	-0.252	0.042	-0.128
	(0.159)	(0.138)	(0.241)
Father's height (cm)	0.031***	0.019***	-0.000
	(0.009)	(0.007)	(0.014)
Father's completed years of schooling	0.003	0.014	0.012
	(0.018)	(0.012)	(0.024)
Mother's completed years of schooling	0.032*	0.039***	0.056**
	(0.019)	(0.013)	(0.026)
Mother's height (cm)	0.042***	0.035***	0.011
	(0.008)	(0.006)	(0.012)
Log of per capita monthly expenditures	0.076	0.101	0.168
	(0.099)	(0.079)	(0.134)
Household size	-0.066*	0.001	-0.016
	(0.040)	(0.030)	(0.059)
Agricultural household=1, otherwise 0	-0.077	-0.063	-0.122
	(0.121)	(0.090)	(0.171)
Barisal	-0.135	-0.049	0.799**
	(0.253)	(0.133)	(0.363)
Chittagong	-0.095	-0.057	0.758***
	(0.195)	(0.128)	(0.284)
Dhaka	-0.146		0.570**
	(0.181)		(0.269)
Khulna	-0.051	-0.023	0.863***
	(0.211)	(0.127)	(0.310)
Rajshahi	-0.514**	-0.161	0.610*
	(0.220)	(0.166)	(0.313)
Rangpur	-0.101	-0.191	1.172***
	(0.235)	(0.156)	(0.286)
Sylhet		-0.047	
		(0.129)	
Constant	-12.286***	-10.608***	-0.647
	(2.100)	(1.492)	(3.072)
Observations	872	881	887
Adjusted R-squared	0.117	0.087	0.409

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

The estimates presented in Table 4.3 clearly indicate that the coefficient on maternal formal education is positive and statistically significant across three models. The size of the coefficient on mothers' education is 0.032 in HAZ model, which is positive and statistically significant at 10 percent. It implies that an extra year of schooling completed by a mother is associated with an increase in HAZ by 0.032 standard deviations of height for children of the same age and gender. In the case of WAZ, the size of the coefficient on mothers' education is 0.039, which is also positive and statistically significant at 1 percent. An additional year of schooling completed by a mother is likely to increase their children's WAZ by 0.039 standard deviations of weight for children of the same reference group. Likewise the coefficient on mothers' education in immunisation model is positive and statistically significant at 5 percent,

which suggests that an extra year of schooling completed by a mother is associated with an increase of 0.056 vaccines. Thus we have found evidence to suggest that in rural Bangladesh mothers' education has a statistically significant and positive association with children's health markers, and the extent of association is more prominent for WAZ and immunisation. Unlike mothers' education, although positively related; fathers' education does not have any significant influence on any child health indicators. Contrary to this study's finding of the insignificance of fathers' education, a previous study in Bangladesh by Srinivasan, Zanello, and Shankar (2013) has found that the effect of paternal education is significant for child nutrition outcome (HAZ). The study has pointed out that in a context wherein a mother faces barriers to access public health service owing to social norms and ultimately compelling her spouse to access it, paternal education may matter.

The insignificance of paternal education on any child health marker in this study, though contrasts with previous studies, may still be plausible if we take account of the specificity of our sample. As revealed in Table 4.2, almost half the sample mothers have reported that they had access to health services and relevant information sources. Furthermore an improvement in mothers' accessibility to health clinic alone has also been reported in the recent Bangladesh Demographic and Health Survey (Headey, Hoddinott, Ali, Tesfaye, & Dereje, 2015).

Two other worth noting points concerning the sample are non-representation of urban children and relatively low educational attainment of the fathers. Unlike studies that have found a significant effect of paternal education on child well-being using Bangladesh demographic and health survey data, our sample consists of only rural children. Thus our sample may not be truly representative of all Bangladeshi children.

We have also noticed that the mean education of the fathers is less than that of the mothers in our sample. If education is meant to increase skills and knowledge about childcare then a relatively low education among the fathers may not have resulted in their skills and knowledge quite as much as what resulted in the case of the mothers. Additionally in rural Bangladesh context it would be rare to find that a father is practically engaged in childcare. This prompts us to view the insignificance of paternal education as unsurprising because our results may be suggestive of the fact that education of the primary carer matters most. All considered the relative unimportance of fathers' education in predicting children's health marker in this study may not be spurious.

We will discuss the results of our controls in what follows before we concentrate on the results for the education variable and the pathways later on in this section. Parents' height appears to be a positive significant predictor of children's nutritional status, while their height is statistically insignificant for immunisation. We do not find any significant gender difference in HAZ, WAZ or immunisation model. Child's age has a negative relation with the HAZ, which is perhaps symptomatic of a non-linear relation between age and height. While age does not seem to have any significant association with WAZ; in the case of immunisation we can see that number of vaccines received by the children rises significantly with age. The significant negative coefficient on age squared means that the rate of receiving vaccines per month gradually falls as children become older. This is so perhaps because most of the vaccines are usually given within the first few months after birth. The log of per capita monthly expenditure has an expected sign, yet it appeared statistically insignificant in all three models. Household size has a significant negative associated with HAZ but it is insignificant in the other two models. This may mean that children of a household with many members tend to suffer from long-term under-nutrition.

We will now present the empirical results of these three models, which we obtain following Equation 4.6 that takes potential pathway variables into account.

We begin with the HAZ model, presented in Table 4.4, where we first control for potential pathway individually from Model 1 to 7, and then have all the potential pathways jointly in Model 8. As we can see, the size and significance of the effect of mothers' education do not change much in comparison with the base coefficient (column 1 in Table 4.3), and none of the potential pathways appears significant. Likewise in the WAZ model, presented in Table 4.5, we can see that the size and significance of the coefficient on mothers' education do not attenuate much in comparison with the base coefficient (column 2 in Table 4.3) across Model 1 to 8. Similar to what we see in Table 4.4 none of the potential pathways appeared significant in Table 4.5.

Table 4.6 represents results in the case of immunisation model. Model 1 through 6 represents estimates that are obtained by controlling for the potential pathway individually and Model 7 represents the estimate that is obtained by controlling for all the potential pathways jointly. Unlike the HAZ and WAZ models, in the case of immunisation a few deviations can be noticed in the size and significance of the coefficient on mothers' education. To recap, the base coefficient on mothers' education in the immunisation model was 0.056 (column 3 in

Table 4.3) which was significant at 5 percent. By contrast, it can be seen in Table 4.6 that the size and the significance of the coefficient on mothers' education clearly attenuate in Models 3 and 4, when 'media' and 'access to health information sources' are controlled for, respectively. The coefficient on mothers' education falls from 0.056 in base model to 0.047 in Model 3, and it turns out to be significant at 10 percent as opposed to 5 percent in the base model. The coefficient on media is 0.356, which is positive and statistically significant at 5 percent. Likewise in Model 4 when mother's access to information sources is accounted for as a potential pathway, the size of the coefficient on mother's education falls to 0.047 alongside losing statistical significance. The coefficient on access to information source is 0.335 which is statistically significant at 5 percent and positive. Accounting for the other potential pathways does not attenuate the magnitude or the significance of the effect of mother's education. Nevertheless, the joint inclusion of all potential pathways attenuates the significance of mothers' education completely and the magnitude of the effect also falls to 0.042 (Model 7) in comparison with the base model (column 3 in Table 4.3).

Table 4.4 OLS estimates of height-for-age Z score (HAZ) model

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Female child=1, otherwise 0	0.166	0.169	0.167	0.167	0.167	0.166	0.168	0.167
	(0.103)	(0.103)	(0.103)	(0.103)	(0.103)	(0.103)	(0.103)	(0.103)
Age of child (months)	-0.099***	-0.099***	-0.099***	-0.099***	-0.099***	-0.099***	-0.100***	-0.099***
	(0.033)	(0.032)	(0.033)	(0.033)	(0.033)	(0.032)	(0.032)	(0.033)
Age squared	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)	(0.001)	(0.001)
Father is missing=1, otherwise 0	-0.249	-0.245	-0.245	-0.251	-0.252	-0.251	-0.249	-0.236
	(0.159)	(0.159)	(0.159)	(0.159)	(0.159)	(0.159)	(0.159)	(0.160)
Father's height (cm)	0.031***	0.031***	0.031***	0.031***	0.031***	0.031***	0.031***	0.031***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Father's completed years of schooling	0.003	0.003	0.004	0.003	0.003	0.004	0.004	0.004
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Mother's completed years of schooling	0.033*	0.033*	0.035*	0.033*	0.032*	0.033*	0.033*	0.037*
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Mother's height (cm)	0.042***	0.042***	0.042***	0.042***	0.042***	0.042***	0.042***	0.042***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Log of per capita monthly expenditures	0.072	0.072	0.093	0.079	0.077	0.082	0.094	0.097
	(0.099)	(0.098)	(0.100)	(0.100)	(0.101)	(0.101)	(0.111)	(0.113)
Household size	-0.065	-0.066*	-0.068*	-0.066*	-0.066*	-0.066*	-0.063	-0.065
	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)	(0.041)	(0.042)
Agricultural household=1, otherwise 0	-0.062	-0.076	-0.074	-0.076	-0.077	-0.075	-0.074	-0.059
	(0.124)	(0.120)	(0.121)	(0.121)	(0.122)	(0.121)	(0.120)	(0.125)
Mother is engaged in IGA=1, otherwise 0	-0.054							-0.048
	(0.110)							(0.110)
Autonomy in expenditure decision-making		-0.013						-0.011
		(0.025)						(0.025)
Exposure to media=1, otherwise 0			-0.103					-0.116
			(0.114)					(0.130)
Access to health information=1, otherwise 0				-0.024				0.020
				(0.110)				(0.127)
Health knowledge score					-0.001			0.004
					(0.018)			(0.020)
Visited antenatal clinic=1, otherwise 0						-0.055		-0.045
						(0.126)		(0.127)
Food consumption score							-0.001	-0.001
							(0.003)	(0.003)
Barisal	-0.139	-0.155	-0.151	-0.135	-0.137	-0.128	-0.131	-0.152
	(0.253)	(0.253)	(0.253)	(0.253)	(0.261)	(0.252)	(0.253)	(0.259)
Chittagong	-0.107	-0.100	-0.073	-0.092	-0.095	-0.091	-0.093	-0.085
	(0.194)	(0.194)	(0.196)	(0.195)	(0.195)	(0.195)	(0.195)	(0.196)
Dhaka	-0.147	-0.157	-0.140	-0.145	-0.147	-0.145	-0.144	-0.142
	(0.181)	(0.180)	(0.180)	(0.180)	(0.183)	(0.181)	(0.181)	(0.181)
Khulna	-0.059	-0.060	-0.053	-0.052	-0.054	-0.044	-0.047	-0.046
	(0.210)	(0.210)	(0.211)	(0.212)	(0.222)	(0.211)	(0.211)	(0.218)
Rajshahi	-0.519**	-0.512**	-0.494**	-0.511**	-0.514**	-0.505**	-0.515**	-0.492**
	(0.220)	(0.222)	(0.221)	(0.220)	(0.220)	(0.222)	(0.221)	(0.224)
Rangpur	-0.098	-0.106	-0.091	-0.096	-0.101	-0.087	-0.107	-0.090
	(0.235)	(0.233)	(0.234)	(0.234)	(0.235)	(0.239)	(0.235)	(0.236)
Constant	-12.264***	-12.263***	-12.411***	-12.316***	-12.289***	-12.346***	-12.411***	-12.467***
	(2.099)	(2.097)	(2.096)	(2.107)	(2.102)	(2.105)	(2.133)	(2.135)
Observations	872	872	872	872	872	872	872	872
Adjusted R-squared	0.117	0.117	0.117	0.116	0.116	0.117	0.117	0.112

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 4.5 OLS estimates of weight-for-age Z-scores (WAZ) model

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Female child=1, otherwise 0	0.039	0.037	0.037	0.038	0.041	0.037	0.037	0.042
	(0.078)	(0.078)	(0.078)	(0.078)	(0.079)	(0.078)	(0.078)	(0.079)
Age of child (months)	0.002	0.002	0.001	0.001	0.000	0.002	0.002	0.001
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Age squared	-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)	(0.001)	(0.001)
Father is missing=1, otherwise 0	0.039	0.043	0.038	0.041	0.036	0.042	0.039	0.031
	(0.138)	(0.138)	(0.137)	(0.138)	(0.137)	(0.138)	(0.137)	(0.137)
Father's height (cm)	0.019***	0.019***	0.020***	0.019***	0.019***	0.019***	0.019***	0.019***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Father's completed years of schooling	0.014	0.014	0.013	0.014	0.014	0.014	0.013	0.013
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Mother's completed years of schooling	0.038***	0.039***	0.037***	0.038***	0.037***	0.039***	0.038***	0.035***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Mother's height (cm)	0.035***	0.035***	0.035***	0.035***	0.035***	0.035***	0.035***	0.035***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Log of per capita monthly expenditures	0.106	0.100	0.089	0.099	0.089	0.100	0.078	0.071
	(0.079)	(0.079)	(0.081)	(0.080)	(0.080)	(0.080)	(0.084)	(0.086)
Household size	-0.001	0.001	0.003	0.001	0.003	0.001	-0.003	-0.001
	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)	(0.030)
Agricultural household=1, otherwise 0	-0.081	-0.063	-0.065	-0.064	-0.077	-0.063	-0.067	-0.096
	(0.093)	(0.090)	(0.090)	(0.090)	(0.090)	(0.090)	(0.089)	(0.094)
Mother is engaged in IGA=1, otherwise 0	0.063							0.060
	(0.085)							(0.086)
Autonomy in expenditure decision-making		-0.001						-0.003
		(0.018)						(0.018)
Exposure to media=1, otherwise 0			0.073					0.059
			(0.087)					(0.100)
Access to health information=1, otherwise 0				0.018				-0.048
				(0.084)				(0.101)
Health knowledge score					0.017			0.016
					(0.013)			(0.015)
Visited antenatal clinic=1, otherwise 0						0.009		0.006
						(0.094)		(0.094)
Food consumption score							0.002	0.001
							(0.002)	(0.002)
Barisal	-0.045	-0.050	-0.032	-0.047	-0.012	-0.050	-0.051	-0.003
	(0.133)	(0.134)	(0.135)	(0.133)	(0.137)	(0.133)	(0.133)	(0.139)
Chittagong	-0.044	-0.057	-0.067	-0.059	-0.077	-0.057	-0.056	-0.067
	(0.129)	(0.128)	(0.127)	(0.128)	(0.128)	(0.128)	(0.128)	(0.131)
Khulna	-0.016	-0.023	-0.016	-0.022	0.012	-0.024	-0.026	0.018
	(0.127)	(0.127)	(0.128)	(0.127)	(0.132)	(0.128)	(0.128)	(0.133)
Rajshahi	-0.155	-0.160	-0.170	-0.162	-0.182	-0.162	-0.156	-0.176
	(0.166)	(0.166)	(0.166)	(0.166)	(0.166)	(0.167)	(0.166)	(0.170)
Rangpur	-0.196	-0.191	-0.194	-0.194	-0.214	-0.193	-0.181	-0.205
	(0.157)	(0.156)	(0.156)	(0.157)	(0.157)	(0.156)	(0.156)	(0.157)
Sylhet	-0.048	-0.046	-0.043	-0.046	-0.063	-0.047	-0.044	-0.058
	(0.129)	(0.129)	(0.130)	(0.130)	(0.129)	(0.129)	(0.129)	(0.131)
Constant	-10.639***	-10.607***	-10.520***	-10.586***	-10.531***	-10.599***	-10.451***	-10.414***
	(1.485)	(1.491)	(1.504)	(1.502)	(1.498)	(1.498)	(1.499)	(1.515)
Observations	881	881	881	881	881	881	881	881
Adjusted R-squared	0.0865	0.0859	0.0867	0.0860	0.0874	0.0859	0.0864	0.0824

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 4.6 OLS estimates of immunisation model

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Female child=1, otherwise 0	0.005	0.005	0.006	0.011	0.012	0.010	0.006
	(0.146)	(0.145)	(0.145)	(0.145)	(0.145)	(0.146)	(0.144)
Age of child (months)	0.691***	0.690***	0.690***	0.687***	0.689***	0.691***	0.688***
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
Age squared	-0.020***	-0.020***	-0.020***	-0.020***	-0.020***	-0.020***	-0.020***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Father is missing=1, otherwise 0	-0.123	-0.141	-0.152	-0.149	-0.137	-0.132	-0.167
	(0.240)	(0.243)	(0.239)	(0.241)	(0.240)	(0.241)	(0.239)
Father's height (cm)	0.000	-0.000	0.000	-0.000	-0.000	-0.000	-0.000
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Father's completed years of schooling	0.012	0.012	0.010	0.011	0.012	0.010	0.010
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Mother's completed years of schooling	0.057**	0.054**	0.047*	0.047*	0.054**	0.053**	0.042
	(0.026)	(0.026)	(0.027)	(0.026)	(0.027)	(0.026)	(0.027)
Mother's height (cm)	0.011	0.011	0.010	0.010	0.010	0.011	0.009
	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)	(0.012)	(0.013)
Log of per capita monthly expenditures	0.160	0.175	0.108	0.127	0.150	0.152	0.093
	(0.134)	(0.134)	(0.135)	(0.136)	(0.136)	(0.136)	(0.138)
Household size	-0.014	-0.016	-0.009	-0.013	-0.014	-0.017	-0.007
	(0.059)	(0.059)	(0.059)	(0.059)	(0.060)	(0.059)	(0.059)
Agricultural HH=1, otherwise 0	-0.096	-0.125	-0.132	-0.136	-0.141	-0.125	-0.111
	(0.176)	(0.171)	(0.171)	(0.170)	(0.170)	(0.171)	(0.174)
Mother is engaged in IGA=1, otherwise 0	-0.093						-0.099
	(0.148)						(0.151)
Autonomy in expenditure decision-making		0.027					0.027
		(0.034)					(0.035)
Exposure to media=1, otherwise 0			0.356**				0.255
			(0.151)				(0.167)
Access to health information=1, otherwise 0				0.335**			0.227
				(0.149)			(0.172)
Health knowledge score					0.023		-0.008
					(0.032)		(0.035)
Visited antenatal clinic=1, otherwise 0						0.159	0.105
						(0.144)	(0.145)
Barisal	0.792**	0.840**	0.859**	0.809**	0.872**	0.778**	0.844**
	(0.365)	(0.362)	(0.363)	(0.364)	(0.370)	(0.364)	(0.374)
Chittagong	0.737**	0.767***	0.687**	0.711**	0.752***	0.747***	0.657**
	(0.286)	(0.283)	(0.281)	(0.284)	(0.283)	(0.284)	(0.285)
Dhaka	0.569**	0.590**	0.549**	0.552**	0.592**	0.564**	0.549**
	(0.270)	(0.267)	(0.268)	(0.269)	(0.269)	(0.269)	(0.269)
Khulna	0.850***	0.879***	0.871***	0.876***	0.932***	0.844***	0.843***
	(0.310)	(0.310)	(0.309)	(0.308)	(0.318)	(0.311)	(0.321)
Rajshahi	0.600*	0.604*	0.541*	0.571*	0.602*	0.584*	0.503
	(0.314)	(0.314)	(0.313)	(0.313)	(0.312)	(0.315)	(0.318)
Rangpur	1.178***	1.182***	1.137***	1.099***	1.161***	1.134***	1.091***
	(0.286)	(0.286)	(0.286)	(0.289)	(0.285)	(0.288)	(0.291)
Constant	-0.599	-0.700	-0.172	-0.215	-0.558	-0.474	0.069
	(3.075)	(3.085)	(3.107)	(3.110)	(3.086)	(3.068)	(3.131)
Observations	887	887	887	887	887	887	887
Adjusted R-squared	0.409	0.409	0.412	0.412	0.409	0.409	0.411

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

4.4.2 Discussion

A few points emerge from the above analysis of pathway exploration. From the HAZ and WAZ model, we can clearly see that despite accounting for the potential proxies for confounders , mothers' education still exerts a positive and statistically significant effect on children's long-term and short-term nutritional status. Thus it may cautiously be inferred that maternal education per se is crucial in influencing children's nutritional status, which is robust to a wide range of maternal personal characteristics. Otherwise, we would have seen that the magnitude or the significance of the effect had fallen notably in any model in Table 4.4 and 4.5. The estimates that are presented in those tables are likely to be partially free from bias in comparison with the base estimates of the HAZ and WAZ model of Table 4.3. The positive and significant coefficient on mothers' schooling even after controlling for potential pathways is, thus, suggestive of a direct effect of mothers' education on children's nutritional status in rural Bangladesh.

Contrary to the HAZ and WAZ models, the direct effect of mothers' education on children's immunisation seems weak and the effect is likely to operate through some pathways including mothers' exposure to media and mothers' access to health information sources. Evidently when we control for those two potential pathways individually in the immunisation model, the coefficient on mothers' education not only loses its statistical significance but also becomes smaller in magnitude. Moreover the significance of mothers' education completely disappears when all potential pathways are accounted for, implying that the coefficient on mothers' education in the base model had picked up some effect of those two potential pathway variables. This suggests that mothers' schooling has no independent effect of its own on children's immunisation. We have further examined what happens to the effect of maternal education on immunisation if we control for only those two significant potential pathways jointly unlike the Model 7 (Table 4.6) that controls for both significant and insignificant potential pathways simultaneously. In fact what we find here is similar to the one that we observe in the case of Model 7, which means that mothers' education completely loses its statistical significance in the immunisation regression if we account for only significant potential pathways. Since this finding is similar to Model 7, we do not report it in Table 4.6 primarily to maintain consistency of the presentation of result Tables across child health markers. The relative importance of those two potential pathways is further confirmed by a significant F-test of the joint significance of the coefficients on access to media and on access to health information. Based on what we observe in Table 4.6, it may be inferred that

mothers' education may have influenced immunisation through improving mothers' accessibility to media and health information.

We attempt to understand the reason for the attenuation of the significance of maternal education for children's immunisation. For the purpose of a better understanding, we need to take into consideration the extent of the country's immunisation programmes. The Bangladesh Government has adopted a universal immunisation programme and an expanded programme on immunisation (EPI), which have been remarkably successful both in terms of coverage, reducing differences in immunisation status across gender and region, and reducing child mortality throughout the country. In addition, the Government continues efforts to extend the coverage of immunisation programmes so that none of the country's infants remains unvaccinated. Creating mass awareness through media, holding vaccine campaigns, advertisements, providing the service at people's doorstep through health extension workers are some of the most mentionable initiatives taken in Bangladesh. Importantly some vaccination programmes – for example polio and vitamin A capsules, deworming medicines – are provided freely by the Government and again mass media and health workers do a great job spreading this information among the people. Given that education is likely to increase women's exposure to modern mass media and health information sources and is likely to increase mothers' ability to comprehend information from the media and others sources, it may be plausible that the effect of mothers' education on immunisation work out via those two potential pathways (Model 3 and 4 in Table 4.6).

4.5 Conclusion

The primary aim of this chapter was to generate evidence of the impact of mothers' education on child health through identifying pathways of impact in the context of rural Bangladesh where female schooling has increased in recent decades while progress in addressing child under-nutrition is lacking. Our OLS regression results suggest that there is a positive and statistically significant association between mothers' education and children's nutritional status in rural Bangladesh. This is true regardless of whether we looked at the impact on child health inputs (immunisation) or long-term (HAZ) and short-term (WAZ) health outcomes. We additionally have attempted to address concern over the potential bias of maternal education owing to omitted maternal characteristics that can influence child health as well as being correlated with mothers' schooling. In the absence of a credible exclusion restriction to estimate an IV model, we do this by augmenting our OLS model for seven potential pathways

through which mothers' education may benefit children's health. This approach is based on the assumption that the pathway indicators would potentially capture various aspects of omitted maternal characteristics. We consider seven potential pathways including mothers' engagement in the income generating activities, autonomy, exposure to media, access to health-related information sources, health knowledge, use of antenatal service, and household dietary diversity. This approach might have partially reduced the potential bias of the estimate of the effect of mothers' education on children's nutritional status. Most importantly the result of the significant association between maternal education and children's height and weight persists even in the augmented models of children's nutritional status. Although our study may not have been able to address entirely the issue of bias by the methodology adopted here, it may be useful in that it sheds light on the beneficial aspect of educating mothers. This may be an important finding because such a significant association is found despite the overall low level of schooling among sample mothers on the one hand, and the insignificance of fathers' schooling as well as of household income on the other hand. As such our study corroborates the growing evidence on the importance of mother's education for children's physical development (Aslam & Kingdon, 2012; Burchi, 2012; Desai & Alva, 1998; Frost et al., 2005; Glewwe, 1999).

In the next chapter, we look beyond mothers' education and examine the impact of mothers' empowerment on household food security, and children's and adults' calorie and protein intake.

Appendix 2 Distribution of the sample children's nutritional status

Table 4.7 Distribution of the sample children's nutritional status across age and gender

Age in months	HAZ			WAZ		
	Percent below -3SD	Percent below -2SD	Mean	Percent below -3SD	Percent below -2SD	Mean
0-5	2.76	3.90	-1.04	2.73	4.43	-1.29
6-8	1.38	1.72	-1.30	1.25	1.93	-1.23
9-11	1.84	3.79	-1.50	1.25	2.50	-1.41
12-17	5.40	8.61	-1.97	2.16	6.82	-1.45
18-24	6.43	5.05	-2.16	2.73	5.23	-1.73
Gender						
Boys	20.65	22.27	-1.69	11.01	19.50	-1.45
Girls	15.00	23.86	-1.57	9.23	22.30	-1.43
All	17.80	23.08	-1.63	10.11	20.91	-1.44

Source: Author's own calculation
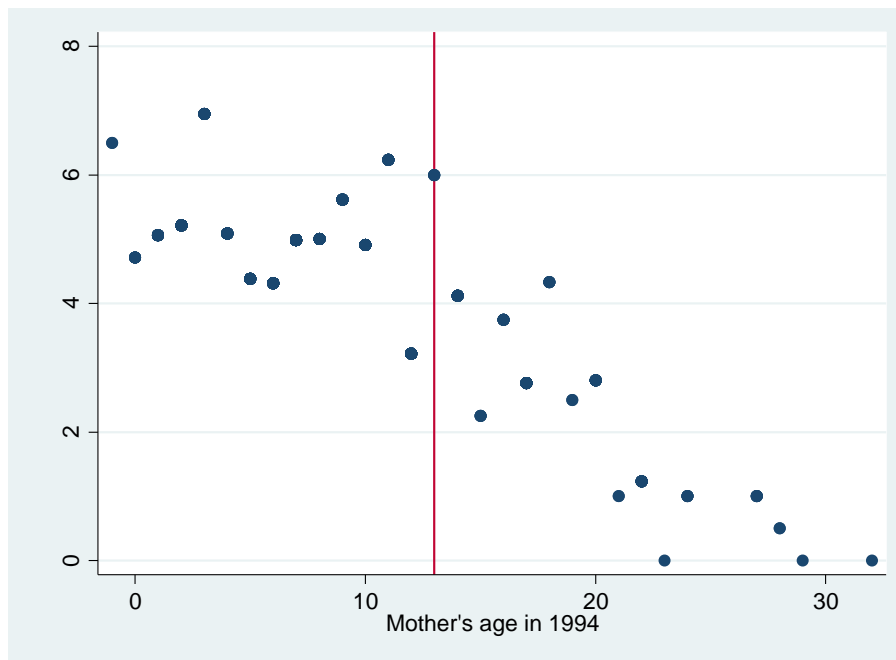
Figure 4.2 Mothers' average years of completed schooling across their age

Chapter 5

Impact of women's empowerment on food and nutrition security: children, adults, and household level analysis

Abstract

In this chapter, we analyse the impact that gender relationships have on agricultural households' food security. To this end, we explore the impact of primary females' empowerment in agriculture on household members' calorie and protein intake and household dietary diversity. We measure empowerment by a multidimensional index that captures adequacy over ten indicators across five different domains including agricultural production, asset possession, control over income, community influence, and time allocation. The OLS regression estimate suggests that both children's and adults' calorie and protein intake significantly increases with an increase in female empowerment. Likewise household's dietary diversity also significantly increases with female empowerment. Female household members, especially daughters are found to be the most deprived as regards calorie and protein intake, signifying intra-household discrimination of food allocation within households in rural Bangladesh. We find that primary females' education is a positive and statistically significant determinant of household dietary diversity. Finally our finding of the positive and significant impact of female empowerment on food security indicators remain unchanged when we estimate the models by instrumental variables technique on account of potential endogeneity of the empowerment variable.

5.1 Introduction

In chapter 4, we have examined the effect of mothers' education, a potential determinant of empowerment, on a wide range of children's health markers and found that it has a statistically significant and positive effect on children's nutritional status. It is well recognised that nutritional status depends on the intake of nutrients from balanced and diversified diets. In addition, the patterns of food distribution within households also contribute to malnutrition among certain subgroups such as young children and female members (Engle & Nieves, 1993). For instance, Bangladesh features a long-standing discrimination in the intra-household allocation of nutrients against female and children (M. Hossain, Naher, & Shahabuddin, 2005). About one-fifth of the country's ever-married women aged between 15-49 years are malnourished (BMI<18.5) and so are one-third of the country's under-five children (stunted) (NIPORT et al., 2016). Since preparing meals and distributing food among household members is a customary responsibility of women, it is likely that their knowledge as well as bargaining power has an important bearing on the household members', especially children's, intake of nutrients and on the household's food selection. Hence women's empowerment is vital for ensuring households' food security (Sharaunga et al., 2016).

Keeping the above in mind, in this chapter we are interested in analysing what impact women's empowerment may have on household food security in rural Bangladesh. However food security analysis at the household level tells little about discrimination in intra-household food allocation (Dawsey & Bookwalter, 2016). Therefore we extend our investigation further to analyse the impact of women's empowerment on individuals' nutrient intake, and finally on intra-household allocation of food. In particular, we want to test two hypotheses: (i) whether an increase in women's empowerment will lead to a greater intake of calories, proteins, and diversified diets; and (ii) whether or not the gender differential in food allocation that might exist within households can be addressed by increasing women's empowerment.

The questions are particularly pertinent as far as Bangladesh's food security and nutritional status are concerned. According to the most recent household income and expenditure survey of Bangladesh, about 26 percent of the rural population is unable to afford an intake of the normative energy level of 2,122 kilocalories per person per day (BBS, 2017). Together with a deficiency in energy intake, people also suffer from seriously imbalanced diets as more than 80 percent calories are obtained merely from cereals (M. Hossain et al., 2005). Consequently,

a higher incidence of malnutrition is widely prevalent in the country, especially among young children and women. On the other hand, about 46 percent of households in rural areas depend on agriculture for their livelihood (BBS, 2011a), with women playing a very significant role by doing the bulk of unpaid post-harvest operations, for instance, preparation of threshing floor, threshing, beating, parboiling, drying, husking, winnowing, sieving, and storing alongside taking care of livestock, poultry, and homestead gardening (K. Begum, 1989). Despite their significant contribution, women generally have little or no power over household decisions in relation to the allocation of resources e.g. whether a household should grow a cash crop or a food crop, or how much of an input should be applied, or how to source material inputs, or even how to allocate income. They also rarely have access to and control over agricultural resources. Given this context, the impact that women's empowerment in agriculture may have on improving household and individual food security merits an in-depth empirical investigation.

In order to empirically estimate the effect of women's empowerment on food security, we use regression analysis and look at three measures of food security – (i) intake of calories and (ii) intake of proteins measured at individual level, and (iii) a weighted index of household dietary diversity. For measuring empowerment, as discussed in chapter 2, we have used a weighted five domains index. Our analytical strategy involves regressing food security indicator on women's empowerment index along with controls for demographic, socioeconomic, household, and regional factors. The OLS estimates suggest that women's empowerment is a positive and statistically significant determinant of individuals' nutrient intake, as well as the household's dietary diversity. Our analysis also finds evidence of significant gender difference in the allocation of calorie and protein—daughters consume significantly fewer calories and proteins than sons, and so do the adult females. Women's formal education also appears to be a positive and statistically significant determinant of household's dietary diversity. However the OLS estimate of the effect of empowerment could be biased if our empowerment index does not comprehensively pick up the effect of unobservables that might influence both mothers' agency as well as food security. These might include certain community and gender norm variables and we address this concern by estimating the effect through instrumental variables technique, in which the empowerment index has been instrumented by the number of community activities the woman had participated in in the past 12 months. The IV estimates once again confirm the positive and significant impact of women's empowerment on calorie intake and household dietary

diversity. These results lead us to suggest that women's empowerment in agricultural households is beneficial not just for a particular subgroup but also for all, and more importantly for households in general.

Our investigation makes a number of contributions to the literature. First, it presents systematic evidence of an impact of women's empowerment on food security both within and between-household context. This has been made possible by utilising a particularly rich dataset containing information on food consumption at the individual level. Second, we use a multidimensional weighted index for empowerment, which is specifically designed to capture the empowerment of women in agricultural household, to document the effect of empowerment across multiple indicators of food security. The multidimensional index has the advantage over other traditional indirect measures (e.g. relative or absolute difference in age, education, or income) in capturing various aspects of empowerment of women in agricultural households. In other words, unlike (Malapit, Sraboni, et al., 2015; Sraboni et al., 2014) we depart from the existing studies by simultaneously accounting for the multidimensionality in both the domains of food security as well as women's empowerment. Third, our study addresses a methodological concern about the potential endogeneity of women's empowerment as a determinant of food security. Finally, the analysis in this chapter is based on nutrient intake data disaggregated by gender and thereby providing us with a rare opportunity to assess how the effect of women's empowerment on individuals' calorie and protein intake varies.

The remainder of this chapter is organised as follows. In the next section, we review the relevant literature, which is followed by a discussion on the sample, theoretical framework, empirical techniques, and measurement of key variables in section 3. Empirical results and their discussions are presented in section 4. Finally, the chapter concludes with few remarks in section 5.

5.2 Literature review

It is worth starting with the definition of food security. According to the Food and Agriculture Organisation (FAO) of the United Nations, "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 1996). Food security has three pillars: availability, access, and utilisation of food. In an authoritative report of the

IFPRI, Quisumbing et al. (1995) underscored that women are key to food security. They argued that women influence all the three pillars of food security. Women constitute about 43 percent of the world's farmers and accordingly grow much of the world's food (FAO, 2011a) Thus women influence food production and availability by providing both paid and unpaid labour in agricultural operations, and they enhance food access by complementing household income earned from employment in agriculture. Finally, by combining adequate and appropriate care and hygiene practices, women ensure nutritional security (utilisation of food) as they are the primary carers. In this way, women establish an interlinking relationship between agriculture and household welfare in the form of food security. Nevertheless, women's ability to do so is obstructed by their lack of access to resources and lack of voice in the decisions that impact their lives and the lives of their families (FAO, 2011a). Women in rural agricultural households, who are critical actors for household food security, have low levels of empowerment in agriculture (Sharaunga et al., 2015) owing to factors such as socio-cultural norms, lack of education, barriers to earning income, lack of freedom of mobility outside the home, and a discriminatory religious law of inheritance.

Studies have shown that when women earn income, their bargaining power within the household may be improved, and the resulting improvement in the bargaining power is likely to enable their voices to be heard in household decision-making (Balagamwala et al., 2015). As agriculture provides employment opportunities for rural women, it plays a very crucial role in enhancing women's empowerment. When women are able to make household decisions, they are likely to make pro-nutrition choices (Guyer, 1980; Engle, 1988) cited in (Kennedy & Peters, 1992). In this way, agriculture reinforces women's empowerment and household food and nutrition security.

Sharaunga et al. (2016) have shown that if the primary female member of a household is empowered then the household is more likely to be food secure because such empowerment increases women's access to and control over productive resources. This, in turn, is likely to enable women to pursue diversified livelihoods. In this way, women's empowerment helps to ensure the stability of income in the household and eventually food security. Harris-Fry et al. (2015) found an inverse relationship between women's agency and household food insecurity. They have shown that if women do not face barriers to market access then the risks of households' food insecurity is lower.

Sraboni et al. (2014), who analysed the impact of women's empowerment on household food security, found that both the average per capita calorie availability in the household and dietary diversity of household increases, when the primary female decision maker is empowered. They also found that if the primary female's membership of groups in which she acts as a decision maker increases then household food security is also likely to be improved. In another study in Bangladesh, Malapit, Sraboni, et al. (2015) found that when the gap between spouses with regard to decision-making concerning credit and asset tends to be smaller; children's nutritional status tends to be better, especially of girls.

Apart from women's empowerment, their education is also crucial for food security. Studies cited in the previous chapter have shown that mothers' education is a significant correlate of children's nutritional status. Educated women may also better gauge the nutritional requirement of individuals with varied workload (Beyene & Muche, 2010). The age of women is also important for household food security because age proxies her experience (Sharaunga et al., 2016). As a woman grows older she may know better about the food requirements for her family members given the age and gender composition of the family.

Food security at the micro level (household and individual level) is influenced by other socioeconomic characteristics as well. Studies that have analysed the determinants of household food security highlight a number of factors such as household's monthly income, share of budget spent on food (Akerele, Ibrahim, & Adewuyi, 2014), education and employment of household head, dependency ratio, household size (Akerele et al., 2014; Faridi & Wadood, 2010), possession of land, price of staple food, and dwelling condition (Faridi & Wadood, 2010).

Within a household, the individual level food intake depends on the person's age, gender, body size, and physical activity level (Smith & Subandoro, 2007), pregnancy and lactation status (Hoddinott, 1999). How much food a household member will get may also be influenced by the member's relative economic importance within the household. For example, Engle and Nieves (1993) found that in Guatemala male household heads had significantly higher protein-rich diets as they are the most important economic contributors within the household. Following the same analogy, children get fewer calories. Apart from economic importance, food allocation within the household is also discriminated along gender line which is typical in poor developing countries. For example L. C. Chen, Huq and Souza (1981) found evidence of significant gender gap in food allocation in Bangladesh where neonatal

mortality is high for boys in comparison with girls; however, the trend is reversed at the post-natal stage. They argued that such reversal of child mortality along gender lines could be attributed to discriminating care and nutrition provided to girls.

From a nutritional point of view, consuming enough calories may not necessarily ensure nutritional security because calorie consumption is meant to be the indicator of whether or not energy requirement is met. However, this does not guarantee that the requirement of nutrients such as proteins, vitamins, minerals is fulfilled. Hence attention needs to be extended to the household's dietary composition in terms of macronutrients and micronutrients (Ruel, 2003). Importantly a more diversified diet is closely associated with calorie and protein adequacy (Swindale & Bilinsky, 2006). An improved diet comprising different food groups is essential for maintaining normal physical growth as well as meeting nutritional requirements, especially of young children (Rah et al., 2010). While dietary diversity is strongly linked with nutritional outcome on the one hand, it is also strongly influenced by women's empowerment on the other hand. For example Bhagowalia, Menon, Quisumbing, and Soundararajan (2012) have found that mothers' participation in household decision making has a positive and significant effect on increasing children's diet diversity in Bangladesh.

One problem associated with estimating the effect of women's empowerment on food security has been highlighted by Sraboni et al. (2014) who argue that women's empowerment and household food security may have been influenced by the same unobservable factors. In a similar vein, Yimer and Tadesse (2016) argue that empowerment and dietary diversity could be determined by the same factors. A prime example of the unobserved factor would be gender norms and socio-cultural factors which generally determine who would make decisions about resource allocation. Such norms and socio-cultural factor generally influences power relationships within a household and relative importance of household members. Importantly evidence exists in this connection in the case of Bangladesh (Patalagsa et al., 2015), which suggests that a specific subgroup (adult men) within a household receives more importance when it comes to allocation of nutrients as well as improved diets. In a context like this, women clearly lack in agency to influence intra-households allocation of food. Similarly such norms and cultural factors (women are often not allowed to go marketplace) may constrain women's ability to influence households' purchase of food from the market and the resulting households' dietary diversity may lack representation of dietary needs of household members. This implies that household specific gender norms could influence both women's agency and food security indicators, which may not be adequately picked up by the

five domains empowerment index and thus remains embodied in the disturbance term. As a result, the estimate of the effect of women's empowerment on food security obtained by OLS regression analysis may suffer from endogeneity bias.

On the basis of the existing literature, a few points are to be noted. Food security is crucial for nutritional adequacy and it depends on the availability of, access to, and utilisation of food. Women are primarily responsible for meal preparation and allocation of prepared food among household members, but they generally lack the power to make decisions on household resource allocation. Moreover, there is evidence that food allocation within households often does not take place in accordance with needs and undermines the nutritional requirements of children and women. In such context, whether improving women's empowerment would lead to better food security calls for a rigorous investigation which poses some analytical challenges. However empirical literature on Bangladesh concerning the issue of intra-household allocation of food in the context of agricultural households is still very limited because of the dearth of disaggregated household data on food consumption. A few studies that have used the BIHS data and empowerment index have primarily assessed the effect of women's empowerment on children's nutritional status rather than nutrient intake and intra-household allocation of nutrient which is the focus of this chapter. Here we intend to address the question with a view to finding reliable estimates of the relationship between women's empowerment and individual and household food security as well as the intra-household allocation of food.

5.3 Data, measurement, and empirical strategy

This section illustrates our sample, and measurement of key variables, and the econometric strategies that we follow for analysing the impact of females' empowerment on food security indicators.

5.3.1 The sample

Our working sample comprises household members of the 3,843 agricultural households of the BIHS 2012 (refer to chapter 3 for selection process). In these households, the primary male and primary female household members are co-residing spouses. We split the household members into two broad categories based on relation and age. For instance, household members, who are younger than 18 years and are children of the household head, form the

child subsample[12]. The rest of the household members constitute our adult subsample. The main reason for splitting household members into age-specific subsamples is that unlike adults, children do rely entirely on their parents for food, nutrition, and care. Therefore it would be reasonable to assume that the impact of mothers' empowerment works differently for children than for other household members who do not exclusively rely on the primary female for care and nutrition. The child subsample consists of 5,857 children, of which 2,993 are sons and 2,864 are daughters. The adults' subsample comprises 9,900 individuals of which 4,944 are male and 4,956 are female (see Table 5.13 in appendix 3 for detailed information on household composition).

5.3.2 Measurement of the dependent variables

Since we are interested in food security at both individual and household levels, essentially our dependent variable i.e. the indicator of food security varies across the level of analysis. As implied by the definition, food security basically refers to having sufficient intake of nutrients to be derived from varied food to provide energy for maintaining individual-appropriate health. Conventionally individual-level food security is expressed by individuals' food intake measured in calories, and at the household level, food security is expressed through dietary diversity (Hoddinott, 1999). The rationale is that diet quantity gives information on the availability and consumption of total food energy, whereas diet quality provides information on the ability of food to provide both micro and macro nutrients (Abdulai & Aubert, 2004). Furthermore food intake data give accurate and direct information on individuals' nutrient intake and therefore yield precise information on individual food security. On the other hand, the relevance of households' diet composition as a food security indicator stems from the recommendation of nutritionists who emphasize increasing variation in diets so as to meet the need for both macronutrients and micronutrients (Headey & Ecker, 2013). In line with this, we use the amount of calorie intake by an individual as the dependent variable in the child and adults food security model. Looking at merely energy intake indicator may not reveal whether nutrient requirement is met. For instance, consuming adequate calories does not ensure adequate nutrients especially protein (Gittelsohn, Thapa, & Landman, 1997). A person can have enough calories by consuming only starchy staples and few or no protein items, in which case sufficient calories would not follow adequate nutrients. Protein is generally derived from animal-originated food e.g. fish, meat, egg, milk, and organs of animals, which

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[12] There are 630 household members who aged below 18 years but are non-child of the household head and the primary female, whom we exclude from the children subsample.

are rarely consumed by people in the developing countries (Abdulai & Aubert, 2004). Hence in addition to the calorie indicator, we look at individuals' intake of protein as an additional indicator in our food security analysis. By examining intake of protein, we would be able to obtain a better substantive of the intra-household dynamics of food allocation in the rural Bangladeshi agricultural households. Because we suspect that protein being a costly source of nutrient may be discriminately allocated within a household. Thus, for the individual level regression, we have two dependent variables: level of calorie intake and level of protein intake. On the other hand, we compute a weighted index of diet diversity which is based on frequencies of the households' consumption of specific foods or food groups over a reference period in order to quantify the household level food security indicator.

A major concern with regard to data on food consumption is that they are likely to be sensitive to seasonality. For instance, just prior to the harvest of major crops, agricultural households may experience food insecurity owing to lack of jobs or employment as well as a shortage of food and a surge in food prices. Conversely, the intensity of food shortage or food insecurity in the agricultural households may be less in the period immediately after harvest. However, the IFPRI researchers have taken adequate measure to ensure that the BIHS food consumption data are not affected by such seasonality. They have conducted the survey during months that do not coincide with the two lean periods in Bangladesh (Sraboni et al., 2014). Nevertheless we recognise that instability in accessing food in the lean period may have a considerable effect on agricultural households' food security because at that time households may require adopting various coping strategies including skipping meals. However we are not able to specifically focus on the issue in this study as the dataset does not allow us to assess by how much a person consumes less in the event of a lean season.

A. Individual-level food security indicators

The BIHS collected data on quantities of food consumed by household members, using a 24 hours recall method. We use these data to estimate individual-level intake of calories and protein by using an appropriate conversion factor as stated in Equation 5.1 and 5.2, respectively (Akerele et al., 2014; Aromolaran, 2004).

Quantities of consumed food i.e. A_{ij} in Equation 5.1 and 5.2 are given in the BIHS, which we have converted into calorie content by using respective food-calorie conversion factor (B_j), and into protein content by using respective food-protein conversion factor (C_j). For

appropriate B_j and C_j, we have used the conversion factors provided by the Institute of Nutrition and Food Science of the University of Dhaka (Shaheen et al., 2013). The unit of calorie intake is kilocalorie (kcal) and of protein intake is gram (gm).

$$kcal_i = \sum_{j=1}^{m} A_{ij} B_j \qquad \text{Equation 5.1}$$

$$protein_i = \sum_{j=1}^{m} A_{ij} C_j \qquad \text{Equation 5.2}$$

Where,

$kcal_i$ = daily energy intake by i-individual expressed in terms of kilocalorie (kcal)

$protein_i$ = daily intake of protein by i-individual expressed in terms of gram (gm)

A_{ij} = weight of j-food item in grams consumed by i-individual

B_j = per unit food energy content of the j-food item

C_j = per unit protein content of j-food item

j = 1, 2, …, m; j is the number of food item consumed by i-individual in the reference day

B. Household-level food security indicator

To denote household level food security we compute household food consumption score (FCS) following the guidelines of the World Food Programme (WFP, 2008). This score is a weighted index which is computed from frequencies of consumption of different food groups by a household over the past seven days of the survey. The BIHS collected data on frequencies of consumption of different food groups over the past week of the survey, which means that the consumption frequency ranges from 0 to 7. These frequencies specific to food groups are multiplied by the corresponding weights presented in Table 5.1 and the weighted frequencies are then summed up as Equation 5.3 to find the weighted food consumption score of a household. Table 5.1 shows the relevant food groups along with their respective weights as per the WFP's guidelines.

Table 5.1 Food items and corresponding weights

	Food items	Food group	Weight
1	Maize, maize porridge, rice, sorghum, millet paste, bread and other cereals	Main staples	2
	Cassava, potatoes and sweet potatoes, other tubers, plantains		
2	Beans, peas, groundnuts and cashew nuts	Pulses	3
3	Vegetables, leaves	Vegetables	1
4	Fruits	Fruit	1
5	Beef, mutton, lamb, poultry, fish, seafood	Meat and fish	4
6	Milk, yoghurt and any other dairy	Milk	4
7	Sugar and sugar products, honey	Sugar	0.5
8	Oils, fats, and butter	Oil	0.5
9	Spices, tea, coffee, salt, fish powder, small amount of tea milk for tea	Condiments	0

Adopted from (WFP, 2008)

As can be seen from Table 5.1, the relevant nine food groups are staples (cereals), legumes/pulses, vegetables, fruits, meat/fish/eggs, milk/dairy, oil, sugar, condiments. Equation 5.3 describes the mathematical notation of household food consumption scores.

$$FCS_h = \sum_{n=1}^{9} consumption\, frequency \times weight \qquad \qquad \text{Equation 5.3}$$

According to the WFP, if the weighted food consumption score falls below 21 then the household's diet diversity is considered to be 'poor', and a score over 35 is regarded as 'acceptable'; while any score between 21.5 and 35 means the variation in diets lies in the borderline between acceptable and poorly diversified. The category poor would indicate that the household falls short of consuming diversified food (Jones, Ngure, Pelto, & Young, 2013). One key feature of the food consumption score is that it is expressed by a continuous number unlike the simple count-based categorical dietary diversity scores (WFP, 2008). The range of the food consumption scores varies between 0 and 112.

Table 5.2 Distribution of the 3,843 agricultural households according to the WFP's threshold

Food consumption score	Profile	Proportion of households
0-21	Poor	0.55
21.5-35	Borderline	15.45
35 or more	Acceptable	84.00

Source: Author's own calculation

Figure 5.1 enables us to get a quick glance at the variation of diets of the sample households. The figure shows the proportion of the households who had eaten a specific food group at least once in the week before the survey. Evidently, all households had eaten cereals which

basically include rice (the main staple in Bangladesh). Figure 5.1 also tells us that some food such as vegetables, tubers, roots, and oils are consumed by almost all households over the week before the survey. Although about 95 percent of the households have consumed fish at least once in the past week, more than half of the households did not consume animal-based protein such as meat and milk even once in the past week. Not only is the consumption of animal protein less among the households, but also intake of plant-based protein e.g. pulses and legumes is also less as more than half of the households did not eat any pulses over the previous week. Consumption of fruits, which are crucial sources of micronutrients i.e. vitamins and minerals, is considerably less among the rural agricultural households in Bangladesh. Overall, the diagram indicates that the majority of the Bangladeshi rural households' diets are predominantly reliant upon starchy cereals and lack the components of macronutrients i.e. protein as well as micronutrients vitamins and minerals. Nahar (2013) showed that about four-fifths of a typical rural Bangladeshi's diet consists of cereals (mainly rice) followed by non-leafy vegetables, roots and tubers; whereas micronutrient-rich foods such as fish, meat, milk accounts for less than 10 percent of the rural people's diet.
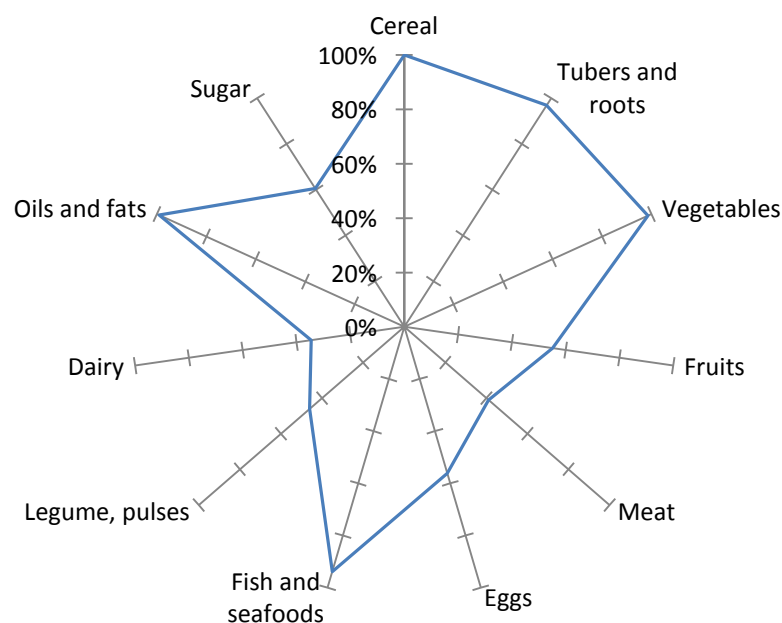
Figure 5.1 Proportion of households that consumed food groups at least once in past week
Source: Author's own calculation

(C) Measurement of empowerment

As discussed in chapter 2, we measure females' empowerment using a weighted multidimensional index, termed as the five domains empowerment index (Alkire et al., 2013a) which takes into account a woman's empowerment in 10 indicators over five domains.

Table 5.3 shows the five domains along with the specific indicators and the corresponding weights, which are used to estimate the empowerment index for the primary woman of the h-th household, following Equation 5.4. A score of 1 is assigned to an indicator if the woman is empowered in the respective indicator; otherwise 0 is assigned.

Table 5.3 Indicators and respective weight of the empowerment index

Domains		Indicators	Weight
1. Production decision making	I1	Input in production decisions	1/10
	I2	Autonomy in production	1/10
2. Access to productive resources	I3	Ownership of assets	1/15
	I4	Purchase, sales or transfer of assets	1/15
	I5	Access to decision on credit	1/15
3. Income	I6	Control over use of income	1/5
4. Community leadership	I7	Group membership	1/10
	I8	Speaking in public	1/10
5. Time allocation	I9	Workload	1/10
	I10	Leisure	1/10

Adapted from Alkire et al. (2013a)

The index for the primary woman of h-th household is obtained by

$$em5d_h = \sum_{i=1}^{10} Indicator_i \times weight_i \qquad \text{Equation 5.4}$$

If the estimated score of the weighted index is less than 0.80 for a woman, then it will mean the woman is not empowered in 4 domains and accordingly she will be regarded as the one who lacks empowerment.

5.3.3 Theoretical framework

We approach our analysis from the perspective of a cooperative bargaining household model following Aromolaran (2004). Generally household models can be classified into two broad categories: income pooling and bargaining models. Income pooling models can again be divided into unitary and collective models. The main assumption of the unitary model (as seen in chapter 2) is that the preferences of household members are uniform or that the preference of just one household member is imposed on all other members. A unitary household usually maximises a welfare function whose only component is the utility function

of the dictator or household head. On the other hand, the collective model allows for differences in preferences between actors within a household. In the collective model, a household welfare function is defined as

$$U^h = \sum_{i=1}^{I} \Phi_i U_i; \quad i = 1, \ldots, I \qquad \text{Equation 5.5}$$

Where $\Phi_i = K$ and U^h is the household welfare function, U_i is individual $i's$ utility function in a household with I individuals. Φ_i is the welfare or Pareto weight attached to the utility function of each individual i.

The non-income pooling or bargaining model assumes that a change in resource control power within the household is likely to lead to changes in Φ_i, and the changes in Φ_i are in turn expected to result in a changed demand pattern or expenditure share, provided that there are differences in the preferences of primary male and primary female decision makers. Thus, the bargaining model predicts that a power shift would affect demand.

Assume that a household consists of a primary male (m), a primary female (f), and other members who are non-income earners (c). Each member's preference is different, and household income is not pooled. Let us suppose, each individual derives utility from two composite goods: calorie or energy generating good (C), and non-calorie generating goods (Q). Calories depend on the consumption of food items X_j and in turn, depends on price P_j. Calorie consumption also depends on individual's taste or individual characteristics γ^i, and household level characteristics γ^h.

Let us assume, the Pareto weight of the male, Φ^m, and the female Φ^f, sum to unity, implying other members (c) have no bargaining power i.e. $\Phi^c = 0$.

Household income Y^h is the sum of individual income of man Y^m, and the woman, Y^f.

The household is faced with the following maximisation problem

$$\max U_h = \Phi^m U^m(C,Q) + \Phi^f U^f(C,Q)$$

Subject to: $Y^h = P_j X_j + Q$

$$Y^h = Y^m + Y^f$$

$$C = C(X_j, \gamma^i, \gamma^h)$$

$\Phi^i \neq K$; where K is a constant and i=(m, f)

$$\Phi^i = \Phi^f \left(Y^f / Y^h \right)$$

From this constrained maximisation problem, we can derive an optimal demand function for food (calorie, protein) as a function of prices, household income, a power-sharing or distributional factor, individual, and household level characteristics. Formally,

$$C = C(X_j(p), Y^h, \Phi^f(Y^f/Y^h), \gamma^i, \gamma^h) \qquad \text{Equation 5.6}$$

5.3.4 Empirical strategy

Our empirical strategy involves estimating Equation 5.6 by the Ordinary Least Squares (OLS) method. We regress the food security indicator on females' empowerment index together with individual characteristics, household-level variables, income, and the price of staples. Thus the econometric model for estimating Equation 5.6 can be specified as the following Equation 5.7

$$y_i = \beta_0 + \beta_1 em5d_{h,i} + \beta_2 female_i + X_{p,i}\beta_3 + X_{h,i}\beta_4 + R_i\beta_5 + \varepsilon_i \qquad \text{Equation 5.7}$$

Where y_i stands for individual-level calorie or protein intake by person-i, $em5d_{h,i}$ is the empowerment index of the primary female of the household-h in which person-i lives, $female_i$ stands for the gender of person-i. The vectors $X_{p,i}$, $X_{h,i}$ and R_i represent vectors of personal, household, and regional level characteristics, respectively. The β_is are the regression parameters to be estimated, and ε_i is the error term.

In order to estimate the effect of women's empowerment on household food security, we run a household level regression model in which the dependent variable is food consumption scores (FCS). For the household level regression, we estimate the model specified in Equation 5.8 which omits the vector of individuals' personal characteristics.

$$FCS_h = \beta_0 + \beta_1 em5d_h + X_{h,i}\beta_2 + R_i\beta_3 + \varepsilon_i \qquad \text{Equation 5.8}$$

In both models, our key interest remains on the coefficient on empowerment, β_1, which captures the extent to which mothers' empowerment is associated with calorie and protein intake, and dietary diversity.

In order to examine whether female empowerment has a gender-differentiated effect on calorie and protein intake, we extend Equation 5.7 to include an interaction term between female and empowerment index as shown in Equation 5.9.

$$y_i = \beta_0 + \beta_1 em5d_{h,i} + \beta_2 female_i + \beta_3\left(em5d_{h,i} \times female_i\right) + X_{p,i}\beta_4 + X_{h,i}\beta_5 + R_i\beta_6 + \varepsilon_i$$

<div align="right">Equation 5.9</div>

In Equation 5.9, β_1 captures the effect of female empowerment on male's calorie (or protein) intake; while the impact on girls or women will be $\beta_1 + \beta_3$. Our second question in this chapter is whether women's empowerment has a differential effect on calorie and protein intake by gender, which will be assessed by the coefficient on the interaction between empowerment and female, β_3. If β_3 appears statistically significant then it would mean that women's empowerment disproportionately influences female members' food intake.

While estimating the effect of empowerment on adults' calorie and protein intake, we have an extra control for relationship dummy, $D_{r,i}$ to take account of the person's relationship with the primary female. Given that the adult subsample is composed of various relations[13], an omission of a control for the relationship with the primary woman of the household would not help to understand the intra-household dynamics of food allocation. Thus in the case of adults subsample, we estimate Equation 5.10.

$$y_i = \beta_0 + \beta_1 em5d_{h,i} + \beta_2 female_i + \beta_3\left(em5d_{h,i} \times female_i\right) + X_{p,i}\beta_4 + X_{h,i}\beta_5 + D_{r,i}\beta_6 + R_i\beta_7 + \varepsilon_i$$

<div align="right">Equation 5.10</div>

Finally, in order to see how the effect of empowerment on adult individuals' food intake varies across relationship, we further estimate Equation 5.10 with an interaction between empowerment index and the relationship dummy as Equation 5.11.

$$y_i = \beta_0 + \beta_1 em5d_{h,i} + \beta_2 female_i + \beta_3\left(em5d_{h,i} \times female_i\right) + X_{p,i}\beta_4 + X_{h,i}\beta_5 + D_{r,i}\beta_6 +$$
$$\beta_7\left(em5d_{h,i} \times D_{r,i}\right) + R_i\beta_8 + \varepsilon_i$$

<div align="right">Equation 5.11</div>

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[13]We have tabulated the relation of the household members in Table 5.13 in appendix 3.

The detailed list of control variables includes the following. As regards the primary female, we account for her completed years of schooling, ratio of her age to husband's age. These variables are likely to capture her human resource. Since how much food an individual consumes may depend on the person's demographic and physical activities, the vector of personal level characteristics in our regression includes age, gender, height, physical activity level. Food consumption in a household may also be influenced by the household's demographic structure and socioeconomic status. Therefore we control for household-level variables such as the size of household; age and gender composition of household; occupation of household head, log of per capita monthly expenditures. Households with many members may experience either food security or food insecurity depending on age and gender-based composition. A high proportion of young and old members relative to working-age member may result in food insecurity because of high dependency ratio. Households' expenditure—a proxy for income—is very crucial for households' access to food. Likewise we control for the price of main staple food (rice) to account for households' access to food. Because one of the pillars of food security is the availability of food, we include variables such as possession of land, number of food crops grown by the household, and exposure to financial shock. Possession to land may have a vital effect on household food security because it provides the most important resource for producing food, and the more food a household grows the more likely it is that foods are available to the household. However it is very likely that food production being reliant on nature is often affected by natural disaster (e.g. flood, cyclone, untimely rain), which may cause a financial crisis in the agricultural households. We control for this by using information on whether flood had damaged the households' agricultural production. Another essential aspect of food security is the utilisation of food, which is likely to be influenced by the hygiene practice followed in a household. In order to account for this, we control for the source of drinking water and defecation method. In the case of an extended family, it may be common that in-laws co-reside and in such a context the primary female's decision making power may be comprised especially if mother-in-law co-resides. Given the socio-cultural context of rural Bangladesh, we want to control the fact whether a mother-in-law co-resides in the household. Finally geographical dummies account for any variation in food security across divisions being the largest administrative unit in Bangladesh.

5.3.5 Issue of potential endogeneity

As we have discusses in section 5.2 (literature review), the OLS estimate of the effect of mothers' empowerment index ($\hat{\beta}_1$) may be biased, if the food security indicators and empowerment are determined by the same factors but are not included in our model. As an example, there may be a prevalence of gender norms in a household such that the nutritional requirements of a specific subgroup, based on gender and age, receive priority and the primary female has little to do with altering the nutrient allocation to that group. This is especially true in the context of South Asia (Haddad, Pena, Nishida, Quisumbing, & Slack, 1996). In rural Bangladesh it is a common custom regarding food allocation within a household is that men eat first then children and female members eat at last (Patalagsa et al., 2015). Generally men do the food shopping and women cook and serve the meal to household members. Such norms are thus very likely to impede the primary female's ability to decide what food to purchase for the household, and how nutrient will be allocated among the household members. In other words, female empowerment and food security indicators may be influenced by such household-specific gender norms which are omitted in the regression model. Furthermore the empowerment index captures empowerment in agriculture; however, it does not explicitly take into account the specific aspect of women's agency in the allocation of food among household members. Thus we suspect that the empowerment index and the disturbance term in the OLS regression may be influenced by the household-specific omitted gender norms, which may cause the estimated coefficient on empowerment index to be biased.

In principle, the IV approach can deal with the above issue and can estimate unbiased estimates of $\hat{\beta}_1$ by the two-stage least squares (2SLS) method provided that a suitable instrument exists in the dataset for the endogenous variable i.e. mothers' empowerment. We explore the dataset for finding such instruments, which would be correlated with mothers' empowerment but at the same time are not correlated with the error term in the regression i.e. not directly correlated with the dependent variable.

The BIHS asked the primary female member whether she had contributed money or time in the past 12 months to any community activities such as (i) building small well or maintenance of irrigation facilities in the community; (ii) building or maintaining roads in the community; (iii) development projects or public works projects in the community; (iv) building or

maintaining of temple; (v) look after any other family in the event of sickness; (vi) provide agricultural labour to any other family; and (vii) provide child care to any other family. From this information, it is possible to derive how many community activities a mother had participated in in the previous 12 months. In a patriarchal social context that prevails in rural Bangladesh, women are less likely to have freedom of mobility outside the home. Clearly participation in the above-mentioned community activities requires women to go outside their homes. Through participation women are likely to interact with other women and thereby may acquire a better sense of self-worthiness and may become aware of their rights. The more activities they had participated, the more aware they are likely to be. These in turn may provide them with confidence to become pro-active. We use information on the number of activities mothers' had participated in as an instrument for their empowerment on the ground that through participation in the community activities mothers' empowerment may have been increased in the current period; but the current state of empowerment did not influence in the previous year's participation. Furthermore past year's participation in the community activities is unlikely to influence current nutrient intake of household members and households' diet diversity directly; instead its effect on food security indicators operate only through women's current empowerment. We cautiously assume here that using a lag information about participation reduces a potential concern about reverse causation from current empowerment and to past year's participation. Additionally we recognise that women's engagement in such community activities is unlikely to enhance their nutrition knowledge, which could have had an influence on household food security. In addition to this assumption, we also report the formal IV diagnostic tests. However in case our assumptions do not hold, the strategy may become invalid in this particular instance.

5.3.6 Sample characteristics

Table 5.4 presents the summary statistics of the variables of interest across age and household.

Table 5.4 Summary statistics of the variables of interest across age and household

Variables	All children		All adults		Household	
	Mean	SD	Mean	SD	Mean	SD
Dependent variable						
Calorie intake	1641.337	759.635	2510.663	698.753		
Protein intake	31.835	19.346	48.789	22.328		
Food consumption score					50.822	16.848
Independent variables						
Individual characteristics						
Female=1, otherwise 0	48.90%		50.06%			
Age (years)	8.689	4.589	39.917	15.542		
Age squared	96.562	81.067	1834.909	1435.326		
Height (cm)			155.778	8.356		
Currently breast-fed=1, otherwise 0	11.40%		-			
Physical activity level: Sedentary=1, otherwise 0	94.45%		16.52%			
Physical activity level: Moderate=1, otherwise 0	1.79%		18.74%			
Physical activity level: Heavy=1, otherwise 0	3.76%		64.75%			
Relationship dummies						
Primary female			38.80%			
Husband			38.56%			
Adult son			8.96%			
Adult daughter			2.93%			
Mother or father in law			5.27%			
Others			5.48%			
Primary female related variables						
Empowerment index					0.548	0.191
Primary female's years of completed schooling					2.977	3.396
Ratio of primary female's age to primary male's age					0.814	0.081
Primary female is household head=1, otherwise 0					0.10%	
Household level variables						
Household size					4.426	1.59
Ratio of male age 0 to 4 years to household size					0.049	0.102
Ratio of male age 5 to 9 years to household size					0.058	0.107
Ratio of male age 10 to1 4 years to household size					0.060	0.109
Ratio of male age 15 to55 years to household size					0.267	0.151
Ratio of male age 56 years or above to household size					0.072	0.136
Ratio of female age 0 to 4 years to household size					0.048	0.101
Ratio of female age 5 to 9 years to household size					0.054	0.102
Ratio of female age 10 to1 4 years to household size					0.056	0.103
Ratio of female age 15 to55 years to household size					0.295	0.129
Ratio of female age 56 years or above to household size					0.041	0.103
Mother-in-law co-resides=1, otherwise 0					11.42%	
Household head's occupation: Farming=1, otherwise 0					72.03%	
Household head's occupation: Trading=1, otherwise 0					8.64%	
Household head's occupation: Other=1, otherwise 0					19.33%	
Socioeconomic variables						
Log of per capita monthly expenditures					7.100	0.539
Landless household=1, otherwise 0					43.33%	
Negative shock occurred, yes=1, otherwise 0					21.35%	
Access to food						
Price of rice (Taka per Kg)					30.743	3.88
Number of food crops grown by the household					2.435	1.869
Hygiene practice related variables						
Use sanitary latrine=1, otherwise 0					26.41%	
Drink water from well=1, otherwise 0					20.48%	
Administrative divisions						
Barisal					10.40%	
Chittagong					8.25%	
Dhaka					3.07%	
Khulna					18.16%	
Rajshahi					12.34%	
Rangpur					10.27%	
Sylhet					9.88%	
Instrument						
Number of community activities participated by female					0.831	1.168
Observations	5,857		9,900		3,843	

Source: Author's own calculation

The average daily intake of energy of a child is about 1,641 kcal, and an adult's intake is about 2,510 kcal. Evidently, there seems to be a considerable gender difference in the level of calorie intake. Girls and women consume fewer calories than their male counterparts. The difference in boys' and girls' calorie intake is about 139 kcal, and the difference is more pronounced between adult males' and adult females' calorie intake, which is about 409 kcal. The gender gap in the level of intake of calories may be attributed to the fact that girls and women require fewer calories than their male counterparts. Hence it would be useful to examine whether the margin in nutrient intake complies with this normative difference. Since energy requirements depend on a complex set of demographic, physiological, and geographical factors, it may not be very straightforward to draw a normative difference between two individuals' nutrient requirements. In this regard, we have consulted with a report on Bangladesh that states the normative difference of calorie requirement between the genders (Nahar, 2013). One may start with a reference person, for instance, a 60 kg man aged between 30 and 60 years undertaking the moderate activity. This particular man's calorie requirement is 2,482 kcal. The calorie requirement of a woman having exactly the same characteristics is 2,256 kcal. Thus the normative difference in nutrient intake between man and women is 226 kcal. Similarly, for children, the nutrient requirement of a boy aged 9 years weighing 25 kg undertaking sedentary activity is 1,750 kcal and that of a girl of same characteristics is 1,638 kcal. Thus the normative difference will be 112 kcal. Taking this into account, we can see the observed differences in calorie intake across genders in all age groups is greater than the normative difference, pointing to the fact that girls and adults female members are nutritionally disadvantaged in rural agricultural households in Bangladesh. The intake of protein is about 32 gm for a child and that of an adult is about 49 gm in a day. Similar to the case of calorie intake, we can also see a sharp difference in the level of intake of protein between boys and girls, and between adult males and adult females. Turning to the household food security indicator, we can see the average household food consumption score is about 51, implying an acceptable extent of variation in the sample household's diet.

The average score of the primary females' five domains empowerment index is 0.548, which indicates that the primary women have adequacy in less than 3 domains. In conformity with the criterion of the index, we see that, on an average, the sample primary women are not empowered. This implies the women's weaker bargaining power within the households in respect of decision-making relating to agriculture. The average years of schooling completed

by a primary female is about 3 years i.e. below primary education, which signifies the low level of human capital of rural women in Bangladesh.

Turning onto the household composition, we can see that about 77 percent of adults account for primary female and their husband who are head of the household. Among the rest of the adults, about 9 percent are adult sons, 2.93 percent are adult daughters, 5.27 percent are in-laws, and 5.48 percent include other relations.

For individual characteristics, we have information on gender, age, height, and physical activity. We have identified an individual's physical activity level based on his or her occupation following Nahar (2013). While the majority of the children fall into the category of light work (sedentary); most of the adults are engaged in heavy work, as expected. Among the children, 2.57 percent boys are engaged in heavy work; whereas the percentage is 0.79 for girls. Similarly, more adult males are engaged in heavy activities (nearly 70 percent) in comparison with their female counterparts (52.60 percent).

In respect of household-level characteristics we can see the average size of a household is less than 5 persons, which is consistent with a national statistic for the rural areas of Bangladesh (BBS, 2011a). In 72 percent households, the household head is engaged in farming, and the rest are engaged in trading and other employment. There are about 43 percent households in our sample who do not own any cultivable land or pond, implying they are functionally landless. The households seem to have grown less than three food crops.

About 21 percent households faced some kind of financial shocks within the past five years. Only about one-fifth of households source water from a tube-well or well, and nearly three-quarters of the sample households do not use a closed latrine.

5.4 Empirical results and discussions

5.4.1 Results

In this section, we present the regression estimates of three food security models across subsamples in Table 5.5 through 5.7 and their discussion is presented in the section 5.4.2. While presenting the estimation results in Table 5.5 to 5.7, we present both the OLS and IV estimates. In Table 5.5, we present estimates of children's calorie and protein intake models and in Table 5.6 we present the same for the adults. Both calorie and protein intake models are first estimated by the OLS as specified in Equation 5.9, which we present in column 1 and

5 in Table 5.5. We also obtain another version of the OLS estimates without an interaction term between gender dummy and women's empowerment, which we present in column 2 and 6 in Table 5.5. In Table 5.6, we first present the estimates following Equation 5.10 in column 1 and 5, followed by estimates obtained without the interaction between female and empowerment index and presented in column 2 and 6. Afterwards, the estimates of the models are obtained through the IV. Table 5.7 stands for the OLS (Equation 5.8) and IV estimates of household food security model.

5.4.1.1 Child level analysis of food security in agricultural households

From Table 5.5, we can see that the estimated coefficient on the empowerment index is positive and statistically highly significant, which is in line with our expectation that women's greater bargaining power would be positively associated with children's nutrient and calorie intake. The size of the OLS estimate of the coefficient on the empowerment index is 231.901 in the calorie intake model, which applies to sons. For daughters, the extent of the effect is $\hat{\beta}_1 + \hat{\beta}_3$ (231.901-170.789), i.e. 61.11. Evidently, the effect of women's empowerment on children's calorie intake is highly significant and positive for both boys and girls, but the extent of the effect is much greater for sons' calorie intake.

Table 5.5 OLS and IV estimates of the determinants of children's calorie and protein intake

Variables	(1) OLS kcal	(2) OLS kcal	(3) IV first e.index	(4) IV second kcal	(5) OLS protein	(6) OLS protein	(7) IV first e.index	(8) IV second protein
Empowerment index	231.901***	150.212***		549.706***	4.612***	2.340**		5.057
	(48.965)	(35.077)		(178.566)	(1.600)	(1.116)		(6.008)
Female=1, otherwise 0	-22.520	-117.142***	-0.003	-115.510***	0.357	-2.274***	-0.003	-2.263***
	(39.156)	(15.983)	(0.006)	(16.058)	(1.214)	(0.517)	(0.006)	(0.514)
Empowerment index*female	-170.789***				-4.749**			
	(66.140)				(2.127)			
Age (years)	159.450***	159.534***	0.003	158.517***	2.979***	2.981***	0.003	2.974***
	(7.902)	(7.907)	(0.003)	(7.985)	(0.240)	(0.240)	(0.003)	(0.239)
Age squared	-2.635***	-2.643***	-0.000	-2.621***	-0.054***	-0.054***	-0.000	-0.054***
	(0.428)	(0.428)	(0.000)	(0.431)	(0.013)	(0.014)	(0.000)	(0.013)
Height (cm)								
physical activity, moderate=1, otherwise 0	-83.474	-82.369	-0.016	-72.400	-0.814	-0.784	-0.016	-0.716
	(55.379)	(55.325)	(0.018)	(56.671)	(1.667)	(1.668)	(0.018)	(1.673)
physical activity, heavy=1, otherwise 0	39.922	42.191	0.018	36.312	1.758	1.821	0.018	1.781
	(41.733)	(41.741)	(0.013)	(41.556)	(1.379)	(1.380)	(0.013)	(1.382)
Breast-fed=1, otherwise 0	-224.658***	-225.152***	-0.008	-221.908***	-4.917***	-4.931***	-0.008	-4.909***
	(25.530)	(25.527)	(0.011)	(25.810)	(0.713)	(0.712)	(0.011)	(0.711)
Number of HH members	-6.333	-6.337	0.005**	-7.865	-0.180	-0.180	0.005**	-0.191
	(5.573)	(5.574)	(0.002)	(5.649)	(0.175)	(0.175)	(0.002)	(0.174)
Ratio of male aged 0-4 to total HH member	-312.637**	-323.141**	0.071	-343.607***	-6.521	-6.813	0.071	-6.952
	(128.135)	(128.194)	(0.044)	(129.287)	(4.202)	(4.216)	(0.044)	(4.259)
Ratio of male aged 5-9 to total HH member	-404.811***	-409.774***	0.100**	-447.949***	-9.681**	-9.819**	0.100**	-10.078**
	(125.169)	(125.382)	(0.042)	(127.483)	(4.040)	(4.052)	(0.042)	(4.167)
Ratio of male aged 10-14 to total HH member	-492.644***	-494.847***	0.174***	-565.565***	-13.837***	-13.898***	0.174***	-14.379***
	(121.832)	(121.979)	(0.042)	(128.129)	(4.414)	(4.421)	(0.042)	(4.700)
Ratio of male aged 15-55 to total HH member	-267.586**	-267.087**	0.111***	-307.951***	-10.198**	-10.184**	0.111***	-10.462**
	(112.480)	(112.544)	(0.036)	(114.415)	(3.978)	(3.982)	(0.036)	(4.078)
Ratio of female aged 0-4 to total HH member	-253.394**	-253.008**	0.083*	-281.147***	-7.005*	-6.994*	0.083*	-7.185*
	(125.378)	(125.578)	(0.045)	(127.418)	(4.098)	(4.106)	(0.045)	(4.180)
Ratio of female aged 5-9 to total HH member	-284.624**	-289.813**	0.135***	-338.822***	-9.718**	-9.863**	0.135***	-10.196**
	(126.063)	(126.293)	(0.043)	(129.382)	(4.021)	(4.028)	(0.043)	(4.189)
Ratio of female aged 10-14 to total HH member	-518.884***	-525.830***	0.204***	-608.061***	-14.016***	-14.209***	0.204***	-14.768***

Variables	(1) OLS kcal	(2) OLS kcal	(3) IV first e.index	(4) IV second kcal	(5) OLS protein	(6) OLS protein	(7) IV first e.index	(8) IV second protein
	(127.565)	(127.685)	(0.042)	(135.157)	(4.391)	(4.398)	(0.042)	(4.740)
Ratio of female aged 15-55 to total HH member	-847.155***	-853.006***	0.249***	-957.777***	-14.918***	-15.080***	0.249***	-15.793***
	(140.359)	(140.655)	(0.048)	(149.113)	(4.470)	(4.475)	(0.048)	(4.848)
Ratio of female aged 56+ to total HH member	-872.644***	-888.035***	0.433***	-1,054.422***	-12.149	-12.577*	0.433***	-13.708*
	(218.313)	(218.983)	(0.080)	(232.414)	(7.431)	(7.445)	(0.080)	(7.954)
HH head's occupation, Trader=1, otherwise 0	-98.166***	-97.705***	0.002	-99.398***	-2.962***	-2.949***	0.002	-2.960***
	(21.671)	(21.657)	(0.009)	(21.646)	(0.656)	(0.655)	(0.009)	(0.653)
HH head's occupation, Other=1, otherwise 0	-33.787**	-33.116**	0.001	-34.304**	-0.263	-0.245	0.001	-0.253
	(16.140)	(16.139)	(0.006)	(16.246)	(0.567)	(0.566)	(0.006)	(0.564)
Ratio of female's age to male's age	224.239***	219.727***	0.080***	182.267**	7.756***	7.630***	0.080***	7.375***
	(74.734)	(74.774)	(0.028)	(76.807)	(2.429)	(2.427)	(0.028)	(2.451)
Female's years of schooling	-2.929	-2.960	0.004***	-4.577**	0.072	0.071	0.004***	0.060
	(2.094)	(2.095)	(0.001)	(2.211)	(0.069)	(0.069)	(0.001)	(0.070)
Log of per capita monthly expenditures	164.008***	163.344***	0.015***	156.751***	7.707***	7.688***	0.015***	7.643***
	(13.989)	(13.999)	(0.005)	(14.140)	(0.446)	(0.446)	(0.005)	(0.457)
Price of rice (Tk/Kg)	-7.815***	-7.710***	-0.002**	-7.087***	-0.097	-0.094	-0.002**	-0.090
	(2.189)	(2.186)	(0.001)	(2.211)	(0.082)	(0.082)	(0.001)	(0.081)
Female headed HH=1, otherwise 0	-100.750	-105.120	0.220***	-188.312**	0.248	0.126	0.220***	-0.439
	(66.489)	(66.873)	(0.041)	(84.531)	(5.698)	(5.504)	(0.041)	(5.643)
Mother-in-law co-resides=1, otherwise 0	52.011	53.218*	-0.063***	75.023**	0.984	1.018	-0.063***	1.166
	(32.144)	(32.207)	(0.012)	(33.421)	(1.015)	(1.016)	(0.012)	(1.054)
Number of food crops grown	35.873***	35.894***	0.007***	32.491***	1.245***	1.245***	0.007***	1.222***
	(3.858)	(3.858)	(0.001)	(4.097)	(0.113)	(0.113)	(0.001)	(0.127)
Uses closed latrine=1, otherwise 0	7.754	7.434	0.004	3.858	2.223***	2.214***	0.004	2.190***
	(15.981)	(15.989)	(0.005)	(16.096)	(0.544)	(0.544)	(0.005)	(0.539)
Drinks water from well=1, otherwise 0	11.070	10.339	0.012**	5.418	-0.203	-0.224	0.012**	-0.257
	(16.669)	(16.672)	(0.006)	(16.831)	(0.522)	(0.522)	(0.006)	(0.530)
Landless household=1, otherwise 0	-67.609***	-66.864***	-0.017***	-58.548***	-2.007***	-1.986***	-0.017***	-1.930***
	(13.562)	(13.569)	(0.005)	(14.097)	(0.432)	(0.432)	(0.005)	(0.452)
HH experienced shock=1, otherwise 0	-28.449*	-29.345*	0.012**	-34.922**	-0.773	-0.798	0.012**	-0.836*
	(15.204)	(15.196)	(0.005)	(15.471)	(0.495)	(0.494)	(0.005)	(0.488)
Barisal	-24.822	-24.157	-0.045***	-7.877	-0.779	-0.770	-0.002	-0.796
	(25.365)	(25.374)	(0.009)	(26.443)	(1.031)	(1.032)	(0.010)	(1.023)
Chittagong	-178.411***	-178.090***	-0.139***	-127.163***	-3.696***	-3.696***	-0.096***	-3.487***
	(25.127)	(25.127)	(0.010)	(33.313)	(0.917)	(0.918)	(0.011)	(1.031)
Dhaka					-1.440**	-1.449**	0.043***	-1.586**
					(0.727)	(0.728)	(0.007)	(0.755)
Khulna	-143.636***	-142.285***	-0.085***	-111.692***	-4.934***	-4.905***	-0.042***	-4.835***
	(20.705)	(20.719)	(0.008)	(24.045)	(0.781)	(0.781)	(0.009)	(0.795)
Rajshahi	-109.056***	-109.267***	-0.016**	-102.522***	-5.361***	-5.375***	0.028***	-5.467***
	(22.035)	(22.008)	(0.008)	(22.250)	(0.831)	(0.832)	(0.008)	(0.833)
Rangpur	-117.329***	-116.139***	-0.048***	-97.329***	-7.160***	-7.135***	-0.005	-7.145***
	(22.085)	(22.090)	(0.009)	(23.593)	(0.803)	(0.803)	(0.009)	(0.801)
Sylhet	-55.185**	-54.871**	-0.043***	-34.673				
	(22.415)	(22.446)	(0.007)	(23.731)				
Number of community activities participated			0.033***				0.033***	
			(0.002)				(0.002)	
Constant	-78.084	-24.492	0.236***	-117.512	-34.156***	-32.657***	0.192***	-33.152***
	(178.841)	(177.931)	(0.058)	(184.332)	(5.853)	(5.827)	(0.058)	(5.773)
Observations	5,857	5,857	5,857	5,857	5,857	5,857	5,857	5,857
R-squared	0.614	0.614		0.605	0.399	0.399		0.398
Weak ID test stat (Kleibergen-Paap rk Wald F)				229.6				229.6
Anderson-Rubin Wald chi2 test, p value				0.001				0.400
Endogeneity test, p value H0: Exogenous				0.021				0.644

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

In column 2, the coefficient on women's empowerment is 150.212, which is again statistically highly significant and positive. In this specification, we have no interaction term between the gender dummy and the empowerment index and notably, the coefficient on the female dummy turns out to be statistically highly significant. It means that being a daughter is significantly associated with an intake of about 117 fewer kilocalories.

Moving on to the IV estimates, we can see that the instrument is statistically significant at first stage, and in the second stage the coefficient on the empowerment index is still statistically highly significant, positive, and becomes larger than the OLS estimate. The p value (0.001) of the Anderson-Rubin Chi^2 test rejects the null of the irrelevance of the endogenous variable. Test of endogeneity rejects (p value of the test is 0.021) the null hypothesis that women's empowerment index is exogenous in the children's calorie intake model. The Kleibergen-Paap F statistic is 229.600 which confirms that the instrument is not weak. Thus neglecting the issue of endogeneity of women's empowerment may underestimate the true effect of empowerment on young children's calorie intake.

In the protein intake model, the effect of women's empowerment is statistically highly significant and positive for sons but it is negative for daughters. This can be easily seen from column 5, where we can see the magnitude of the effect for sons is 4.612, but for daughters, it is 4.612 less 4.749 i.e. -0.137. In the specification where we do not account for the interaction term, the coefficient on female dummy becomes statistically significant and negative (column 6). The size of the female coefficient is -2.274, meaning that daughters have a protein intake of 2.3 gram less than sons. With regard to the IV estimates, we can see the test of endogeneity fails to reject the null hypothesis of exogeneity of empowerment index in the children's protein intake model. Hence the OLS estimates are preferred instead of the IV estimates in this instance.

Among the other characteristics of the primary women (mothers), their relative age seems to have a significant effect while their years of schooling does not. Children who belong to landless households seem to have consumed significantly fewer calories and proteins in comparison with the children of households having cultivable land resource. The effect of household expenditures is found to have an expected positive sign, which is also statistically significant.

5.4.1.2 Adult level analysis of food security in agricultural households

From Table 5.6, it is apparent that the effect of women's empowerment is also statistically significant and positive for adults' calorie and protein intake. The estimated coefficient of the effect of women's empowerment for an adult male is 334.262 (column 1). In contrast, the effect of empowerment on an adult female's intake of calories is about 274 (334.262-60.053); although the gender differential effect of empowerment is not statistically significant. Notably, the female dummy is highly significant and negative, which means being a female

adult is associated with an intake of about 289 fewer kilocalories. In column 2 where we have not controlled for the interaction term between empowerment and gender, the negative female dummy becomes even larger—about -321, the amount by which an adult female consumes fewer calories than male counterparts in the rural agricultural households.

With regard to the IV estimates, we can see that the instrument has been significant at the first stage and the coefficient on empowerment index is still positive and it shows a significant impact on adults' calorie intake. The test of endogeneity rejects the null of exogeneity of women's empowerment index in the adults' calorie intake model as indicated by the p value (<0.05) of the test. The Anderson-Rubin Chi^2 test rejects the null that women's empowerment index is irrelevant, which is revealed by the p value (0.000) of the test. The Kleibergen-Paap F statistic is 534.800 which confirms that the instrument is not weak.

In the case of adults' protein intake, we see a very similar result to what we have found in adults' calorie intake model. The estimate of the effect of women's empowerment on males' protein intake is 6.481 and on women's protein intake is 4.456 (6.481- 2.025), indicating that the effect of women's empowerment on adult men's intake of protein is greater than the effect on adult women. Although the interaction term between empowerment and female is statistically insignificant, the significant female dummy (column 5) confirms that adult women's intake of protein with respect to their adult male counterparts is significantly less (3.2 gm) (column 5).

Among the relationship dummies, two dummies seem significant and negative in the calorie model, which are the dummy on in-laws member and the dummy on others, and for protein model, only in-laws dummy appeared significant and negative.

Similar to the children's protein model, here the test of endogeneity also fails (p value is 0.774) to reject the null of exogeneity of the women's empowerment index; therefore the OLS estimate is preferred to the IV estimates.

Table 5.6 OLS and IV estimates of the determinants of adults' calorie and protein intake

Variables	(1) OLS kcal	(2) OLS kcal	(3) IV first e.index	(4) IV second kcal	(5) OLS protein	(6) OLS protein	(7) IV first e.index	(8) IV second protein
Empowerment index	334.262***	304.121***		899.163***	6.481***	5.465***		4.063
	(50.581)	(33.852)		(154.372)	(1.613)	(1.084)		(5.039)
Female=1, otherwise 0	-289.042***	-320.815***	0.029**	-342.306***	-3.243*	-4.314***	0.029**	-4.264***
	(61.754)	(51.927)	(0.015)	(53.097)	(1.889)	(1.555)	(0.015)	(1.560)
Female*empowerment index	-60.053				-2.025			
	(63.140)				(2.064)			
Age (years)	8.478***	8.485***	0.002**	7.331***	0.273***	0.273***	0.002**	0.276***
	(2.522)	(2.520)	(0.001)	(2.578)	(0.078)	(0.078)	(0.001)	(0.078)
Age squared	-0.166***	-0.166***	-0.000*	-0.158***	-0.004***	-0.004***	-0.000*	-0.004***
	(0.026)	(0.026)	(0.000)	(0.027)	(0.001)	(0.001)	(0.000)	(0.001)
Height (cm)	6.066***	6.066***	-0.000	6.086***	0.159***	0.159***	-0.000	0.159***
	(1.090)	(1.090)	(0.000)	(1.104)	(0.035)	(0.035)	(0.000)	(0.035)
physical activity, moderate=1, otherwise 0	83.080***	83.651***	-0.031***	103.522***	1.274	1.293	-0.031***	1.246
	(26.242)	(26.229)	(0.007)	(26.977)	(0.891)	(0.891)	(0.007)	(0.903)
physical activity, heavy=1, otherwise 0	109.568***	109.238***	-0.007	115.334***	1.608**	1.597**	-0.007	1.582**
	(21.755)	(21.751)	(0.006)	(21.973)	(0.738)	(0.737)	(0.006)	(0.736)
Husband=1, otherwise 0	42.841	44.291	0.020	31.068	2.486	2.535	0.020	2.566*
	(51.834)	(51.836)	(0.015)	(52.814)	(1.542)	(1.542)	(0.015)	(1.542)
Adult son=1, otherwise 0	-1.394	-0.088	0.039**	-25.855	2.974	3.018*	0.039**	3.079*
	(59.905)	(59.933)	(0.017)	(61.294)	(1.821)	(1.821)	(0.017)	(1.834)
Adult daughter=1, otherwise 0	-42.214	-43.920	0.039***	-68.497	-0.841	-0.899	0.039***	-0.841
	(45.377)	(45.356)	(0.013)	(46.167)	(1.445)	(1.443)	(0.013)	(1.464)
Mother or father in law=1, otherwise 0	-111.254**	-110.428**	-0.008	-102.594**	-2.421*	-2.393*	-0.008	-2.411*
	(43.447)	(43.468)	(0.013)	(44.487)	(1.367)	(1.366)	(0.013)	(1.365)
Others=1, otherwise 0	-68.624**	-69.083**	0.007	-73.917**	-0.952	-0.968	0.007	-0.957
	(34.870)	(34.863)	(0.010)	(35.645)	(1.097)	(1.096)	(0.010)	(1.096)
Number of HH members	-3.455	-3.426	0.001	-4.184	0.109	0.110	0.001	0.111
	(5.302)	(5.302)	(0.001)	(5.362)	(0.169)	(0.169)	(0.001)	(0.168)
Ratio of male aged 0-4 to total HH member	325.335***	324.844***	-0.012	336.111***	10.716***	10.700***	-0.012	10.673***
	(104.292)	(104.301)	(0.030)	(106.236)	(3.479)	(3.479)	(0.030)	(3.482)
Ratio of male aged 5-9 to total HH member	-78.095	-78.604	0.088***	-131.201	-0.121	-0.138	0.088***	-0.014
	(94.995)	(95.002)	(0.027)	(98.062)	(3.167)	(3.168)	(0.027)	(3.196)
Ratio of male aged 10-14 to total HH member	-141.732	-142.263	0.125***	-225.819**	-5.518*	-5.536*	0.125***	-5.339*
	(88.003)	(88.018)	(0.026)	(92.910)	(3.012)	(3.012)	(0.026)	(3.109)
Ratio of male aged 15-55 to total HH member	55.613	55.042	0.057***	25.009	-1.681	-1.700	0.057***	-1.629
	(65.336)	(65.348)	(0.019)	(67.321)	(2.237)	(2.238)	(0.019)	(2.244)
Ratio of female aged 0-4 to total HH member	276.349***	276.017***	-0.002	277.501***	7.737**	7.726**	-0.002	7.723**
	(99.465)	(99.475)	(0.030)	(101.298)	(3.241)	(3.241)	(0.030)	(3.232)
Ratio of female aged 5-9 to total HH member	19.737	18.965	0.109***	-41.357	-2.864	-2.890	0.109***	-2.747
	(97.179)	(97.172)	(0.028)	(100.160)	(3.041)	(3.040)	(0.028)	(3.080)
Ratio of female aged 10-14 to total HH member	-27.031	-27.381	0.140***	-111.134	-2.950	-2.962	0.140***	-2.765
	(93.589)	(93.605)	(0.027)	(98.098)	(3.119)	(3.119)	(0.027)	(3.187)
Ratio of female aged 15-55 to total HH member	-174.883*	-175.202*	0.140***	-264.488**	-0.950	-0.961	0.140***	-0.751
	(98.607)	(98.607)	(0.029)	(103.228)	(3.231)	(3.231)	(0.029)	(3.298)
Ratio of female aged 56+ to total HH member	-215.501	-215.785	0.109***	-275.419**	0.174	0.165	0.109***	0.305
	(131.753)	(131.753)	(0.039)	(135.676)	(4.496)	(4.495)	(0.039)	(4.504)
HH head's occupation, Trader=1, otherwise 0	-76.493***	-76.611***	-0.002	-75.932***	-1.483*	-1.487*	-0.002	-1.489*
	(23.242)	(23.246)	(0.007)	(23.420)	(0.783)	(0.783)	(0.007)	(0.781)
HH head's occupation, Other=1, otherwise 0	-37.326**	-37.421**	-0.015***	-28.689	0.109	0.105	-0.015***	0.085
	(17.455)	(17.457)	(0.005)	(17.681)	(0.619)	(0.619)	(0.005)	(0.621)
Ratio of female's age to male's age	-110.558	-110.699	0.118***	-189.137**	-2.694	-2.699	0.118***	-2.514
	(83.184)	(83.172)	(0.023)	(86.298)	(2.858)	(2.858)	(0.023)	(2.903)
Female's years of schooling	-5.077**	-5.077**	0.002***	-6.445***	0.059	0.059	0.002***	0.063
	(2.211)	(2.211)	(0.001)	(2.258)	(0.075)	(0.075)	(0.001)	(0.075)
Log of per capita monthly expenditures	204.232***	204.300***	0.017***	191.529***	9.668***	9.671***	0.017***	9.701***
	(15.046)	(15.048)	(0.004)	(15.189)	(0.506)	(0.506)	(0.004)	(0.518)
Price of rice (Tk/Kg)	-5.428***	-5.434***	-0.002***	-4.071**	-0.093	-0.093	-0.002***	-0.097
	(1.898)	(1.899)	(0.000)	(1.934)	(0.082)	(0.082)	(0.000)	(0.082)
Female headed HH=1, otherwise 0	-347.062**	-347.980**	0.270***	-497.106***	-4.558	-4.589	0.270***	-4.238
	(136.641)	(136.899)	(0.050)	(159.961)	(6.613)	(6.623)	(0.050)	(6.697)
Mother-in-law co-resides=1, otherwise 0	77.855***	77.733***	-0.032***	95.612***	1.945**	1.941**	-0.032***	1.899**
	(26.624)	(26.623)	(0.008)	(27.359)	(0.865)	(0.865)	(0.008)	(0.871)
Number of food crops grown	44.482***	44.492***	0.005***	40.455***	1.786***	1.787***	0.005***	1.796***
	(3.643)	(3.643)	(0.001)	(3.832)	(0.124)	(0.124)	(0.001)	(0.129)
Uses closed latrine=1, otherwise 0	-5.388	-5.410	0.002	-10.361	1.887***	1.886***	0.002	1.898***
	(15.316)	(15.317)	(0.004)	(15.577)	(0.514)	(0.514)	(0.004)	(0.512)
Drinks water from well=1, otherwise 0	23.511	23.500	0.002	20.449	-0.641	-0.642	0.002	-0.634
	(16.932)	(16.938)	(0.005)	(17.210)	(0.536)	(0.536)	(0.005)	(0.537)
Landless household=1, otherwise 0	-74.823***	-74.877***	-0.022***	-59.493***	-2.263***	-2.265***	-0.022***	-2.301***
	(14.358)	(14.356)	(0.004)	(14.900)	(0.459)	(0.459)	(0.004)	(0.479)
HH experienced shock=1, otherwise 0	-5.526	-5.525	0.012***	-13.095	-0.626	-0.626	0.012***	-0.608
	(15.366)	(15.367)	(0.004)	(15.640)	(0.497)	(0.497)	(0.004)	(0.495)
Barisal	-73.139***	-73.097***	-0.022***	-63.799**	-1.237	-1.235	-0.022***	-1.257
	(25.697)	(25.704)	(0.007)	(26.035)	(0.877)	(0.877)	(0.007)	(0.886)
Chittagong	-225.317***	-225.250***	-0.138***	-147.848***	-1.858**	-1.856**	-0.138***	-2.039*
	(26.440)	(26.454)	(0.008)	(34.041)	(0.834)	(0.834)	(0.008)	(1.060)

Variables	(1) OLS kcal	(2) OLS kcal	(3) IV first e.index	(4) IV second kcal	(5) OLS protein	(6) OLS protein	(7) IV first e.index	(8) IV second protein
Khulna	-163.979***	-163.978***	-0.093***	-111.180***	-4.368***	-4.368***	-0.093***	-4.492***
	(20.185)	(20.186)	(0.006)	(24.656)	(0.671)	(0.671)	(0.006)	(0.809)
Rajshahi	-181.885***	-181.842***	-0.004	-176.842***	-7.281***	-7.280***	-0.004	-7.292***
	(21.838)	(21.836)	(0.006)	(21.951)	(0.719)	(0.719)	(0.006)	(0.721)
Rangpur	-163.885***	-163.813***	-0.050***	-135.194***	-9.510***	-9.507***	-0.050***	-9.575***
	(23.465)	(23.462)	(0.007)	(25.073)	(0.798)	(0.798)	(0.007)	(0.826)
Sylhet	-141.064***	-140.950***	-0.035***	-112.372***	-0.646	-0.642	-0.035***	-0.709
	(26.243)	(26.242)	(0.006)	(27.272)	(0.835)	(0.835)	(0.006)	(0.865)
Number of community activities participated			0.038***				0.038***	
			(0.002)				(0.002)	
Constant	316.133	331.590	0.301***	195.529	-48.115***	-47.594***	0.301***	-47.274***
	(232.673)	(232.061)	(0.064)	(238.969)	(7.891)	(7.855)	(0.064)	(7.928)
Observations	9,900	9,900	9,900	9,900	9,900	9,900	9,900	9,900
R-squared	0.203	0.203		0.179	0.169	0.169		0.168
Weak ID test stat (Kleibergen-Paap rk Wald F)				534.8				534.8
Anderson-Rubin Wald chi2 test, p value				0.000				0.420
Endogeneity test, p value H0: Exogenous				0.000				0.774

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

5.4.1.3 Analysis of dietary diversity in agricultural households

Now let us look at the effect of empowerment on household level food security which has been measured by a weighted dietary diversity score viz. food consumption score. Table 5.7 presents the OLS and the IV estimates of the determinants of food consumption score. As we can see from column 1, the OLS estimate of the effect of empowerment on household food consumption score is 10.246 which is statistically highly significant. We can also see that woman's education is positively and significantly associated with household's dietary diversity. In the case of the IV estimate, the instrument works out significantly and the test of endogeneity rejects (p value 0.000) the null of exogeneity of women's empowerment in food consumption model. The Anderson-Rubin Chi^2 test (p value 0.000) and the Kleibergen-Paap F statistic (188.700) confirm that the women's empowerment index is not irrelevant and the instrument is not weak, respectively. In the second stage, the IV estimate of the effect of women's empowerment is also positive and significantly different from zero.

Table 5.7 OLS and IV estimates of the determinants of household food consumption score

Variables	(1) OLS fcs	(2) IV first e.index	(3) IV second fcs
Empowerment index	10.246***		29.463***
	(1.199)		(5.645)
Number of HH members	1.938***	0.003	1.856***
	(0.198)	(0.002)	(0.202)
Ratio of male aged 0-4 to total HH member	1.134	-0.052	2.451
	(3.134)	(0.041)	(3.269)
Ratio of male aged 5-9 to total HH member	-8.487***	0.056	-9.431***
	(2.962)	(0.038)	(3.033)
Ratio of male aged 10-14 to total HH member	-5.625*	0.112***	-7.951**
	(3.092)	(0.039)	(3.258)
Ratio of male aged 15-55 to total HH member	-3.465	0.035	-3.940*
	(2.173)	(0.028)	(2.245)
Ratio of female aged 0-4 to total HH member	1.528	-0.031	2.393
	(3.213)	(0.041)	(3.335)
Ratio of female aged 5-9 to total HH member	-5.351*	0.075*	-6.497**

Variables	(1) OLS fcs	(2) IV first e.index	(3) IV second fcs
	(3.115)	(0.040)	(3.221)
Ratio of female aged 10-14 to total HH member	-3.241	0.117***	-5.456
	(3.224)	(0.040)	(3.383)
Ratio of female aged 15-55 to total HH member	-5.939	0.122***	-8.398**
	(3.686)	(0.047)	(3.846)
Ratio of female aged 56+ to total HH member	-2.847	0.100	-4.619
	(4.967)	(0.063)	(5.145)
HH head's occupation, Trader=1, otherwise 0	-0.525	0.004	-0.626
	(0.869)	(0.011)	(0.878)
HH head's occupation, Other=1, otherwise 0	-0.287	-0.008	-0.151
	(0.619)	(0.008)	(0.639)
Ratio of female's age to male's age	0.205	0.123***	-2.474
	(2.965)	(0.037)	(3.157)
Female's years of schooling	0.356***	0.002***	0.302***
	(0.078)	(0.001)	(0.081)
Log of per capita monthly expenditures	11.778***	0.012**	11.452***
	(0.556)	(0.006)	(0.580)
Price of rice (Tk/Kg)	0.073	-0.002***	0.117
	(0.073)	(0.001)	(0.075)
Female headed HH=1, otherwise 0	-6.760**	0.243***	-11.140***
	(3.037)	(0.070)	(3.314)
Mother-in-law co-resides=1, otherwise 0	0.478	-0.034***	1.133
	(0.987)	(0.012)	(1.029)
Number of food crops grown	1.621***	0.007***	1.455***
	(0.140)	(0.002)	(0.151)
Uses closed latrine=1, otherwise 0	0.857	0.004	0.681
	(0.551)	(0.007)	(0.568)
Drinks water from well=1, otherwise 0	0.654	-0.003	0.683
	(0.623)	(0.008)	(0.639)
Landless household=1, otherwise 0	-2.951***	-0.026***	-2.357***
	(0.512)	(0.006)	(0.548)
HH experienced shock=1, otherwise 0	-0.648	0.012*	-0.909
	(0.576)	(0.007)	(0.588)
Barisal	-2.197*	0.113***	-4.291***
	(1.149)	(0.015)	(1.353)
Dhaka	-3.078***	0.133***	-5.453***
	(0.988)	(0.013)	(1.258)
Khulna	-2.698***	0.043***	-3.448***
	(1.046)	(0.015)	(1.119)
Rajshahi	-5.796***	0.127***	-7.997***
	(1.131)	(0.014)	(1.349)
Rangpur	-9.789***	0.085***	-11.254***
	(1.147)	(0.016)	(1.287)
Sylhet	-1.728	0.096***	-3.155**
	(1.168)	(0.014)	(1.290)
No of community activities participated		0.037***	
		(0.003)	
Constant	-45.739***	0.216***	-49.622***
	(5.559)	(0.064)	(5.853)
Observations	3,843	3,843	3,843
R-squared	0.299		0.256
Weak ID test stat (Kleibergen-Paap rk Wald F)			188.700
Anderson-Rubin Wald chi2 test, p value			0.000
Endogeneity test, p value H0: Exogenous			0.000

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

5.4.2 Discussion

The aim of our analysis is to understand the impact of women's empowerment on household food security, individuals' intake of nutrients, and intra-household allocation of food. Having presented and summarised the empirical results, we now move on to the discussion of the most notable findings.

First, we have found very strong evidence to suggest that women's empowerment in agricultural households is conducive to ensuring food security. Women's empowerment is likely to increase not only households' dietary diversity but also individuals' intake of nutrients be it calories or proteins. More importantly women's empowerment in agricultural households tends to benefit not just one specific age groups but all household members. Such a strong, positive effect on food security indicators persists even after controlling for a wide range of personal, household, financial, and regional factors.

Second, we have found that women's empowerment influences individual-level food security disproportionately on the basis of gender. Both in the child and adult subsamples, we have investigated whether the impact of empowerment on calorie and protein intake depends on the gender of an individual. We have examined this by including an interaction between the gender dummy and the women empowerment index, and found that the extent to which empowerment is associated with individual-level food security is weaker for female household members. This finding is further verified in appendix 3 where calorie and protein intake models are estimated separately for sons and daughters, and for adult men and adult women. For the calorie intake model, the size of the coefficient on empowerment tends to be larger for sons (206.743) in comparison with daughters (89.874), and similarly for men (327.965) compared to women (283.090). By comparing the level at which the effect of empowerment is significant on intake of nutrients across young boys and young daughters, we can see that the effect is more pronounced for young sons. Additionally women's empowerment has no significant effect on young daughters' protein intake at all.

Although women's empowerment increase sons' and adult men's intake of calories pronouncedly, it also has a positive impact on women's intake of calories. As can be seen $\hat{\beta}_1$, which measures the estimated effect of empowerment on male's intake of nutrient, is positive throughout and $\hat{\beta}_1 + \hat{\beta}_3$, which measures the estimated effect of empowerment on female members' intake of calories, is also positive throughout, except for young daughters' protein intake (column 5 in Table 5.5).

The evidence of gender discriminated effect of females' empowerment on individual level food security prompts concerns about the intra-household allocation of food within rural households in Bangladesh. The socio-cultural norm prevailing in rural Bangladesh generally favours sons. Parents tend to value sons more than daughters because they perceive sons to be the breadwinners and old age security. A low economic return to women' labour in the job

market demotivates parents' attitude towards investing in daughters' human capital development and this neglect is further enforced by cultural norms. The evidence of lower intake of nutrients by daughters and female members may be suggestive of a case in which mothers may prefer fulfilling the nutritional requirements of potential future earners i.e. sons even at the expense of compromising daughters' need, should she face a situation of tighter food allocation.

When we compare the effect of empowerment across young daughters (Table 5.9) and adult women (Table 5.11), we can see that the effect is less prominent for the former. Women's empowerment, in fact, does not have any significant effect on young girls' protein intake (column 4 in Table 5.9) and the extent of the significance of the effect on their calorie intake is also weak (column 1 in Table 5.9). Thus it becomes apparent that young daughters constitute the most vulnerable group within a household in respect of nutrition. This can have serious implications because malnourished girls are likely to grow into malnourished adults and more likely to give birth to malnourished babies. If the nutritional requirements of young girls continue to be neglected in poor households, then it would be practically infeasible to achieve health and nutrition-related SDGs.

A significant gender gap in the level of calorie and protein intake among adult household members is noticeable even after controlling for demographic factors as well as physical activity. This may indicate that female household members generally constitute the group who would adjust food consumption first in response to food shortage so that the food consumption of the rest of the household members' (e.g. principal income earner in a family and children) is not compromised (Miah, Mandal, Haque, & Palash, 2010). The higher relative importance of men puts them in a superior position within a household and when meals are served at home, men eat first then children and women eat at last (Patalagsa et al., 2015). Women's low intake of calories also explains the poor national nutritional status of women observed in the rural areas of Bangladesh as pointed out in the Bangladesh Demographic and Health Survey (NIPORT et al., 2016).

With regard to the effect of women's education on food security, we find that women's education is not significantly associated with individual's calorie or protein intake perhaps because our models contain a direct measure of empowerment. While an incremental change in education is likely to diversify households' diets significantly; an increase in their empowerment is not crucial for household members' intake of nutrients.

Our analyses find the significant effect of some other variables on individual and household food security. Demographic indicators such as age and height are positive and significant determinants of both calorie and protein intake.

Among the household characteristics, monthly expenditures and number of food crops grown by households seem to influence food security positively. On the other hand, being in a household having no cultivable land significantly reduces calorie and protein intake. The occupation of household head also plays a role in food security, for instance being in a household where the household head is engaged in trading or any other work but farming is negatively associated with calorie intake.

The household's demographic structure seems to have a significant negative effect on food security as shown in children, adults, and household models. Defecation method is one of the most crucial indicators of hygiene practice followed in a household. Our results suggest that individuals, who live in a household that uses a closed (sealed) toilet, consume significantly more proteins than those who live in households without sealed toilets.

Geographic locations also have a significant influence on food security. Bangladesh is divided into integrated and non-integrated zones by two mighty rivers viz. the Padma and the Jamuna. Barisal and Khulna divisions of the south-west, and Rajshahi and Rangpur divisions in the north-west, constitute the non-integrated zones. The rest of the three divisions constitute integrated zone. The significant negative division dummies indicate that with respect to the base region, intake of calories and protein, and household dietary diversity are significantly lower in respective divisions. From our results on the children subsample (Table 5.5 column 1 and column 5) and on adults (Table 5.6 column 1 and column 5), we can see the intake of calories in lowest in Chittagong division while intake of protein is lowest in Rangpur division where households' dietary diversity is also lowest in comparison with the base divisions.

5.5 Conclusion

In the rural areas of Bangladesh, women are integrally linked to agriculture as they perform many important tasks in addition to their culturally imposed tasks of care and food preparation. Despite their such a significant role, they lack the power to take household decisions regarding allocation of resources: this lack of power is likely to affect their operation to link between agriculture and household food security. In such a context, we wanted to understand empirically whether or not women's empowerment in terms of greater

decision-making power and control over productive resources in agricultural households is capable of improving individual and household food security.

By utilising a weighted multidimensional empowerment index which is specifically designed to capture the empowerment of women in agriculture, we have estimated the effect of women's empowerment on household dietary diversity. We extend our analysis beyond household level to understand intra-household dynamics that may have a role in individuals' food security. For this, we carried out individual level analysis across children and adults subsamples where food security is measured through intake of calories and intake of proteins.

We find a strong evidence of the positive and statistically significant impact of women's empowerment on household food security as well as on individuals' intake of nutrients. We recognise a concern that the significant positive effect of empowerment on food security indicators may suffer from potential endogeneity bias, which we have addressed by the IV technique. Importantly our IV estimates also confirmed the positive and significant relationship between women's empowerment and food security in the agricultural households.

However we find evidence of gender gap in intra-household food allocation: young and adult daughters constitute the most vulnerable subgroup within households as regards receiving energy and protein, and sons and adult men are more privileged. This can be a matter of serious concern because if girls and women continue to be deprived of nutrition then not only will their health be affected but also their productivity can be low. Moreover the risk of their giving birth of an underweight baby will be high.

To conclude, policy interventions aimed at improving health and nutrition of people engaged in agriculture sector in Bangladesh should focus on strategies that would lead to a shift in the power relationship between men to women within household. Thus women's empowerment in agricultural household may be a policy tool.

Appendix 3 Subsample estimates

Table 5.8 OLS and IV estimates of the determinants of boys' calorie and protein intake

Variables	(1) OLS kcal	(2) IV first e.index	(3) IV second kcal	(4) OLS protein	(5) IV first e.index	(6) IV second protein
Empowerment index	206.743***		866.107***	3.963**		15.004
	(50.155)		(268.218)	(1.637)		(9.602)
Female=1, otherwise 0						
Empowerment index*female						
Age (years)	146.179***	0.002	144.604***	2.931***	0.002	2.905***
	(12.368)	(0.005)	(12.639)	(0.362)	(0.005)	(0.361)
Age squared	-1.456**	-0.000	-1.437**	-0.042**	-0.000	-0.042**
	(0.667)	(0.000)	(0.679)	(0.020)	(0.000)	(0.020)
Height (cm)						
physical activity, moderate=1, otherwise 0	45.577	-0.032	74.306	2.556	-0.032	3.037
	(129.062)	(0.051)	(144.330)	(3.153)	(0.051)	(3.354)
physical activity, heavy=1, otherwise 0	9.600	0.025*	-6.352	1.269	0.025*	1.002
	(46.302)	(0.014)	(47.038)	(1.552)	(0.014)	(1.573)
Breast-fed=1, otherwise 0	-245.806***	-0.010	-238.928***	-5.386***	-0.010	-5.270***
	(38.985)	(0.016)	(40.169)	(1.055)	(0.016)	(1.067)
Number of HH members	-0.762	0.004	-2.636	0.219	0.004	0.187
	(8.528)	(0.003)	(8.782)	(0.268)	(0.003)	(0.268)
Ratio of male aged 0-4 to total HH member	-377.365**	0.041	-397.781**	-5.393	0.041	-5.735
	(191.371)	(0.064)	(192.806)	(6.354)	(0.064)	(6.382)
Ratio of male aged 5-9 to total HH member	-383.630**	0.098	-444.219**	-9.270	0.098	-10.284
	(188.491)	(0.060)	(190.574)	(6.135)	(0.060)	(6.338)
Ratio of male aged 10-14 to total HH member	-615.219***	0.146**	-712.664***	-16.221**	0.146**	-17.853**
	(176.398)	(0.058)	(183.501)	(6.627)	(0.058)	(7.065)
Ratio of male aged 15-55 to total HH member	-385.775**	0.099*	-453.135***	-12.749**	0.099*	-13.877**
	(167.886)	(0.052)	(171.821)	(5.938)	(0.052)	(6.142)
Ratio of female aged 0-4 to total HH member	-281.013	0.036	-303.012	-7.611	0.036	-7.979
	(196.066)	(0.068)	(197.771)	(6.522)	(0.068)	(6.556)
Ratio of female aged 5-9 to total HH member	-289.254	0.089	-341.816*	-9.116	0.089	-9.996
	(190.396)	(0.062)	(192.626)	(6.051)	(0.062)	(6.214)
Ratio of female aged 10-14 to total HH member	-624.282***	0.190***	-751.346***	-13.128**	0.190***	-15.256**
	(188.818)	(0.059)	(198.393)	(6.269)	(0.059)	(6.867)
Ratio of female aged 15-55 to total HH member	-774.076***	0.251***	-954.660***	-7.523	0.251***	-10.547
	(215.569)	(0.070)	(225.162)	(6.921)	(0.070)	(7.524)
Ratio of female aged 56+ to total HH member	-876.718***	0.323***	-1,082.586***	-3.202	0.323***	-6.649
	(330.681)	(0.117)	(337.423)	(11.545)	(0.117)	(12.084)
HH head's occupation, Trader=1, otherwise 0	-111.342***	0.009	-118.301***	-2.657***	0.009	-2.773***
	(30.957)	(0.012)	(31.783)	(1.011)	(0.012)	(1.020)
HH head's occupation, Other=1, otherwise 0	-43.527*	0.010	-50.638**	-0.096	0.010	-0.215
	(23.443)	(0.008)	(24.115)	(0.851)	(0.008)	(0.853)
Ratio of female's age to male's age	134.000	0.039	97.925	2.994	0.039	2.390
	(113.342)	(0.039)	(115.193)	(3.660)	(0.039)	(3.618)
Female's years of schooling	-3.709	0.003***	-6.080*	0.026	0.003***	-0.014
	(3.035)	(0.001)	(3.221)	(0.102)	(0.001)	(0.104)
Log of per capita monthly expenditures	175.495***	0.008	169.727***	8.409***	0.008	8.312***
	(20.905)	(0.007)	(20.999)	(0.686)	(0.007)	(0.686)
Price of rice (Tk/Kg)	-9.929***	-0.001	-9.617***	-0.198**	-0.001	-0.193**
	(2.631)	(0.001)	(2.720)	(0.091)	(0.001)	(0.091)
Female headed HH=1, otherwise 0	-104.557	0.174**	-214.993	-14.785***	0.174**	-16.635***
	(109.892)	(0.079)	(153.963)	(4.461)	(0.079)	(5.345)
Mother-in-law co-resides=1, otherwise 0	43.115	-0.048***	71.407	-0.203	-0.048***	0.271
	(48.156)	(0.018)	(48.971)	(1.595)	(0.018)	(1.619)
Number of food crops grown	43.388***	0.007***	37.459***	1.415***	0.007***	1.315***
	(5.868)	(0.002)	(6.339)	(0.176)	(0.002)	(0.202)
Uses closed latrine=1, otherwise 0	20.458	-0.002	17.694	2.152***	-0.002	2.106***
	(23.194)	(0.008)	(23.550)	(0.792)	(0.008)	(0.786)
Drinks water from well=1, otherwise 0	22.319	0.004	18.627	0.040	0.004	-0.022
	(24.856)	(0.008)	(25.197)	(0.768)	(0.008)	(0.772)
Landless household=1, otherwise 0	-77.848***	-0.008	-69.807***	-2.391***	-0.008	-2.256***
	(19.686)	(0.007)	(20.180)	(0.632)	(0.007)	(0.647)
HH experienced shock=1, otherwise 0	-30.277	0.003	-32.750	-0.458	0.003	-0.500
	(22.610)	(0.008)	(22.960)	(0.757)	(0.008)	(0.750)
Barisal	-7.913	-0.037***	13.953	-0.319	0.005	-0.482
	(36.804)	(0.012)	(38.534)	(1.541)	(0.013)	(1.520)

Variables	(1) OLS kcal	(2) IV first e.index	(3) IV second kcal	(4) OLS protein	(5) IV first e.index	(6) IV second protein
Chittagong	-197.387***	-0.138***	-113.819**	-3.260**	-0.096***	-2.390
	(36.718)	(0.014)	(49.775)	(1.338)	(0.015)	(1.568)
Dhaka				-0.722	0.042***	-1.251
				(1.063)	(0.010)	(1.093)
Khulna	-122.937***	-0.074***	-79.717**	-3.819***	-0.032**	-3.625***
	(29.771)	(0.011)	(33.201)	(1.156)	(0.013)	(1.170)
Rajshahi	-87.158***	-0.019*	-73.804**	-3.923***	0.022*	-4.228***
	(32.150)	(0.011)	(33.316)	(1.221)	(0.012)	(1.227)
Rangpur	-119.888***	-0.037***	-96.521***	-6.020***	0.005	-6.157***
	(30.300)	(0.012)	(32.656)	(1.161)	(0.014)	(1.165)
Sylhet	-44.738	-0.042***	-13.151			
	(32.255)	(0.010)	(34.173)			
Number of community activities participated		0.032***			0.032***	
		(0.003)			(0.003)	
Constant	-12.308	0.300***	-204.533	-36.625***	0.259***	-39.315***
	(259.736)	(0.081)	(280.774)	(8.129)	(0.082)	(8.324)
Observations	2,993	2,993	2,993	2,993	2,993	2,993
R-squared	0.634		0.613	0.409		0.399
Weak ID test stat (Kleibergen-Paap rk Wald F)			108.4			108.4
Anderson-Rubin Wald chi2 test, p value			0.000			0.116
Endogeneity test, p value H0: Exogenous			0.010			0.241

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 5.9 OLS and IV estimates of the determinants of girls' protein and calorie intake

Variables	(1) OLS kcal	(2) IV first e.index	(3) IV second kcal	(4) OLS Girls protein	(5) IV first e.index	(6) IV second protein
Empowerment index	89.874*		243.861	0.718		-3.932
	(47.941)		(233.262)	(1.500)		(7.068)
Female=1, otherwise 0						
Empowerment index*female						
Age (years)	168.144***	0.005	167.566***	2.956***	0.005	2.974***
	(11.658)	(0.005)	(11.673)	(0.354)	(0.005)	(0.354)
Age squared	-3.864***	-0.000	-3.848***	-0.063***	-0.000	-0.063***
	(0.641)	(0.000)	(0.640)	(0.020)	(0.000)	(0.020)
Height (cm)						
physical activity, moderate=1, otherwise 0	-46.000	-0.014	-42.486	-0.316	-0.014	-0.422
	(61.842)	(0.020)	(61.926)	(1.897)	(0.020)	(1.887)
physical activity, heavy=1, otherwise 0	-27.467	-0.022	-22.225	0.456	-0.022	0.297
	(105.716)	(0.026)	(105.199)	(3.424)	(0.026)	(3.425)
Breast-fed=1, otherwise 0	-189.963***	-0.000	-189.665***	-4.072***	-0.000	-4.081***
	(34.254)	(0.016)	(34.072)	(0.980)	(0.016)	(0.979)
Number of HH members	-10.495	0.006**	-11.288	-0.634***	0.006**	-0.610***
	(7.226)	(0.003)	(7.261)	(0.228)	(0.003)	(0.229)
Ratio of male aged 0-4 to total HH member	183.955	0.121*	170.452	1.294	0.121*	1.701
	(186.567)	(0.066)	(188.016)	(5.939)	(0.066)	(5.973)
Ratio of male aged 5-9 to total HH member	-130.748	0.105*	-146.558	-4.138	0.105*	-3.661
	(169.402)	(0.062)	(171.437)	(5.265)	(0.062)	(5.299)
Ratio of male aged 10-14 to total HH member	-219.531	0.229***	-255.448	-9.984*	0.229***	-8.900
	(172.512)	(0.063)	(183.026)	(5.732)	(0.063)	(5.979)
Ratio of male aged 15-55 to total HH member	-215.368	0.116**	-229.956	-9.142*	0.116**	-8.702
	(149.568)	(0.053)	(150.098)	(5.350)	(0.053)	(5.348)
Ratio of female aged 0-4 to total HH member	-247.760	0.141**	-266.832	-10.009*	0.141**	-9.433*
	(168.980)	(0.064)	(173.290)	(5.422)	(0.064)	(5.524)
Ratio of female aged 5-9 to total HH member	-232.849	0.183***	-259.271	-10.896**	0.183***	-10.099*
	(168.816)	(0.061)	(175.500)	(5.413)	(0.061)	(5.605)
Ratio of female aged 10-14 to total HH member	-202.013	0.239***	-239.289	-12.108*	0.239***	-10.982*
	(175.251)	(0.063)	(187.350)	(6.202)	(0.063)	(6.509)
Ratio of female aged 15-55 to total HH member	-427.463**	0.275***	-470.630**	-14.513**	0.275***	-13.210**
	(193.097)	(0.072)	(206.542)	(6.178)	(0.072)	(6.567)
Ratio of female aged 56+ to total HH member	-475.626*	0.578***	-561.656*	-15.378*	0.578***	-12.780
	(284.201)	(0.111)	(319.279)	(9.162)	(0.111)	(9.935)
HH head's occupation, Trader=1, otherwise 0	-82.175***	-0.006	-81.547***	-3.290***	-0.006	-3.309***
	(29.858)	(0.012)	(29.502)	(0.822)	(0.012)	(0.825)

Variables	(1) OLS kcal	(2) IV first e.index	(3) IV second kcal	(4) OLS Girls protein	(5) IV first e.index	(6) IV second protein
HH head's occupation, Other=1, otherwise 0	-26.458	-0.008	-25.555	-0.258	-0.008	-0.286
	(22.283)	(0.009)	(22.149)	(0.762)	(0.009)	(0.764)
Ratio of female's age to male's age	320.118***	0.122***	299.465***	11.082***	0.122***	11.706***
	(101.649)	(0.041)	(107.306)	(3.274)	(0.041)	(3.453)
Female's years of schooling	-2.051	0.004***	-2.761	0.116	0.004***	0.137
	(2.880)	(0.001)	(3.029)	(0.093)	(0.001)	(0.092)
Log of per capita monthly expenditures	149.045***	0.023***	145.168***	6.799***	0.023***	6.916***
	(18.402)	(0.006)	(19.142)	(0.558)	(0.006)	(0.601)
Price of rice (Tk/Kg)	-5.483	-0.003**	-5.039	0.024	-0.003**	0.011
	(3.788)	(0.001)	(3.804)	(0.149)	(0.001)	(0.146)
Female headed HH=1, otherwise 0	-205.070**	0.221***	-236.746**	10.759***	0.221***	11.716***
	(102.227)	(0.028)	(110.287)	(3.090)	(0.028)	(3.266)
Mother-in-law co-resides=1, otherwise 0	25.777	-0.081***	36.523	1.660	-0.081***	1.336
	(42.015)	(0.017)	(44.901)	(1.184)	(0.017)	(1.271)
Number of food crops grown	29.013***	0.007***	27.700***	1.073***	0.007***	1.113***
	(4.996)	(0.002)	(5.268)	(0.143)	(0.002)	(0.157)
Uses closed latrine=1, otherwise 0	-6.318	0.012	-8.566	2.334***	0.012	2.402***
	(21.747)	(0.008)	(22.008)	(0.742)	(0.008)	(0.750)
Drinks water from well=1, otherwise 0	-0.097	0.019**	-2.801	-0.355	0.019**	-0.273
	(22.081)	(0.008)	(22.342)	(0.701)	(0.008)	(0.714)
Landless household=1, otherwise 0	-52.327***	-0.025***	-47.960**	-1.627***	-0.025***	-1.759***
	(18.455)	(0.007)	(19.665)	(0.583)	(0.007)	(0.623)
HH experienced shock=1, otherwise 0	-28.901	0.021***	-32.786	-1.089*	0.021***	-0.971
	(20.157)	(0.007)	(20.962)	(0.638)	(0.007)	(0.642)
Barisal	-47.420	-0.054***	-39.847	-1.204	-0.010	-1.187
	(34.108)	(0.012)	(35.207)	(1.329)	(0.014)	(1.319)
Chittagong	-158.165***	-0.139***	-138.611***	-4.074***	-0.094***	-4.419***
	(34.443)	(0.014)	(44.111)	(1.265)	(0.015)	(1.343)
Dhaka				-2.193**	0.044***	-1.948*
				(0.995)	(0.010)	(1.030)
Khulna	-168.223***	-0.099***	-154.259***	-6.108***	-0.055***	-6.285***
	(28.868)	(0.012)	(35.224)	(1.047)	(0.013)	(1.070)
Rajshahi	-127.349***	-0.013	-124.955***	-6.569***	0.031***	-6.396***
	(30.351)	(0.011)	(30.306)	(1.126)	(0.012)	(1.117)
Rangpur	-110.706***	-0.060***	-101.606***	-8.073***	-0.015	-8.103***
	(32.834)	(0.012)	(35.013)	(1.127)	(0.013)	(1.121)
Sylhet	-65.723**	-0.044***	-57.596*			
	(30.971)	(0.010)	(32.575)			
Number of community activities participated		0.033***			0.033***	
		(0.003)			(0.003)	
Constant	-301.452	0.145*	-323.593	-31.074***	0.101	-30.651***
	(251.613)	(0.086)	(250.714)	(8.569)	(0.086)	(8.421)
Observations	2,864	2,864	2,864	2,864	2,864	2,864
R-squared	0.592		0.590	0.392		0.390
Weak ID test stat (Kleibergen-Paap rk Wald F)			118.7			118.7
Anderson-Rubin Wald chi2 test, p value			0.293			0.578
Endogeneity test, p value H0: Exogenous			0.494			0.500

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 5.10 OLS and IV estimates of the determinants of adult men's calorie and protein intake

Variables	OLS kcal	IV first e.index	IV second kcal	OLS protein	IV first e.index	IV second protein
Empowerment index	327.965***		932.788***	6.086***		3.952
	(52.598)		(238.526)	(1.656)		(7.771)
Female=1, otherwise 0						
Empowerment index*female						
Age (years)	7.054	0.004***	4.412	0.360***	0.004***	0.369***
	(4.566)	(0.001)	(4.726)	(0.134)	(0.001)	(0.138)
Age squared	-0.156***	-0.000***	-0.131***	-0.005***	-0.000***	-0.005***
	(0.046)	(0.000)	(0.047)	(0.001)	(0.000)	(0.001)
Height (cm)	5.860***	-0.000	5.942***	0.223***	-0.000	0.223***
	(1.605)	(0.000)	(1.618)	(0.053)	(0.000)	(0.053)
physical activity level, moderate=1, otherwise 0	-27.499	-0.039**	-0.633	0.429	-0.039**	0.334

Variables	OLS kcal	IV first e.index	IV second kcal	OLS protein	IV first e.index	IV second protein
	(71.177)	(0.018)	(70.815)	(2.666)	(0.018)	(2.658)
physical activity level, heavy=1, otherwise 0	140.377***	-0.012	150.719***	2.260**	-0.012	2.224**
	(31.634)	(0.008)	(31.925)	(0.995)	(0.008)	(0.999)
Husband=1, otherwise 0	119.384	0.025	104.746	4.083*	0.025	4.135*
	(76.723)	(0.019)	(77.645)	(2.145)	(0.019)	(2.134)
Adult son=1, otherwise 0	59.025	0.050**	26.877	5.301**	0.050**	5.414**
	(76.586)	(0.020)	(78.274)	(2.190)	(0.020)	(2.211)
Adult daughter=1, otherwise 0						
Mother or father in law=1, otherwise 0	-38.441	0.022	-46.854	0.429	0.022	0.459
	(102.002)	(0.029)	(103.506)	(3.040)	(0.029)	(3.019)
Others=1, otherwise 0						
Number of HH members	-3.722	0.001	-4.355	0.083	0.001	0.085
	(8.461)	(0.002)	(8.532)	(0.264)	(0.002)	(0.262)
Ratio of male aged 0-4 to total HH member	278.892	-0.034	299.665*	12.233**	-0.034	12.160**
	(171.623)	(0.044)	(174.260)	(5.681)	(0.044)	(5.649)
Ratio of male aged 5-9 to total HH member	-186.184	0.063	-227.245	-1.587	0.063	-1.443
	(157.196)	(0.041)	(160.442)	(5.115)	(0.041)	(5.132)
Ratio of male aged 10-14 to total HH member	-207.073	0.098**	-277.645*	-5.745	0.098**	-5.496
	(143.167)	(0.039)	(148.161)	(4.714)	(0.039)	(4.830)
Ratio of male aged 15-55 to total HH member	47.593	0.035	28.388	-1.718	0.035	-1.651
	(108.723)	(0.029)	(110.828)	(3.642)	(0.029)	(3.636)
Ratio of female aged 0-4 to total HH member	204.755	-0.016	212.662	7.630	-0.016	7.602
	(163.675)	(0.045)	(165.916)	(5.187)	(0.045)	(5.156)
Ratio of female aged 5-9 to total HH member	-75.531	0.079*	-120.469	-2.701	0.079*	-2.543
	(160.739)	(0.042)	(163.590)	(4.954)	(0.042)	(4.981)
Ratio of female aged 10-14 to total HH member	-68.679	0.116***	-142.282	-3.389	0.116***	-3.129
	(151.689)	(0.039)	(156.341)	(4.959)	(0.039)	(5.037)
Ratio of female aged 15-55 to total HH member	-250.076	0.114***	-328.870**	-1.340	0.114***	-1.062
	(154.027)	(0.042)	(159.482)	(5.026)	(0.042)	(5.099)
Ratio of female aged 56+ to total HH member	-372.339*	0.092	-429.025**	-0.230	0.092	-0.030
	(204.647)	(0.056)	(210.586)	(7.029)	(0.056)	(7.036)
Household head's occupation, Trader=1, otherwise 0	-25.981	-0.006	-19.789	-0.058	-0.006	-0.080
	(41.486)	(0.011)	(41.463)	(1.306)	(0.011)	(1.303)
Household head's occupation, Other=1, otherwise 0	0.546	-0.017**	11.769	1.175	-0.017**	1.136
	(29.261)	(0.008)	(29.648)	(0.963)	(0.008)	(0.968)
Ratio of female's age to male's age	-212.124	0.120***	-293.512**	-5.215	0.120***	-4.928
	(129.572)	(0.034)	(134.439)	(4.373)	(0.034)	(4.451)
Female's years of schooling	-8.538**	0.002**	-10.077***	0.002	0.002**	0.008
	(3.529)	(0.001)	(3.593)	(0.119)	(0.001)	(0.119)
Log of per capita monthly expenditures	188.574***	0.018***	174.745***	9.884***	0.018***	9.933***
	(23.232)	(0.005)	(23.358)	(0.757)	(0.005)	(0.781)
Price of rice (Tk/Kg)	-5.150*	-0.003***	-3.591	-0.124	-0.003***	-0.129
	(2.854)	(0.001)	(2.899)	(0.124)	(0.001)	(0.124)
Female headed HH=1, otherwise 0	-318.327	0.260***	-466.830*	-1.791	0.260***	-1.267
	(218.428)	(0.080)	(253.130)	(12.452)	(0.080)	(12.484)
Mother-in-law co-resides=1, otherwise 0	99.999**	-0.033***	118.419***	2.086	-0.033***	2.021
	(41.233)	(0.011)	(42.334)	(1.310)	(0.011)	(1.319)
No of food crops grown	52.975***	0.005***	48.730***	1.975***	0.005***	1.990***
	(5.547)	(0.001)	(5.872)	(0.186)	(0.001)	(0.194)
Uses closed latrine=1, otherwise 0	13.829	0.002	9.713	2.136***	0.002	2.150***
	(23.757)	(0.006)	(23.969)	(0.784)	(0.006)	(0.779)
Source of drinking water is well=1, otherwise 0	24.317	0.000	22.579	-0.685	0.000	-0.679
	(26.305)	(0.007)	(26.456)	(0.830)	(0.007)	(0.829)
Landless household=1, otherwise 0	-96.062***	-0.022***	-80.467***	-2.792***	-0.022***	-2.847***
	(22.140)	(0.006)	(22.971)	(0.703)	(0.006)	(0.734)
HH experienced shock=1, otherwise 0	19.097	0.011*	11.636	-0.320	0.011*	-0.294
	(23.452)	(0.006)	(23.728)	(0.754)	(0.006)	(0.748)
Barisal	-102.542***	-0.020**	-94.212**	-1.256	-0.020**	-1.286
	(38.896)	(0.009)	(39.029)	(1.341)	(0.009)	(1.348)
Chittagong	-253.901***	-0.136***	-177.200***	-2.369*	-0.136***	-2.639
	(40.549)	(0.011)	(51.694)	(1.266)	(0.011)	(1.608)
Khulna	-142.005***	-0.092***	-88.182**	-4.145***	-0.092***	-4.335***
	(31.394)	(0.008)	(38.682)	(1.025)	(0.008)	(1.240)
Rajshahi	-187.134***	-0.004	-182.573***	-7.781***	-0.004	-7.797***
	(33.319)	(0.008)	(33.484)	(1.096)	(0.008)	(1.095)
Rangpur	-153.957***	-0.048***	-125.745***	-9.499***	-0.048***	-9.598***
	(36.297)	(0.010)	(38.582)	(1.241)	(0.010)	(1.275)
Sylhet	-149.619***	-0.031***	-123.715***	-1.410	-0.031***	-1.501
	(40.551)	(0.009)	(41.890)	(1.269)	(0.009)	(1.301)
No of community activities participated		0.038***			0.038***	
		(0.002)			(0.002)	

Variables	OLS kcal	IV first e.index	IV second kcal	OLS protein	IV first e.index	IV second protein
Constant	510.596	0.277***	381.989	-61.280***	0.277***	-60.826***
	(353.393)	(0.088)	(362.503)	(11.813)	(0.088)	(11.927)
Observations	4,944	4,944	4,944	4,944	4,944	4,944
R-squared	0.122		0.099	0.134		0.133
Weak ID test stat (Kleibergen-Paap rk Wald F)			266.5			266.5
Anderson-Rubin Wald chi2 test, p value			0.000			0.611
Endogeneity test, p value H0: Exogenous			0.007			0.777

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 5.11 OLS and IV estimates of the determinants of adult women's calorie and protein intake

Variables	OLS kcal	IV first e.index	IV second kcal	OLS protein	IV first e.index	IV second protein
Empowerment index	283.090***		881.499***	4.839***		4.804
	(42.586)		(196.697)	(1.413)		(6.447)
Female=1, otherwise 0						
Empowerment index*female						
Age (years)	9.318***	0.000	9.112***	0.255**	0.000	0.255**
	(3.161)	(0.001)	(3.180)	(0.104)	(0.001)	(0.104)
Age squared	-0.180***	0.000	-0.183***	-0.004***	0.000	-0.004***
	(0.034)	(0.000)	(0.034)	(0.001)	(0.000)	(0.001)
Height (cm)	6.140***	-0.000	6.074***	0.080*	-0.000	0.080*
	(1.457)	(0.000)	(1.480)	(0.046)	(0.000)	(0.046)
physical activity level , moderate=1, otherwise 0	50.748	-0.019*	63.404*	1.173	-0.019*	1.172
	(37.430)	(0.011)	(38.158)	(1.467)	(0.011)	(1.466)
physical activity level, heavy=1, otherwise 0	69.860*	0.005	68.335*	1.790	0.005	1.790
	(38.332)	(0.012)	(38.785)	(1.518)	(0.012)	(1.513)
Husband=1, otherwise 0						
Adult son=1, otherwise 0						
Adult daughter=1, otherwise 0	-69.252	0.042***	-95.453*	-1.028	0.042***	-1.026
	(52.472)	(0.015)	(53.626)	(1.708)	(0.015)	(1.734)
Mother or father in law=1, otherwise 0	-95.181*	-0.021	-79.746	-2.041	-0.021	-2.042
	(52.766)	(0.018)	(54.492)	(1.728)	(0.018)	(1.725)
Others=1, otherwise 0	-80.263**	0.011	-86.574**	-0.703	0.011	-0.703
	(39.252)	(0.012)	(40.346)	(1.245)	(0.012)	(1.244)
Number of HH members	-0.615	0.001	-1.234	0.116	0.001	0.116
	(6.727)	(0.002)	(6.802)	(0.218)	(0.002)	(0.217)
Ratio of male aged 0-4 to total HH member	327.276**	0.002	334.047**	8.875**	0.002	8.875**
	(129.022)	(0.041)	(131.745)	(4.324)	(0.041)	(4.307)
Ratio of male aged 5-9 to total HH member	-17.379	0.106***	-77.759	0.589	0.106***	0.593
	(117.279)	(0.038)	(122.217)	(4.054)	(0.038)	(4.088)
Ratio of male aged 10-14 to total HH member	-111.829	0.143***	-205.014*	-5.923	0.143***	-5.918
	(110.093)	(0.036)	(118.281)	(3.958)	(0.036)	(4.076)
Ratio of male aged 15-55 to total HH member	32.872	0.073***	-4.813	-1.893	0.073***	-1.891
	(81.195)	(0.027)	(84.317)	(2.873)	(0.027)	(2.877)
Ratio of female aged 0-4 to total HH member	303.390**	0.004	303.146**	7.215*	0.004	7.215*
	(124.437)	(0.041)	(127.107)	(4.224)	(0.041)	(4.207)
Ratio of female aged 5-9 to total HH member	68.225	0.132***	-3.569	-3.518	0.132***	-3.514
	(120.409)	(0.038)	(125.774)	(3.884)	(0.038)	(3.934)
Ratio of female aged 10-14 to total HH member	-23.506	0.156***	-114.852	-2.900	0.156***	-2.895
	(118.202)	(0.037)	(125.607)	(4.054)	(0.037)	(4.135)
Ratio of female aged 15-55 to total HH member	-126.128	0.156***	-221.353	-1.053	0.156***	-1.047
	(128.105)	(0.042)	(134.849)	(4.178)	(0.042)	(4.260)
Ratio of female aged 56+ to total HH member	-78.689	0.117**	-137.464	0.958	0.117**	0.962
	(170.981)	(0.056)	(175.500)	(5.792)	(0.056)	(5.785)
Household head's occupation, Trader=1, otherwise 0	-101.972***	-0.000	-103.811***	-2.523**	-0.000	-2.522**
	(29.172)	(0.010)	(29.573)	(0.993)	(0.010)	(0.990)
Household head's occupation, Other=1, otherwise 0	-55.688**	-0.015**	-47.998**	-0.713	-0.015**	-0.713
	(22.300)	(0.007)	(22.566)	(0.812)	(0.007)	(0.813)
Ratio of female's age to male's age	-2.029	0.110***	-76.422	0.470	0.110***	0.474
	(107.519)	(0.034)	(110.933)	(3.741)	(0.034)	(3.777)
Female's years of schooling	-1.892	0.002**	-3.143	0.125	0.002**	0.125
	(2.739)	(0.001)	(2.802)	(0.096)	(0.001)	(0.095)

Variables	OLS kcal	IV first e.index	IV second kcal	OLS protein	IV first e.index	IV second protein
Log of per capita monthly expenditures	221.252***	0.015***	209.558***	9.438***	0.015***	9.439***
	(18.999)	(0.005)	(19.217)	(0.670)	(0.005)	(0.680)
Price of rice (Tk/Kg)	-5.700**	-0.002***	-4.456*	-0.067	-0.002***	-0.067
	(2.541)	(0.001)	(2.592)	(0.108)	(0.001)	(0.107)
Female headed HH=1, otherwise 0	-368.521**	0.291***	-528.819***	-5.457	0.291***	-5.447
	(169.345)	(0.068)	(201.210)	(6.552)	(0.068)	(6.744)
Mother-in-law co-resides=1, otherwise 0	46.703	-0.029**	62.550*	1.913	-0.029**	1.912
	(35.354)	(0.011)	(36.261)	(1.181)	(0.011)	(1.186)
No of food crops grown	36.269***	0.005***	32.299***	1.577***	0.005***	1.577***
	(4.682)	(0.001)	(4.886)	(0.164)	(0.001)	(0.169)
Uses closed latrine=1, otherwise 0	-21.843	0.003	-27.768	1.719**	0.003	1.719***
	(19.389)	(0.006)	(19.889)	(0.668)	(0.006)	(0.666)
Source of drinking water is well=1, otherwise 0	21.461	0.004	16.890	-0.722	0.004	-0.721
	(21.400)	(0.007)	(21.999)	(0.684)	(0.007)	(0.685)
Landless household=1, otherwise 0	-54.599***	-0.021***	-39.531**	-1.686***	-0.021***	-1.687***
	(18.433)	(0.006)	(19.031)	(0.595)	(0.006)	(0.616)
HH experienced shock=1, otherwise 0	-28.455	0.012**	-36.366*	-0.906	0.012**	-0.905
	(19.854)	(0.006)	(20.284)	(0.649)	(0.006)	(0.646)
Barisal	-42.964	-0.024***	-32.503	-1.154	-0.024***	-1.155
	(33.509)	(0.009)	(34.236)	(1.132)	(0.009)	(1.147)
Chittagong	-197.893***	-0.141***	-118.210***	-1.278	-0.141***	-1.282
	(34.052)	(0.011)	(44.016)	(1.081)	(0.011)	(1.368)
Khulna	-185.202***	-0.094***	-131.516***	-4.621***	-0.094***	-4.624***
	(25.361)	(0.009)	(30.719)	(0.867)	(0.009)	(1.044)
Rajshahi	-176.963***	-0.006	-170.940***	-6.837***	-0.006	-6.837***
	(28.235)	(0.008)	(28.265)	(0.932)	(0.008)	(0.935)
Rangpur	-173.105***	-0.052***	-143.020***	-9.641***	-0.052***	-9.643***
	(29.868)	(0.010)	(32.060)	(1.007)	(0.010)	(1.049)
Sylhet	-133.861***	-0.038***	-102.754***	0.113	-0.038***	0.111
	(33.466)	(0.008)	(34.798)	(1.093)	(0.008)	(1.137)
No of community activities participated		0.038***			0.038***	
		(0.002)			(0.002)	
Constant	-180.301	0.334***	-338.667	-40.285***	0.334***	-40.275***
	(291.121)	(0.088)	(300.955)	(10.192)	(0.088)	(10.268)
Observations	4,956	4,956	4,956	4,956	4,956	4,956
R-squared	0.146		0.114	0.149		0.149
Weak ID test stat (Kleibergen-Paap rk Wald F)			264.3			264.3
Anderson-Rubin Wald chi2 test, p value			0.000			0.457
Endogeneity test, p value H0: Exogenous			0.001			0.995

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 5.12 OLS estimates of the determinants of adults' nutrient intake: effect of relationship

Variables	(1) All adults kcal	(2) All adults protein	(3) Male adults kcal	(4) Male adults protein	(5) Female adults kcal	(6) Female adults protein
Empowerment index	316.675	3.337	352.121	5.054	298.271***	5.687***
	(247.065)	(7.514)	(354.926)	(8.787)	(47.514)	(1.604)
Female=1, otherwise 0	-302.725**	-5.179				
	(135.980)	(4.111)				
Female*empowerment index	-29.042	1.906				
	(242.844)	(7.352)				
Age (years)	8.299***	0.265***	7.015	0.356***	9.042***	0.244**
	(2.531)	(0.079)	(4.540)	(0.133)	(3.206)	(0.106)
Age squared	-0.164***	-0.004***	-0.155***	-0.005***	-0.176***	-0.004***
	(0.026)	(0.001)	(0.045)	(0.001)	(0.035)	(0.001)
Height (cm)	6.051***	0.158***	5.847***	0.222***	6.115***	0.079*
	(1.091)	(0.035)	(1.606)	(0.053)	(1.458)	(0.046)
physical activity, moderate=1, otherwise 0	84.342***	1.327	-22.151	0.603	49.013	1.169
	(26.279)	(0.892)	(71.302)	(2.666)	(37.375)	(1.463)
physical activity, heavy=1, otherwise 0	110.388***	1.638**	144.959***	2.397**	67.665*	1.766
	(21.810)	(0.739)	(31.822)	(0.999)	(38.300)	(1.513)
Husband=1, otherwise 0	52.323	1.415	148.135	3.984		
	(140.934)	(4.287)	(189.153)	(4.547)		

Variables	(1) All adults kcal	(2) All adults protein	(3) Male adults kcal	(4) Male adults protein	(5) Female adults kcal	(6) Female adults protein
Adult son=1, otherwise 0	-104.126	-1.529	-35.555	1.450		
	(152.771)	(4.745)	(195.501)	(4.916)		
Adult daughter=1, otherwise 0	-175.940*	0.494			-207.872**	0.486
	(96.509)	(3.556)			(99.045)	(3.646)
Mother or father in law=1, otherwise 0	-18.288	-0.484	107.704	6.169	-16.301	-1.062
	(87.818)	(2.660)	(250.007)	(7.465)	(94.801)	(2.910)
Others=1, otherwise 0	-15.698	1.082			-4.217	2.514
	(84.555)	(2.603)			(89.374)	(2.795)
Empowerment index*Husband	-10.781	2.392	-58.031	0.172		
	(253.086)	(7.718)	(358.787)	(8.938)		
Empowerment index*Adult son	192.194	8.536	166.311	6.956		
	(272.574)	(8.372)	(372.411)	(9.498)		
Empowerment index*Adult daughter	224.963	-2.364			231.594	-2.689
	(164.595)	(5.621)			(163.657)	(5.627)
Empowerment index*Mother or father in law	-176.188	-3.549	-280.016	-10.891	-156.443	-1.921
	(147.527)	(4.783)	(448.895)	(13.102)	(155.219)	(5.141)
Empowerment index*Others	-97.218	-3.786			-139.227	-5.908
	(139.766)	(4.309)			(145.159)	(4.496)
Number of HH members	-3.602	0.107	-3.661	0.085	-0.884	0.114
	(5.299)	(0.169)	(8.451)	(0.263)	(6.729)	(0.218)
Ratio of male aged 0-4 to total HH member	326.799***	10.684***	273.541	12.053**	331.394**	8.879**
	(104.320)	(3.480)	(171.446)	(5.682)	(128.982)	(4.320)
Ratio of male aged 5-9 to total HH member	-73.969	-0.036	-184.169	-1.498	-14.997	0.577
	(95.040)	(3.164)	(157.090)	(5.111)	(117.220)	(4.045)
Ratio of male aged 10-14 to total HH member	-140.101	-5.470*	-205.116	-5.695	-113.059	-5.930
	(88.049)	(3.011)	(143.123)	(4.713)	(110.092)	(3.956)
Ratio of male aged 15-55 to total HH member	58.153	-1.611	49.111	-1.674	33.547	-1.874
	(65.388)	(2.237)	(108.610)	(3.641)	(81.176)	(2.871)
Ratio of female aged 0-4 to total HH member	277.473***	7.666**	198.837	7.408	306.701**	7.135*
	(99.488)	(3.239)	(163.542)	(5.188)	(124.370)	(4.213)
Ratio of female aged 5-9 to total HH member	25.422	-2.731	-72.096	-2.561	71.863	-3.501
	(97.375)	(3.043)	(160.734)	(4.948)	(120.579)	(3.887)
Ratio of female aged 10-14 to total HH member	-24.624	-2.929	-68.701	-3.392	-21.248	-2.900
	(93.623)	(3.119)	(151.572)	(4.956)	(118.151)	(4.054)
Ratio of female aged 15-55 to total HH member	-174.390*	-0.917	-250.532	-1.347	-128.054	-1.064
	(98.635)	(3.232)	(153.938)	(5.024)	(128.107)	(4.180)
Ratio of female aged 56+ to total HH member	-210.222	0.308	-366.773*	0.011	-78.614	0.859
	(131.706)	(4.495)	(204.630)	(7.032)	(170.813)	(5.791)
HH head's occupation, Trader=1, otherwise 0	-74.814***	-1.409*	-19.720	0.151	-102.372***	-2.513**
	(23.217)	(0.783)	(41.484)	(1.310)	(29.168)	(0.994)
HH head's occupation, Other=1, otherwise 0	-35.871**	0.150	3.912	1.280	-54.847**	-0.700
	(17.492)	(0.620)	(29.386)	(0.967)	(22.310)	(0.811)
Ratio of female's age to male's age	-104.428	-2.590	-208.360	-5.096	4.871	0.479
	(83.271)	(2.869)	(129.662)	(4.383)	(107.626)	(3.764)
Female's years of schooling	-5.080**	0.060	-8.357**	0.008	-2.023	0.122
	(2.213)	(0.075)	(3.533)	(0.119)	(2.742)	(0.096)
Log of per capita monthly expenditures	203.414***	9.649***	186.935***	9.832***	221.311***	9.456***
	(15.035)	(0.506)	(23.211)	(0.757)	(18.992)	(0.671)
Price of rice (Tk/Kg)	-5.438***	-0.092	-5.032*	-0.120	-5.798**	-0.067
	(1.901)	(0.082)	(2.858)	(0.125)	(2.546)	(0.108)
Female headed HH=1, otherwise 0	-356.505**	-4.570	-313.792	-1.704	-387.857**	-5.480
	(139.724)	(6.605)	(217.798)	(12.469)	(176.042)	(6.482)
Mother-in-law co-resides=1, otherwise 0	76.132***	1.867**	96.513**	1.935	46.985	1.905
	(26.653)	(0.868)	(41.215)	(1.312)	(35.359)	(1.182)
Number of food crops grown	44.424***	1.783***	52.805***	1.967***	36.281***	1.574***
	(3.646)	(0.125)	(5.559)	(0.186)	(4.683)	(0.165)
Uses closed latrine=1, otherwise 0	-4.998	1.888***	13.894	2.139***	-21.125	1.714**
	(15.310)	(0.514)	(23.758)	(0.784)	(19.361)	(0.669)

Variables	(1) All adults kcal	(2) All adults protein	(3) Male adults kcal	(4) Male adults protein	(5) Female adults kcal	(6) Female adults protein
	(1)	(2)	(3)	(4)	(5)	(6)
	All adults		Male adults		Female adults	
	kcal	protein	kcal	protein	kcal	protein
Drinks water from well=1, otherwise 0	23.798	-0.622	24.553	-0.664	21.823	-0.698
	(16.962)	(0.537)	(26.358)	(0.831)	(21.432)	(0.685)
Landless household=1, otherwise 0	-75.537***	-2.279***	-97.133***	-2.829***	-54.774***	-1.670***
	(14.363)	(0.459)	(22.148)	(0.703)	(18.443)	(0.596)
HH experienced shock=1, otherwise 0	-5.005	-0.603	20.053	-0.283	-28.470	-0.902
	(15.369)	(0.497)	(23.459)	(0.755)	(19.865)	(0.649)
Barisal	-73.054***	-1.231	-102.676***	-1.259	-42.613	-1.139
	(25.723)	(0.878)	(38.936)	(1.342)	(33.535)	(1.133)
Chittagong	-223.641***	-1.848**	-251.195***	-2.284*	-197.288***	-1.354
	(26.506)	(0.836)	(40.607)	(1.268)	(34.183)	(1.085)
Khulna	-163.572***	-4.353***	-140.552***	-4.100***	-185.877***	-4.641***
	(20.195)	(0.672)	(31.418)	(1.027)	(25.378)	(0.868)
Rajshahi	-182.004***	-7.281***	-187.313***	-7.786***	-176.990***	-6.826***
	(21.831)	(0.719)	(33.291)	(1.095)	(28.235)	(0.932)
Rangpur	-163.511***	-9.494***	-153.035***	-9.460***	-173.108***	-9.640***
	(23.451)	(0.798)	(36.279)	(1.242)	(29.844)	(1.007)
Sylhet	-141.018***	-0.624	-148.914***	-1.376	-135.063***	0.105
	(26.218)	(0.835)	(40.487)	(1.270)	(33.488)	(1.093)
Constant	326.481	-46.409***	502.385	-60.543***	-180.149	-40.427***
	(266.673)	(8.727)	(396.705)	(12.530)	(290.916)	(10.194)
Observations	9,900	9,900	4,944	4,944	4,956	4,956
R-squared	0.204	0.169	0.123	0.134	0.146	0.150

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 5.13 Information on household composition and on calorie missing

	Relation list	Male N	Male Age Min	Male Age Max	Male Food intake data are missing	Female N	Female Age Min	Female Age Max	Female Food intake data are missing
1.	Primary respondent	3,839	20	95	26	4	40	60	-
2.	Primary respondent husband/wife	4	35	90	-	3,839	18	80	2
3.	Son/daughter	4,087	0	45	207	3,281	0	74	127
4.	Daughter/son-in-law	14	19	40	1	401	14	40	84
5.	Grandson/daughter	310	0	20	44	293	0	17	53
6.	Father/mother	129	42	120	5	440	38	112	42
7.	Brother/sister	99	10	80	4	63	8	60	6
8.	Niece/nephew	31	0	25	5	32	0	18	4
9.	Primary respondent's cousin	1	11	11	-	1	14	14	-
10.	Father-in-law/mother-in-law	4	70	85	-	33	23	85	3
11.	Brother/sister-in-law	1	12	50	-	38	18	50	6
12.	Husband/wife's niece/nephew	3	11	27	1	4	7	28	-
13.	Husband/wife's cousin	-	-	-	-	-	-	-	-
14.	Other relative	9	0	85	1	26	0	100	1
15.	Permanent servant	14	11	45	-	6	12	52	-
16.	Other non-relative/friends	3	12	35	-	-	-	-	-
	Total	8,548	0	120	294	8,461	0	112	328

Chapter 6

Women's empowerment and life satisfaction: Evidence from rural Bangladesh

Abstract

This chapter examines the relationship between empowerment and life satisfaction (LS) with a particular focus on gender in the case of rural Bangladesh. We utilise a sample of 7,686 married and co-resident couples from 3,843 agricultural households of the BIHS 2012. The ordered probit estimates of the LS model suggest that there is a positive and significant association between empowerment and life satisfaction, which is robust to gender, income class, religion, and regions. We have also found that the women are significantly happier than their male counterparts after controlling for differences in empowerment, income, socio-demographic, health, and geographical factors. Education seems to have a positive significant influence on life satisfaction of both, yet the influence is greater for women. On account of potential endogeneity of empowerment, we have further estimated the LS model by household and community fixed effect, and by instrumental variables (IV) technique. We use the average number of community activities participated by others in the village in the past 12 months as an instrument. Both the fixed-effect and the IV estimates confirm that the relationship between empowerment and LS is positive and significant. While exploring the relationship of domain-specific indicators of empowerment with life satisfaction, we find that women's happiness falls significantly if they had input in decisions concerning agricultural production and use of borrowed money. Thus our study concludes that men and women differ in drawing satisfaction from empowerment.

6.1 Introduction

In the previous two chapters, we analysed the impact that women's enhanced capabilities, in the form of education and empowerment, could have on children's health and on household food security. The evidential positive impact on those development indicators underscores the instrumental role of women's enhanced capabilities. In this chapter, we consider whether women's enhanced capabilities have any implication for their own well-being i.e. the intrinsic value of empowerment, which is often ignored especially in the context of developing countries.

Before we go further into the matter, it would be useful to revisit certain aspects of women's life in Bangladesh. Since these have already been discussed in some detail in chapter 2, we will only briefly mention them here. For clarity of understanding, we need to take into account the socio-cultural context of Southeast Asia where Bangladesh is located. One of the fundamental features of most Southeast Asian societies is patriarchy alongside rigid traditions and customs which neglect women's economic, social, and cultural rights (Niaz, 2003). In line with this, women in the region predominantly tend to experience multiple forms of deprivation and inequality, and even the birth of girls is not welcomed in these societies (Niaz & Hassan, 2006). Throughout life, from childhood to adulthood, women face various forms of gender-based discrimination in all aspects of life: health, education, employment, property rights, and personal security. Customary gendered social norms also legalise different types of violence against women (Niaz, 2003). The social circumstances of Bangladeshi women are not massively different from the typical Southeast Asian context, despite the country's recent progress in regard to gender equality. Girls and women, who represent half of the country's population (BBS, 2016b), face many obstacles to their development. Girls are discriminated against from birth because they are considered to be a financial burden, and inevitably they receive less investment in health, care, and education (UNICEF, 2010). Patriarchal norms create gendered divisions of labour within households so that women specialise in care and household works. The lack of human capital along with the norm of female seclusion (*purdah*) ultimately limits their economic potential and makes them financially dependent on men. Even if they work, they have to face fierce competition in the highly gender-segregated labour market where significant wage discrimination is prevalent. Through marriage, men exercise control over women's access to social, economic, political, and legal institutions (Alim, 2009). Far more common is the lack of ownership of assets, primarily because asset

transfers take place in the line of male-lineage. Also the custom of early marriage serves as a conduit for the transmission of patriarchal attitudes and norms shaping gender roles and rights within the household (Asadullah & Wahhaj, 2017). In Bangladesh, the majority of the population live in rural areas and depend on agriculture for livelihood. Rural women in farm households are making a significant contribution; however, they rarely have access to and control over assets. Given that women's status relative to men is low, men capture almost all powers of decision-making and resource allocation (M. A. Hossain, 2013). Women seldom receive recognition for their contributions and hardly can communicate their voices collectively for own interest. As a result, the welfare of these women in agricultural households in rural Bangladesh largely remains overlooked.

Despite the instrumental role women play in households, their own well-being is rarely considered a priority. While there is some mixed evidence of gender differentials in subjective well-being, few empirical studies have systematically attempted to understand the relationship of empowerment with subjective well-being. Empowerment—a process that entails greater agency to be exercised through resources in order to achieve desired outcomes (discussed in chapter 2)—can have an important bearing on one's subjective well-being. Moreover, the relationship can operate in either direction, positive or negative, because empowerment may also entail additional burdens. In this chapter, we will consider this issue in the context of Bangladesh.

Our study is expected to contribute to the literature in several ways. First, it complements that strand of the literature which focuses on the well-being of poor women in the developing countries by analysing the relationship of empowerment with life satisfaction. Notably few studies have attempted to understand the intrinsic value of empowerment (Fernandez et al., 2015). Second, our study makes use of a recent comprehensive index of empowerment, which better reflects the multidimensionality of empowerment. The constituent indicators of this index help us to identify the role played by specific aspects of decision-making. Third, we contribute to the literature from a methodological perspective by recognising that the relationship between empowerment and life satisfaction may be influenced by unobservable confounding factors as well as reverse causality. In order to correct for the effect of such potential endogeneity bias on the estimated coefficient on empowerment, we have adopted different approaches such as a fixed effects estimation strategy and instrumental variables technique. Finally conducting our study on Bangladesh, itself, is a contribution because (we have seen in chapter 2) despite its strong patriarchal norms (M. A. Hossain, 2013),

Bangladeshi women are making progress in terms of school completion and empowerment owing to various initiatives of the government (Asadullah et al., 2014). The country's changing context therefore provides an interesting background for such an investigation.

We find that there is a positive and statistically highly significant association between empowerment and life satisfaction. The association does not seem to be influenced by any unobserved household or community level confounders. The IV estimates also confirm this positive and significant relationship. Notably, we find that women become significantly happier than their male counterparts after controlling for empowerment in agriculture, and for demographic, health, financial, and household factors. Consistent with the findings of other developing countries, our study also finds that the effect of income on life satisfaction is significant and positive, and is greater for the poor. Education seems to increase life satisfaction positively and significantly, and more importantly, it increases women's life satisfaction more than it does for men. By analysing the relation of domain-specific indicators of empowerment with life satisfaction, we find that women who make decisions concerning agricultural production and use of credit are less happy. This possibly points to the fact that men and women in agricultural households differ in term of drawing satisfaction from empowerment.

This chapter is organised as follows. We present the review of literature in section two, which is followed by a description of sample and methodologies in section three. Estimation results and their discussions are stated in section four and section five presents concluding remarks.

6.2 Review of the literature

This chapter draws on two sets of literature—the first on gender and subjective well-being and the second on female empowerment. Whether and why women are more or less satisfied with life relative to men remains debated in the literature (Asadullah & Chaudhury, 2012; Asadullah, Xiao, & Yeoh, 2015; Boye, 2009; Chui & Wong, 2016; Della Giusta, Jewell, & Kambhampati, 2011; Herbst, 2011; Matteucci & Vieira Lima, 2014). Analysing the impact of work on the life satisfaction of women, some studies find a small happiness gap between working and non-working women (Başlevent & Kirmanoğlu, 2017; Beja, 2014) while others (mostly in high-income countries) find the opposite – women tend to be more satisfied with work or happier with life compared to men (Clark, 1997; Graham & Chattopadhyay, 2013; Matteucci & Vieira Lima, 2014; Meisenberg & Woodley, 2014; Tesch-Römer, Motel-

Klingebiel, & Tomasik, 2008). There can also be important gender differences in social preferences (Croson & Gneezy, 2009) and material aspirations (e.g. Plagnol and Easterlin (2008)) which can cause gender differences in the evaluation of empowerment and its impact on life satisfaction.

The impact of gender on happiness and life satisfaction is not surprisingly, context-specific. In Bangladesh, women are disadvantaged relative to men with respect to inherited assets. They are also deprived of important capabilities such as health and education (Sraboni et al., 2014) and the absence of these substantive freedoms leaves women disempowered to live the life they desire and can undermine their welfare (Graham & Nikolova, 2015). In the Bangladesh context, therefore, Devine, Camfield, and Gough (2008) emphasize the critical importance of the ability to manage households, raise children well, and support ageing parents in determining the personal well-being of Bangladeshi women. This is consistent with existing evidence of the high-value that Bangladeshi women place on caring for their families (Camfield, Choudhury, & Devine, 2009). Yet they also note the importance of financial independence and mobility in women's statements regarding their quality of life (Devine et al., 2008).

Empowerment in the form of participation in household decision making is an important capability and it matters for life satisfaction (Sen, 2008; Veenhoven, 2010). Because it decreases the constraints that women face in resource allocation and decision-making on one hand, and increases women's responsibilities both within and outside the home on the other hand. The net impact of these two processes is uncertain. Women's empowerment can be seen as a process that increases autonomy and control over personal decisions, say, in household decision-making, and expands the capability to change aspects in her life (Ibrahim & Alkire, 2007).

It is often argued that women's rights and family responsibilities have not changed despite improvements in labour market outcomes and this has led to women bearing a double burden that cuts into their leisure leading to happiness loss (Stevenson & Wolfers, 2009). In an extensive review Johnston, Stevano, Malapit, Hull, and Kadiyala (2015) pointed to the fact women's time spent in agriculture compromises their available time needed for their resting, childcare, and food preparation; which may lead to negative welfare consequences. In developing countries, this 'double burden' (of housework and external work) seems to go hand in hand with a lack of empowerment in many aspects of women's lives. Mahmud, Shah,

and Becker (2012) however caution that empowerment can bring with it both rights and the burden of responsibilities. Economic participation can raise women's relative bargaining power but it also implies additional responsibility which may not necessarily be welfare enhancing. The greater mobility and visibility of working women, while empowering, can also lead to increased exposure to violence and decreasing support from men in taking critical decisions (Heath, 2014). Similarly, some evidence shows lower subjective well-being among rural women participating in NGO interventions because by promoting women's involvement in household income generation, these programs also increased emotional stress among them (S. M. Ahmed, Chowdhury, & Bhuiya, 2001). Therefore Basu and Koolwal (2005) argue, the real measure of autonomy is not whether women have the freedom to do certain things but what would happen if they chose to ignore these freedoms. For both (women and men), true freedom requires the freedom to do unproductive things (listen to the radio, visit friends and so on). Hence, whether women's empowerment leads to happiness and well-being in all settings is an important research question.

We are only aware of one study by Fernandez et al. (2015) that has examined women's happiness as a function of the agency using data from Indonesia. The authors concluded that women (and men) are happier when most decisions are jointly made rather than solely. They find that while men are happier when they can take financial decisions jointly with their spouse and can control child-related decisions; woman's well-being is not related either to the proportion of household decisions made by her spouse or to child-related expenditure decisions. Women seemed to be less happy if they alone took decisions on issues such as savings leading the authors to conclude that collaborative approaches or relinquishing control (in some cases) were associated with higher well-being for women.

6.3 Sample, measurement, and empirical strategy

In this section, we discuss our working sample, measurement of the key variables, sample characteristics, and empirical strategies for estimating the relationship between empowerment and life satisfaction.

6.3.1 The sample

Our sample consists of household heads and their spouses for whom data on empowerment measures and life satisfaction are available in the dataset. Among the surveyed households of the BIHS, we have found that there are 3,843 agricultural households that are led by dual

spouses. In total, our sample comprises 7,686 spouses who are primary decision-makers in these households. The selection of the sample takes two factors into consideration. First, the BIHS collected empowerment data in accordance with the framework proposed by Alkire et al. (2013a), which is specifically designed to capture the empowerment of women in the case of agricultural households. Hence any non-agricultural households are excluded from the sample. Second, we drop households where there is no spouse because it is not possible to consider relative power in households with only a single head. For example, there may be households in which the head is a son and the primary female member is his mother, or there can be several other forms of structures. When the household head and primary female member are not spouses, it is very likely that the power dynamic between them is different from the one that would have prevailed had they been spouses. Likewise in the case of life satisfaction, there is also some evidence that individuals living with a spouse or partner are likely to be happier than those who live alone (Della Giusta et al., 2011). This is why we are interested in carrying out our analysis on married and co-residing spouses from the agricultural households of the BIHS.

6.3.2 Measurement of the key variables

The dependent variable in this chapter is subjective well-being which is commonly expressed through one's level of satisfaction with life overall. The sample individuals have reported their satisfaction level in response to the following question:

"How would you rate your satisfaction with your life overall on a scale of 1 to 10, where 1 means you are not satisfied and 10 means you are very satisfied? If you are neither satisfied nor dissatisfied this would be in the middle i.e. 5 on the scale".

Our main independent variable is empowerment which is measured through the five domains empowerment index. We have already discussed its measurement in chapters 2 and 3. To recap, it measures an individual's adequacy over 10 indicators across five domains of empowerment and the weighted sum of adequacy over those 10 indicators generates the individual level values of the index. A person is defined as 'empowered' if his or her score is 0.80 or higher, in other words, empowered in four domains (Alkire et al., 2013a; Sraboni et al., 2014).

As we are exploring the effect of empowerment on life satisfaction and as there are men in the sample, we need to quantify men's empowerment too. It may be worth recalling that the

WEAI framework implies computing five domains empowerment index for both the primary male and the primary female member of a household so that a gendered gap in empowerment can be computed. As such the BIHS has collected empowerment information from the primary male member using the same set of questions used for obtaining empowerment information from women. Computing the five domains empowerment index for men and women facilitates comparison across gender within a household. Following the WEAI framework, we also use the five domains empowerment index to quantify men's empowerment in this chapter.

6.3.3 Sample characteristics

Table 6.1 presents summary statistics of the variables of interest for the full sample as well as across gender subsamples. It also reports t-test result of the difference in mean across genders.

Table 6.1 Summary statistics of the variables of interest across full and gender subsamples

Variables	All		Female		Male		Difference in the mean across gender (male – female)[a]
	Mean or proportion	SD	Mean or proportion	SD	Mean or proportion	SD	
Dependent variable							
Life satisfaction score	7.079	2.328	7.069	2.333	7.088	2.324	0.019
Independent variables							
Individual characteristics							
Female=1, otherwise 0	50.00%	0.500	-	-	-	-	-
Age (years)	41.412	13.220	37.163	11.555	45.661	13.414	8.498***
Age squared	1889.743	1204.243	1514.622	936.857	2264.865	1319.687	750.243***
Years of completed schooling	2.990	3.621	2.975	3.397	3.005	3.834	0.030
Height (cm)	155.788	8.197	150.142	5.721	161.435	6.154	11.293***
Ill in past 4 weeks, yes=1, otherwise 0	35.01%	0.477	33.46%	0.472	36.55%	0.482	0.031***
Health disability, yes=1, otherwise 0	17.74%	0.382	17.48%	0.379	18.00%	0.384	0.005
Works for pay=1, otherwise 0	77.93%	0.415	59.25%	0.491	96.62%	0.181	0.374***
Non-Muslim=1, otherwise 0	11.42%	0.318	11.42%	0.318	11.42%	0.318	-
Empowerment related variables							
Empowerment index	0.621	0.192	0.548	0.191	0.693	0.164	0.144***
Components of empowerment index							
Production domain							
Input in production decision=1, otherwise 0	64.45%	0.478	51.34%	0.500	77.56%	0.417	0.262***
Able to act on own values=1, otherwise 0	69.15%	0.461	66.90%	0.471	71.40%	0.452	0.045***
Resources domain							
Own asset=1, otherwise 0	71.75%	0.450	46.50%	0.499	97.00%	0.170	0.505***
Input in buy, sell, transfer of asset=1, otherwise 0	83.89%	0.368	69.42%	0.461	98.36%	0.127	0.289***
Input in borrowed money usage=1, otherwise 0	54.90%	0.497	47.62%	0.499	62.19%	0.485	0.146***
Income domain							
Input in decision on use of income=1, otherwise 0	86.89%	0.337	85.29%	0.354	88.52%	0.319	0.032***
Leadership domain							
Member in a group=1, otherwise 0	21.96%	0.414	29.82%	0.457	14.10%	0.348	-0.157***
Comfortable in public speaking=1, otherwise 0	49.65%	0.500	32.89%	0.469	74.18%	0.437	0.335***
Time use domain							
Works less than 10.5 hours in a day=1, otherwise 0	14.63%	0.353	17.95%	0.383	11.31%	0.316	0.008
Satisfied with leisure=1, otherwise 0	72.07%	0.448	69.94%	0.458	74.21%	0.437	0.042***
Household-level variables							
Log of per capita monthly expenditures	7.097	0.540					
Household head is female=1, otherwise 0	0.1%	0.032					
Number of child dependent	1.589	1.268					
Number of male dependent	0.033	0.180					
Number of female dependent	0.097	0.297					
Mother-in-law co-resides=1, otherwise 0	5.71%	0.232					
Experienced shock=1, otherwise 0	56.33%	0.496					
Experienced positive economic event=1, otherwise 0	5.71%	0.231					

Variables	All		Female		Male		Difference in the mean across gender (male – female)[a]
	Mean or proportion	SD	Mean or proportion	SD	Mean or proportion	SD	
House is broken=1, otherwise 0	93.26%	0.251					
House has electricity connection=1, otherwise 0	42.83%	0.495					
Administrative division							
Barisal	10.43%						
Chittagong	8.25%						
Dhaka	30.71%						
Khulna	18.16%						
Rajshahi	12.28%						
Rangpur	10.28%						
Sylhet	9.88%						
Instrument							
Average number of community activities participated by villagers in past 12 months	1.182	0.842	0.817	0.714	1.548	0.800	0.073***
Observations	7,686		3,843		3,843		

Source: Author's own calculation. Note: [a] Asterisk in the column indicates the level of significance of the difference in mean across genders based on independent sample T-tests. *** significant at 1 percent, ** significant at 5 percent, * significant at 10 percent

From the summary statistics, we can see that the average life satisfaction score is just over 7, and there is not much difference in the average level of satisfaction across genders. We have performed a t-test to see if the difference in life satisfaction between men and women is statistically significant. The test result has confirmed that there is no statistically significant difference in the level of life satisfaction between men and women.

By contrast, a notable gender difference is evident in the case of empowerment. By comparing across gender, we can see that the mean value of the composite empowerment index is lower for women (0.548) than for men (0.693). In other words, it becomes apparent from the raw data that women in agricultural households have a lower bargaining power than their husbands in rural Bangladesh. Given the country's patriarchal norms and customs, such a difference is not surprising. If we look into the components of the index, more descriptive information can be found as to what contributes to such a gender gap in empowerment. As can be seen, the proportion of having adequacy in component indicators is greater for men in eight out of the 10 indicators. In particular, if we look at the ownership of assets indicator, almost all the men (97 percent) have adequacy whereas more than half women do not own any assets. This clearly reveals a gender discrepancy with regard to ownership of assets. The reverse is true in the case of membership in groups and working hours where more women have adequacy than men. Women's membership in groups is highly prevalent possibly because of the widespread existence of microfinance NGOs in the rural areas of the country. These microfinance NGOs specifically target women clients and lend money on the basis of

group responsibilities. In respect of hours of work, more women than men seem to work less than 10 hours and a half in a day. This might be because fewer women participate in the labour market as indicated by the variable works for pay which indicates that about 59 percent of women work in the labour market in contrast to men (about 97 percent). The rest of the women are mainly engaged in non-earning occupations including housekeeping and care, which in fact may have reduced women's time for leisure, and perhaps this is why we see that fewer women than men have reported satisfaction with leisure, despite fewer hours of work. Interestingly in the case of workloads, both men and women report the least adequacy. Conversely, the largest adequacy can be seen in the case of use of income for women, and in the case of owning assets for men. Overall it has become clearer from these components that generally there is a sharp discrepancy in decision-making power between a household head and a spouse, which is picked up in the composite empowerment index.

Turning to the individual characteristics, we can see that the mean age in the sample is just over 41 years, and on an average, the age gap between spouses is about 7 years. Neither men nor women seem to have completed primary education, with about 3 years of schooling. The average height, a long-term indicator of health, is 155.79 cm, and women seem to be shorter than men. Overall about 35 percent individuals suffered from illness within the past four weeks of the survey, and about 18 percent individuals have some kind of health disability either in listening, speaking, seeing, or physical movement (paralysed). We can also see that the majority of the sample individuals are Muslims.

Among the household characteristics of the sample, we consider the monthly expenditure of the households as a proxy for household income. The average log value of per capita monthly expenditures is 7.097. Among the sample households, only 0.1 percent households are headed by a female. On average, each household has more than 1 child and less than 1 male and female dependant. In 5.71 percent households, a mother-in-law co-resides. About 56 percent households have suffered from some kind of negative shock; while nearly 6 percent households have reported experiencing positive economic events in the past five years. The majority of the households (about 93 percent) are living in some kind of damaged or broken dwellings, and more than half of the households do not have access to electricity.

6.3.4 Empirical strategy

Our main objective in this chapter is to understand empirically the relationship between empowerment and life satisfaction, especially for women. In order to explore this relation, we

regress the self-reported life satisfaction score on the five domain empowerment index along with controls for other correlates of life satisfaction. Specifically, we estimate the following Equation 6.1.

$$LS_i = \beta_0 + \beta_1 em5d_i + \beta_2 female_i + \beta_3 DE_i + \beta_4 HL_i + \beta_5 SE_i + \beta_6 HH_i + \beta_7 D_i + \varepsilon_i$$

<div align="right">Equation 6.1</div>

Here, LS_i is the dependent variable which stands for self-reported life satisfaction score of the i-th individual. The empowerment index is denoted by em5d and 'female' is a dummy of the gender of the respondent. The vectors DE, HL, SE, HH, and D stand for controls relating to demographic, health, socioeconomic, household, and geographical divisions, respectively. The β_is are the parameters of the model and ε stands for the disturbance term. We are interested in β_1 and β_2, which are the coefficient on the empowerment index and female dummy, respectively. The choice of control variables is guided by previous studies on Bangladesh (Asadullah & Chaudhury, 2012) and in other Asian countries (Ngoo, Tey, & Tan, 2015).

Our control variables relating to demographic factors include age, age squared, and religion. The respondents' health-related vector includes height, the incidence of illness, and prevalence of health disability. Socioeconomic controls include education of the respondent and their employment status. The vector of household characteristics includes per capita monthly household expenditures, the number of dependants, the gender of household head, household's exposure to shock and positive economic events, and living conditions in the dwelling.

We include the number of dependants who are children (0-14 years) and adults (60 years or more). We further distinguish between adult female dependants and adult male dependants. When we estimate the LS model for the female, we additionally control for whether or not a mother-in-law co-resides in the household, because in the case of Bangladesh there is evidence that residing with in-laws decreases women's autonomy and freedom of mobility (Balk, 1997).

There is some debate about whether Equation 6.1 should be estimated by OLS or Ordered probit regression. Some studies have regarded the happiness score as a continuous variable and have estimated the life satisfaction model by the Ordinary Least Squares (Bojanowska & Zalewska, 2016; Knight, Song, & Gunatilaka, 2009); while others argue that happiness is a

latent variable which is not directly observable. Instead what we observe is the response to a question on life satisfaction in general and as such the life satisfaction model should be estimated using ordered probit (Groot & van Den Brink, 2002). Notwithstanding this, Ferrer-i-Carbonell and Frijters (2004) and Della Giusta et al. (2011) have pointed out that estimation results do not depend on whether satisfaction is considered as a cardinal or ordinal variable and that in panel data, it is more important to include fixed effects, which requires the dependent variable to be modelled as a continuous variable. In this chapter, we estimate the LS model by both OLS and probit regression.

6.3.5 Problem of endogeneity

At this stage, it may be worth pointing out the fact that estimating the impact of empowerment on life satisfaction can be biased either because of reverse causality or omitted unobservable characteristics (e.g. personal characteristics) (Fernandez et al., 2015). In addition there may be some omitted variables at the community, household and personal level. In particular, it is possible that communities might have different gender norms that could influence women's well-being. These could include the imposition of patriarchal norms on women such as *purdah*, the custom of early marriage or even practices like female genital mutilation in some parts of the world (e.g. Africa). These norms might vary across communities and influence our estimates of the effect of empowerment on the LS. In addition, there could be household level variation in norms that are not captured in our empowerment indices. Again, this could bias the coefficient of empowerment in our model.

Correcting for omitted variables of this kind is not always easy because such factors are not easy to measure. However, we have attempted to correct for them by including household and regional fixed effects, which should capture the unobserved effect of household and regional norms that our model fails to control explicitly. First, we estimate a community fixed effects model which allows us to capture omitted locality specific gender and cultural norms (e.g. the custom of *purdah* governing the outside engagement of women and hence their threat points in intra-household bargaining) that can bias our estimate of the empowerment variable. Second, we exploit the fact that BIHS collected data on both husband and wife to estimate a household fixed effects model. Household levels fixed effects can help control for time-invariant household specific factors that affect well-being and are correlated with women's empowerment. By including both community and household level fixed effects, we are able to control for unobservable factors that might influence life satisfaction at both these levels.

The other cause of potential endogeneity is reverse causality or feedback effect from life satisfaction to empowerment. It is possible that extrovert and happier women proactively take part in household decisions, while at the same time, being involved in these decisions makes them happier and more fulfilled. In order to address this particular issue which undermines the exogeneity of the empowerment variable in the well-being function, we have estimated Equation 6.1 using the instrumental variables (IV) approach as well. To do so, we use information on the average number of community activities that the villagers participated over the past 12 months. The instrument is computed at village level for women and men separately, after excluding the respondent. More explicitly, the construction of the instrument is expressed in the Equation 6.2.

Average number of community activities participated by the villagers,

$$ancap_{v,g} = \frac{\sum_{j=1}^{n-1} ncap_{v,g,j}}{n-1} \qquad \text{Equation 6.2}$$

Where $ancap_{v,g}$ is the number of community activities participated by n-1 individuals of gender g in the village v; $ncap_{v,g,j}$ is the number of community activities j-individual of g-gender in v-village participated in the past 12 months. The number of villagers of g-gender is n and g takes account of the gender of the villagers i.e. male or female. Eventually $ancap_{v,g}$ is used to predict the i-th individual's empowerment index in the first stage. The IV process is delineated as the following Equations 6.3 and 6.4.

$$em5d_i = \alpha_0 + \alpha_1 ancap_v + \alpha_2 female_i + \alpha_3 DE_i + \alpha_4 HL_i + \alpha_5 SE_i + \alpha_6 HH_i + \alpha_7 D_i + v_i$$
$$\text{Equation 6.3}$$

$$LS_i = \gamma_0 + \gamma_1 e\hat{m}5d_i + \gamma_2 female_i + \gamma_3 DE_i + \gamma_4 HL_i + \gamma_5 SE_i + \gamma_6 HH_i + \gamma_7 D_i + u_i$$
$$\text{Equation 6.4}$$

From Table 6.1, we can see that on an average the female villagers had participated in less than one (0.817) activity, male villagers participated in more than one but less than two (1.6) community activities. Although we have discussed the rationale for using this instrument in the previous chapter, it may be useful to point out that our current instrument is slightly different from the one used in the previous chapter.

In chapter 5, we have used the information on how many community activities a mother had participated in the previous 12 months as an instrument for her empowerment index. On the other hand in this chapter, we use information on how many community activities the

villagers had participated in the previous 12 months. Clearly we use two different instruments to deal with the potential endogeneity of the empowerment variable; however, the following rationale may be useful to justify their usage.

While estimating the effect of mothers' empowerment on food security indicators, we suspect empowerment variable is endogenous because the empowerment index possibly does not account for household-specific gender norms that may have a bearing on women's ability to influence households' food consumption bundle and on their ability to influence the allocation of nutrients among household members. That being said, on the other hand, we suspect that the source of endogeneity of empowerment index in the life satisfaction model may originate from a personal trait such that a happier individual may proactively exercise agency and thereby becomes empowered. This indicates to the fact that the source of endogeneity is different across the models.

The criteria of a suitable instrument suggest us that an instrument should not be correlated with the source of bias and that it is correlated with the endogenous variable as highly as possible. Participation in the community activities in the past year may be relevant to the current state of empowerment because through participation individuals are likely to have an exposure to different ideas, likely to be aware of their rights, likely to be confident to raise voices against concerns as well as to seek support in case of an issue. Thus women's participation in the community activities in the previous year may well suggest the extent of current empowerment. However what if the women had already been empowered in the previous year and hence participated in the community activities. Since in the dataset there is no information on the extent of past year's empowerment, we cannot examine if there has been any improvement in the level of empowerment because of the participation. This we recognise as a potential weakness of our strategy. That being said, we have also argued that women's participation in the past year is not directly related to household-specific gender norms concerning intra-household allocation of nutrients in the current period. This means that we expect that women's participation in the previous year has no direct effect on individuals' nutrient intake in the current period.

We could have used the same instrument in the life satisfaction model if we did not suspect the source of endogeneity is arising from a reverse causation because of personal traits. In other words, using individual-level participation information would not guarantee that the instrument is uncorrelated with the source of bias. Hence we prefer using the community level

variable that computes an average of the number of community activities in which the villagers except the individual being studied had participated in the past year. The idea here is that the community average would still give an approximate estimate of individual-level information on participation, which can be used to predict current empowerment. There may still be a concern that a more engaged community might create a happier atmosphere to live in and thereby influences people's life satisfaction, which hints at community-specific characteristics. However we have attempted to address such concern by estimating the life satisfaction model at community fixed-effects level and have found evidence to suggest that the relationship between empowerment and life satisfaction is not influenced by community-specific characteristics.

Following to the above argument for using two different instruments in two different models, we would also like to stress that community-level information on participation may not be truly exogenous in predicting empowerment in the case of food security model. If a higher participation by the villagers is meant to be symptomatic of a prosperous, advanced or well-off community then it is very much likely that the food security of that community's members is also enhanced. Moreover household-specific gender norm may also be associated with community-level characteristics. Hence in the food security chapter we prefer mother-specific participation information rather than community level variable. All things considered, we prefer to use two different instruments in our two separate models with appropriate caution. In what follows we will also perform the formal IV diagnostic tests.

6.4 Results and discussions

The ordered probit estimates of the determinants of life satisfaction are presented in Table 6.2. Column 1 represents ordered probit (OP) estimates, column 2 to 4 represents OLS estimates, and column 5 and 6 represent IV estimates.

As stated our interest is centred around the relationship between the empowerment index and life satisfaction, and the coefficient on the female dummy. In order to check whether empowerment has any differential effect for men and women, we will examine the life satisfaction model across genders, income class, religion, and zone of economic integration.

Table 6.2 Ordered probit, OLS, fixed effect, and IV estimates of life satisfaction model

Variables	(1) O.probit LS	(2) OLS LS	(3) Household FE LS	(4) Community FE LS	(5) IV first e.index	(6) IV second LS
Empowerment index	1.418***	2.966***	1.356***	2.273***		4.460***
	(0.071)	(0.144)	(0.218)	(0.153)		(0.646)
Female=1, otherwise 0	0.195***	0.411***	0.287**	0.278***	-0.070***	0.569***
	(0.039)	(0.081)	(0.130)	(0.079)	(0.006)	(0.106)
Age (years)	-0.000	0.002	0.024	0.022**	0.009***	-0.012**
	(0.006)	(0.012)	(0.026)	(0.011)	(0.001)	(0.013)
Age squared	-0.000	-0.000	-0.000	-0.000**	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Years of schooling	0.017***	0.038***	-0.001	0.040***	0.005***	0.030***
	(0.004)	(0.007)	(0.014)	(0.008)	(0.001)	(0.008)
Height (cm)	0.002	0.005	0.001	0.002	0.001**	0.003
	(0.002)	(0.004)	(0.006)	(0.004)	(0.000)	(0.004)
Ill in past 4 weeks, yes=1, otherwise 0	-0.028	-0.058	0.034	-0.064	0.008*	-0.086
	(0.026)	(0.055)	(0.079)	(0.055)	(0.004)	(0.057)
Health disability, yes=1, otherwise 0	-0.101***	-0.184**	-0.066	-0.113	-0.012**	-0.168**
	(0.035)	(0.074)	(0.113)	(0.072)	(0.006)	(0.075)
Non-Muslim=1, otherwise 0	-0.043	-0.106		-0.115	0.013**	-0.126
	(0.038)	(0.080)		(0.122)	(0.006)	(0.081)
Works for pay=1, otherwise 0	0.016	0.024	-0.034	-0.032	0.019***	-0.003
	(0.033)	(0.069)	(0.087)	(0.070)	(0.006)	(0.069)
Log of per capita monthly expenditures	0.195***	0.406***		0.406***	0.007*	0.398***
	(0.026)	(0.053)		(0.055)	(0.004)	(0.053)
Female headed HH=1, otherwise 0	-0.561	-1.231		-1.474*	0.046	-1.325
	(0.545)	(1.190)		(0.778)	(0.077)	(1.198)
Number of child dependent	-0.038***	-0.082***		-0.069***	0.005***	-0.089***
	(0.011)	(0.024)		(0.024)	(0.002)	(0.024)
Number of male dependent	0.088	0.185		0.205	0.007	0.173
	(0.062)	(0.129)		(0.141)	(0.010)	(0.131)
Number of female dependent	0.040	0.083		0.124	0.023***	0.051
	(0.048)	(0.100)		(0.102)	(0.007)	(0.101)
Mother-in-law co-resides=1, otherwise 0	0.074	0.140	0.006	0.154	-0.030***	0.186
	(0.064)	(0.132)	(0.147)	(0.132)	(0.011)	(0.136)
Economic shock occurred, yes=1, otherwise 0	-0.024	-0.065		-0.221***	0.003	-0.067
	(0.024)	(0.050)		(0.055)	(0.004)	(0.050)
Positive economic event occurred, yes=1, otherwise 0	0.274***	0.545***		0.357***	0.020**	0.511***
	(0.057)	(0.109)		(0.109)	(0.009)	(0.111)
Dwell is broken, yes=1, otherwise 0	-0.341***	-0.644***		-0.547***	-0.003	-0.653***
	(0.054)	(0.101)		(0.104)	(0.008)	(0.102)
Access to electricity, yes=1, otherwise 0	0.108***	0.221***		0.205***	0.022***	0.183**
	(0.026)	(0.053)		(0.064)	(0.004)	(0.056)
Barisal	0.269***	0.543***			0.032***	0.485***
	(0.053)	(0.114)			(0.009)	(0.117)
Chittagong	0.521***	1.071***			-0.084***	1.163***
	(0.054)	(0.112)			(0.010)	(0.118)
Dhaka	0.500***	1.025***			0.043***	0.957***
	(0.041)	(0.086)			(0.007)	(0.090)
Khulna	0.462***	0.955***			-0.008	0.937***
	(0.048)	(0.100)			(0.008)	(0.101)
Rajshahi	0.461***	0.973***			0.015*	0.939***
	(0.047)	(0.099)			(0.008)	(0.101)
Rangpur	0.145***	0.288***			-0.011	0.291***
	(0.046)	(0.100)			(0.009)	(0.101)
Average number of community activities participated by villagers					0.052***	
					(0.003)	
Constant		1.251	5.207***	2.481***	0.125**	1.020
		(0.832)	(1.216)	(0.814)	(0.062)	(0.844)
Observations	7,686	7,686	7,686	7,686	7,686	7,686
R-squared		0.131	0.011	0.071		0.119
Log-likelihood	-14455					
Chi2	1106					
Pseudo R2	0.0357					
Weak ID test stat (Kleibergen-Paap rk Wald F)						413.300
Anderson-Rubin Wald chi2 test, p value						0.000
Endogeneity test, p value H0: Exogenous						0.017
Number of HH or community			3,843	318		

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Let us begin the discussion by focusing on the results of the ordered probit regression presented in column 1 of Table 6.2. We can see that the coefficient on the empowerment

index and female dummy are both positive and statistically highly significant. This suggests that empowerment is a positive and significant determinant of life satisfaction. In other words, our findings suggest that individuals become happier when they have greater agency, control over resources, and capabilities to act upon one's preference.

In addition our ordered probit results indicate that women seem happier, although in the raw data we found no significant difference in life satisfaction between genders. Thus once we control for a wide range of other correlates e.g. education, empowerment, employment; women are significantly happier than men. Intuitively we suggest that the positive changes that have occurred in respect of women's status in Bangladesh over the past few decades contribute to women's quality of life, which is reflected in our analysis. The significant gender difference in life satisfaction in rural Bangladesh is in line with the international literature on contented women (Clark, 1997).

The positive significant effect of empowerment on life satisfaction is robust to household and community fixed effects, implying that the relationship is not governed by any underlying household or community-related norms or unobserved factors. The significance and sign of the coefficient on the empowerment variable do not alter in the fixed effects model (column 3 and 4 in Table 6.2). However, the size of the coefficient on the empowerment index falls when we run the household fixed effects model (column 3). Nevertheless, the unchanged sign and significance of the coefficient on empowerment index effectively rules out any concern about the bias rooted in unobserved household or community level factors.

Next we move onto column 6 which represents the IV estimates of the determinants of the life satisfaction model, which we obtain for correcting the potential endogeneity bias that is likely to result from reverse causality. The first stage result (column 5) indicates that the instrument—average number of community activities the villagers participated in in the past 12 months—is significant and is positively related to the empowerment index. The test of endogeneity rejects (p value is 0.017) the null of exogeneity of empowerment index in life satisfaction model. The Anderson-Rubin Chi^2 test (p values is 0.000) and the Kleibergen-Paap F statistic (413.30) confirm that the empowerment index is not irrelevant and the instrument is not weak, respectively. In the second stage, empowerment index remains statistically significant and positive. The size of the coefficient on empowerment becomes larger in the second stage, which suggests that neglecting endogeneity may underestimate the true effect of empowerment.

With regard to the controls, we can see they operate as expected. Monthly expenditure seems to be a positive and statistically significant determinant of life satisfaction, which is consistent with a previous study on Bangladesh (Asadullah & Chaudhury, 2012). We have also found that education is a positive and significant determinant of individuals' life satisfaction in rural Bangladesh. Our result therefore confirms that income is a significant determinant of life satisfaction in Bangladesh as in many other developing countries and contrary to many developed countries. The occurrence of a positive economic event seems to increase life satisfaction; while an inverse relationship can be seen in regard to negative shocks. The indicators of quality of living conditions–dwelling and access to electricity—have expected signs. Contrary to these, the result also shows that life satisfaction of individuals is significantly and negatively associated with health disability. Being in a female-headed household seems to be negatively associated with life satisfaction, possibly because in countries like Bangladesh these households are usually highly economically and socially marginalised.

Gender disaggregated analysis

We present gender wise estimates of the life satisfaction model in Table 6.3 and 6.4. The estimates presented in these Tables indicate that, in both the OLS and the ordered probit estimates, the empowerment index has a positive and significant impact on life satisfaction for both men and women. By comparing the ordered probit estimates of the effect of empowerment on life satisfaction, it is evident that the size of the effect is greater for men (1.572) than women (1.368). In the OLS models, we can also see that the coefficient on empowerment is lower for women (2.796 and 1.972) than for men (3.283 and 2.881). Turning to the IV estimates, some interesting results can be noticed. The instrument is significant for both women (0.071) (column 4 in Table 6.3) and men (0.039) (column 5 in Table 6.4), and the F-statistic on the excluded instrument is very large suggesting that our results are robust to the problem of a weak instrument. While women's empowerment still appears to be a positive and statistically significant determinant of their life satisfaction in the second stage, this is not the case for men. Empowerment does not seem to have a significant effect on men's life satisfaction, possibly because they are the primary decision-makers in patriarchal societies and hence usually not deprived of voice and say in the first place. Overall the gender disaggregated results suggest that women have higher conditional life satisfaction in Bangladesh than men. Women in rural areas lack both economic and social empowerment as they live in income poverty and they also lack a voice in key life events before as well as after

marriage. In these circumstances empowerment is less common and therefore, where it does exist, is likely to have a larger differential impact.

We will now turn to two extensions of our analysis. First, we analyse this relationship in a set of sub-samples to see if the result is robust across sub-samples. Second, we analyse the various sub-components of the empowerment index to see if a particular aspect of empowerment has a larger or more significant impact than others.

Subsample estimates

We consider the empowerment − life satisfaction relationship in three separate subsamples: economic (richest and poorest quartiles); religious (Muslim vs non-Muslim); and regional (integrated vs non-integrated regions[14]). Our results in Table 6.5 indicate that women have a higher conditional life satisfaction in all the sub-samples except for the two non-integrated regions. While women are happier than men in both the richest and poorest quartiles, the differential is larger in the poorest quartile. Thus, poorest women are happier than their male counterparts in comparison to richest women and their male counterparts. It might help to understand these results if we think of empowerment as being affected by external constraints (income in this case) and internal constraints (i.e. internal to the household). External empowerment is likely to be higher for prosperous households and internal (i.e. within the household) empowerment is likely to be higher for men. In this context, we might expect rich men to be the most empowered in rural Bangladesh (since they are externally empowered by prosperity and also empowered within their households by patriarchy). We might also expect poor women to be least empowered since they face a double disempowerment − that from poverty and also from being a woman. Men in poor households are disempowered externally through poverty but are not disempowered within their households.

Turning to the religious subsamples, we find that Non-Muslim women are happier than non-Muslim men and this differential is larger than that of the Muslim women and men. Finally, women in integrated regions are happier than men in these regions though there is no significant differential in LS in the non-integrated regions. This might well be because integrated regions benefit from better communication infrastructure and greater access to

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[14] By integrated regions, we refer to Dhaka, Chittagong and Sylhet divisions that are geographically well-connected with each other and include all major growth centres in the country. On the other hand, non-integrated divisions (i.e. Ranpur, Rajshahi, and Khulna divisions) are separated from rest of the country by major rivers which considerably increase transport cost and movement of goods and services.

market work which help to improve women's mobility and opportunities for outside engagements in comparison to non-integrated regions.

Referring to the impact of empowerment across these sub-samples, we find that the extent of the effect on life satisfaction slightly varies between the poorest (1.321) and the richest (1.338) subsamples. Evidently empowerment has a differential impact on poorer households, possibly because empowerment makes up for some of the constraints placed by poverty on these households. Empowerment also has a larger impact amongst non-Muslims than Muslims and it has the largest regional impact in the non-integrated Northern region.

In sum, our results confirm that although the magnitude of the impact varies across sub-samples, empowerment has a positive and significant impact on life satisfaction whichever way we divide the sample.

Components of the empowerment indicator

Next we examine the relationship of the components of the empowerment indicator individually with life satisfaction. We do this in order to find out whether certain aspects of empowerment are more important than others in influencing life satisfaction. For this purpose, we add an interaction term between the components and the female dummy to the specification of Equation 6.1 and estimate only by ordered probit regression. The results are presented in Table 6.6.

From Table 6.6, we can see that not all indicators are significant in determining life satisfaction. Seven indicators e.g. 1 to 4, 6, 7 and 10 out of the 10 component indicators are significant and 3 are not significant at all. For individuals in agricultural households, life satisfaction seems to be positively associated with adequacy in: production decisions (i1), ability to act on own value (i2), ownership of assets (i3), input in asset transfer (i4), deciding expenditures (i6), membership in groups (i7), and having enough leisure (i10).

Now focusing on the sign of the coefficient on the interaction term, we can see that while empowerment always increases life satisfaction, there is some evidence that in some cases it has a smaller impact on the life satisfaction of women relative to men. For example, if women make decisions relating to agricultural production, then their life satisfaction increases by a smaller extent (0.218-0.178) compared with that of men who made these decisions (0.218). On the other hand, we can see that if women make decisions concerning the use of borrowed money (i5), they are significantly unhappy; whereas this has no impact on men's life

satisfaction. Borrowing money literally implies that the household is in financial hardship and in such a situation it may be burdensome for women to decide upon how to spend the money. Based on this set of results, it may be said that women would be happier if someone else took decisions relating to borrowed money use. For most other sub-components of the empowerment index, there is no significant difference in the effect of the component on the life satisfaction of men and women.

6.5 Conclusion

In the previous chapters (4 and 5), we focused on the extrinsic importance of women's empowerment in the context of well-being of other household members. In this chapter, we examine the intrinsic value of empowerment by estimating the relationship between empowerment and the subjective well-being of rural women in agricultural households of Bangladesh. As there is limited evidence of the nature and direction of the relationship between empowerment and the subjective well-being for developing countries, our study fills an important gap in the literature.

We are primarily interested in estimating the relationship because we want to examine whether or not empowerment brings additional burden, particularly for the women in agricultural households in rural Bangladesh. While estimating the relationship we address a few challenges that are inherent in this kind of research. One such challenge is the measurement of empowerment, which we have tackled by utilising a multidimensional composite index. We also address a methodological challenge relating to endogeneity rooted in reverse causality and in omitted unobserved household and communal norms. We correct for these problems by estimating our model with household and community fixed effects and by instrumental variables technique. We also estimate the relationship across a number of subsamples as a robustness check. Our analysis has consistently revealed the positive and significant impact of empowerment on life satisfaction, especially for women. By exploring the relationship across domains of empowerment we find that women's empowerment specifically in agricultural production decision; in possession of assets; in buy, sale or transfer of asset; and in use of borrowed money explain the significant gender gap in life satisfaction. However if women have a say in agricultural production decisions and in use of borrowed money, they appear to be less satisfied than men. This is possibly because of the fact that men and women differ in drawing satisfaction from different domains of empowerment. We also find that empowerment is not a statistically significant determinant of men's life satisfaction

perhaps because they do not face constraints and barriers that are culturally imposed on women.

To conclude, policy interventions that aim at improving empowerment and gender equality in society will have a positive and significant influence on the quality of life, especially of women in agricultural households.

Appendix 4 Subsample estimates of life satisfaction model

Table 6.3 Ordered probit, OLS, fixed effect, and IV estimates of women's life satisfaction model

Variables	(1) O.probit LS	(2) OLS LS	(3) Community FE LS	(4) IV first e.inded	(5) IV second LS
Empowerment index	1.368***	2.796***	1.972***		6.909***
	(0.095)	(0.186)	(0.210)		(0.736)
Female=1, otherwise 0					
Age (years)	0.005	0.008	0.028	0.014***	-0.048*
	(0.010)	(0.021)	(0.020)	(0.002)	(0.025)
Age squared	-0.000	-0.000	-0.000	-0.000***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Years of schooling	0.025***	0.051***	0.056***	0.004***	0.033***
	(0.006)	(0.012)	(0.012)	(0.001)	(0.013)
Height (cm)	0.007**	0.014**	0.009	0.000	0.010
	(0.003)	(0.006)	(0.006)	(0.000)	(0.007)
Ill in past 4 weeks, yes=1, otherwise 0	-0.014	-0.014	-0.016	0.011*	-0.125
	(0.038)	(0.077)	(0.077)	(0.006)	(0.085)
Health disability, yes=1, otherwise 0	-0.100**	-0.174*	-0.119	-0.013	-0.121
	(0.049)	(0.103)	(0.101)	(0.008)	(0.110)
Non-Muslim=1, otherwise 0	0.031	0.057	0.171	0.021**	-0.034
	(0.054)	(0.110)	(0.166)	(0.009)	(0.116)
Works for pay=1, otherwise 0	0.009	-0.006	-0.120	0.015***	-0.057
	(0.035)	(0.071)	(0.081)	(0.006)	(0.075)
Log of per capita monthly expenditures	0.174***	0.348***	0.412***	0.013**	0.295***
	(0.037)	(0.074)	(0.075)	(0.006)	(0.079)
Female headed HH=1, otherwise 0	-0.541	-1.286	-1.341	0.176*	-2.113
	(0.771)	(1.665)	(1.061)	(0.091)	(1.601)
Number of child dependent	-0.063***	-0.128***	-0.094***	0.006**	-0.150***
	(0.017)	(0.035)	(0.034)	(0.003)	(0.037)
Number of male dependent	-0.002	0.003	-0.098	-0.016	0.059
	(0.092)	(0.190)	(0.193)	(0.016)	(0.201)
Number of female dependent	0.037	0.069	0.127	0.035**	-0.069
	(0.089)	(0.180)	(0.191)	(0.017)	(0.203)
Mother-in-law co-resides=1, otherwise 0	0.080	0.149	0.173	-0.034**	0.296
	(0.087)	(0.177)	(0.185)	(0.016)	(0.200)
Economic shock occurred, yes=1, otherwise 0	0.035	0.065	-0.096	-0.000	0.089
	(0.034)	(0.069)	(0.074)	(0.006)	(0.073)
Positive economic event occurred, yes=1, otherwise 0	0.229***	0.461***	0.245	0.004	0.414**
	(0.083)	(0.159)	(0.149)	(0.013)	(0.171)
Dwell is broken, yes=1, otherwise 0	-0.385***	-0.718***	-0.536***	0.014	-0.833***
	(0.076)	(0.136)	(0.142)	(0.012)	(0.149)
Access to electricity, yes=1, otherwise 0	0.161***	0.317***	0.301***	0.026***	0.185**
	(0.037)	(0.074)	(0.087)	(0.006)	(0.082)
Barisal	0.063	0.092		0.003	-0.069
	(0.075)	(0.163)		(0.012)	(0.178)
Chittagong	0.372***	0.747***		-0.114***	1.041***
	(0.073)	(0.154)		(0.014)	(0.173)
Dhaka	0.672***	1.337***		0.032***	1.108***
	(0.058)	(0.119)		(0.009)	(0.134)
Khulna	0.548***	1.106***		-0.059***	1.197***
	(0.067)	(0.139)		(0.012)	(0.146)
Rajshahi	0.446***	0.964***		0.037***	0.746***
	(0.064)	(0.135)		(0.011)	(0.148)
Rangpur	0.077	0.149		0.001	0.049
	(0.065)	(0.139)		(0.012)	(0.152)
Average Number of community activities participated by villagers				0.071***	
				(0.004)	
Constant		0.613	1.678	-0.009	0.806
		(1.141)	(1.097)	(0.090)	(1.192)
Observations	3,843	3,843	3,843	3,843	3,843
R-squared		0.167	0.076		0.064
Log-likelihood	-7121				
Chi2	696.9				
Pseudo R2	0.0473				
Weak ID test stat (Kleibergen-Paap rk Wald F)					194.1
Anderson-Rubin Wald chi2 test, p value					0.000
Endogeneity test, p value H0: Exogenous					0.000
Number of community			318		

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 6.4 Ordered probit, OLS, fixed effect, and IV estimates of men's life satisfaction model

Variables	(1) O.probit LS	(2) OLS LS	(3) Community FE LS	(4) IV first e.index	(5) IV second LS
Empowerment index	1.572***	3.283***	2.881***		0.907
	(0.112)	(0.231)	(0.243)		(1.196)
Female=1, otherwise 0					
Age (years)	-0.010	-0.017	0.014	0.008***	0.002
	(0.009)	(0.019)	(0.017)	(0.001)	(0.021)
Age squared	0.000	0.000	-0.000	-0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Years of schooling	0.015***	0.033***	0.031***	0.006***	0.047***
	(0.005)	(0.010)	(0.010)	(0.001)	(0.012)
Height (cm)	-0.002	-0.003	-0.003	0.001***	0.000
	(0.003)	(0.006)	(0.006)	(0.000)	(0.006)
Ill in past 4 weeks, yes=1, otherwise 0	-0.033	-0.081	-0.057	0.002	-0.059
	(0.037)	(0.077)	(0.077)	(0.005)	(0.079)
Health disability, yes=1, otherwise 0	-0.096*	-0.175*	-0.030	-0.009	-0.194*
	(0.050)	(0.105)	(0.101)	(0.007)	(0.105)
Non-Muslim=1, otherwise 0	-0.116**	-0.261**	-0.419**	0.002	-0.253**
	(0.055)	(0.115)	(0.168)	(0.007)	(0.116)
Works for pay=1, otherwise 0	0.180	0.391	0.529***	0.031*	0.465*
	(0.115)	(0.238)	(0.198)	(0.016)	(0.251)
Log of per capita monthly expenditures	0.224***	0.468***	0.404***	-0.001	0.461***
	(0.036)	(0.074)	(0.076)	(0.005)	(0.075)
Female headed HH=1, otherwise 0	-0.610	-1.239	-1.497	-0.079	-1.402
	(0.755)	(1.665)	(1.074)	(0.092)	(1.591)
Number of child dependent	-0.010	-0.026	-0.043	0.001	-0.023
	(0.016)	(0.034)	(0.033)	(0.002)	(0.034)
Number of male dependent	0.165*	0.342*	0.462**	0.029**	0.413**
	(0.087)	(0.176)	(0.193)	(0.012)	(0.178)
Number of female dependent	0.042	0.087	0.091	0.014*	0.115
	(0.058)	(0.120)	(0.118)	(0.008)	(0.122)
Mother-in-law co-resides=1, otherwise 0					
Economic shock occurred, yes=1, otherwise 0	-0.082**	-0.195***	-0.346***	0.008	-0.176**
	(0.034)	(0.071)	(0.075)	(0.005)	(0.073)
Positive economic event occurred, yes=1, otherwise 0	0.318***	0.619***	0.448***	0.034***	0.698***
	(0.079)	(0.147)	(0.151)	(0.011)	(0.156)
Dwell is broken, yes=1, otherwise 0	-0.300***	-0.567***	-0.554***	-0.021**	-0.605***
	(0.077)	(0.147)	(0.144)	(0.009)	(0.149)
Access to electricity, yes=1, otherwise 0	0.058	0.121	0.099	0.016***	0.164**
	(0.036)	(0.075)	(0.088)	(0.005)	(0.079)
Barisal	0.481***	0.993***		0.048***	1.083***
	(0.075)	(0.156)		(0.012)	(0.167)
Chittagong	0.686***	1.399***		-0.065***	1.271***
	(0.079)	(0.159)		(0.013)	(0.176)
Dhaka	0.351***	0.723***		0.044***	0.805***
	(0.059)	(0.125)		(0.010)	(0.132)
Khulna	0.377***	0.787***		0.034***	0.891***
	(0.069)	(0.145)		(0.011)	(0.155)
Rajshahi	0.489***	1.000***		-0.012	0.977***
	(0.069)	(0.143)		(0.011)	(0.148)
Rangpur	0.229***	0.460***		-0.031**	0.387***
	(0.066)	(0.144)		(0.012)	(0.150)
Average Number of community activities participated by villagers				0.039***	
				(0.003)	
Constant		1.994*	2.643**	0.147*	2.443**
		(1.182)	(1.143)	(0.082)	(1.215)
Observations	3,843	3,843	3,843	3,843	3,843
R-squared		0.124	0.089		0.102
Log-likelihood	-7226				
Chi2	537.6				
Pseudo R2	0.0339				
Weak ID test stat (Kleibergen-Paap rk Wald F)					151.900
Anderson-Rubin Wald chi2 test, p value					0.453
Endogeneity test, p value H0: Exogenous					0.038
Number of community			318		

146

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 6.5 Ordered probit estimates of the life satisfaction model across different subsamples

Variables	(1) Poorest	(2) Richest	(3) Muslims	(4) Non-Muslims	(5) Integrated zone	(6) Non-integrated zone South	(7) Non-integrated zone North
Empowerment index	1.321***	1.338***	1.419***	1.430***	1.530***	1.102***	1.585***
	(0.143)	(0.145)	(0.075)	(0.224)	(0.104)	(0.123)	(0.154)
Female=1, otherwise 0	0.217***	0.199**	0.189***	0.279**	0.344***	0.052	0.084
	(0.075)	(0.085)	(0.042)	(0.120)	(0.058)	(0.076)	(0.080)
Log of Per capita monthly expenditures	0.199***	0.182***	0.192***	0.206**	0.215***	0.129**	0.174***
	(0.053)	(0.050)	(0.027)	(0.081)	(0.036)	(0.051)	(0.053)
Controls	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Observations	1,936	1,886	6,808	878	3,754	2,198	1,734
Log-likelihood	-3772	-3378	-12769	-1667	-6969	-4115	-3183
Chi2	1353	240.2	962.2	188.2	638.6	196.8	348.3
Pseudo R2	0.0334	0.0324	0.0352	0.0470	0.0449	0.0227	0.0543

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Table 6.6 Ordered probit estimates of the effect of domain-specific indicator on life satisfaction

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
					Dependent variable: Life satisfaction score					
Female=1, otherwise 0	0.171***	0.048	0.148***	0.119***	0.130***	0.036	-0.058	0.032	0.007	0.068
	(0.043)	(0.042)	(0.043)	(0.040)	(0.044)	(0.040)	(0.066)	(0.048)	(0.069)	(0.042)
(i1) Input in production decision=1, otherwise 0	0.218***									
	(0.042)									
i1*female	-0.178***									
	(0.053)									
(i2) Able to act on own values=1, otherwise 0		0.281***								
		(0.038)								
i2*female		-0.032								
		(0.052)								
(i3) Own asset=1, otherwise 0			0.292***							
			(0.098)							
i3*female			0.065							
			(0.103)							
(i4) Input in buy,sell,transfer of asset=1, otherwise 0				0.412***						
				(0.126)						
i4*female				0.107						
				(0.131)						
(i5) Input in borrowed money usage=1, otherwise 0					-0.024					
					(0.037)					
i5*female					-0.172***					
					(0.049)					
(i6) Input in decision on use of income=1, otherwise 0						0.372***				
						(0.051)				
i6*female						-0.030				
						(0.070)				
(i7) Member in a group=1, otherwise 0							0.159***			
							(0.053)			
i7*female							0.104			
							(0.065)			
(i8) Comfortable in public speaking=1, otherwise 0								0.012		
								(0.037)		
i8*female								0.025		
								(0.051)		
(i9) Works less than 10.5 hours in a day=1, otherwise 0									0.023	
									(0.053)	
i9*female									0.086	
									(0.069)	
(i10) Satisfied with leisure=1, otherwise 0										0.544***
										(0.038)
i10*female										0.030
										(0.051)
Controls	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Observations	7,686	7,686	7,686	7,686	7,686	7,686	7,686	7,686	7,686	7,686
Log-likelihood	-14577	-14593	-14631	-14618	-14647	-14598	-14651	-14657	-14653	-14470
Chi2	876.1	832.9	773.8	809.2	745.6	858.3	739	728.3	735.7	1081

Note: (1) The values in the parenthesis are robust standard errors (2) * significant at 10 percent, ** significant at 5 percent, *** significant at 1 percent

Chapter 7

Conclusion and policy implication

7.1 Summary of the study and conclusion

Despite its recent graduation to lower middle-income country status, the rural economy of Bangladesh remains predominantly agricultural. Agriculture is the most important sector in the country not only because it provides food to the hundreds of millions of the country's population but also because it provides employment to about 48 percent of the country's labour force. The national economy and the success of various development initiatives to combat poverty, hunger, and malnutrition therefore critically depend on the development of the agriculture sector as well as the people engaged in the sector. Of particular interest is the development of women, given their widely recognised role in agriculture alongside their culturally designated role of caregiving and food preparation for households.

It is common to see that rural women, especially in agricultural households, have little or no formal education, skills, technical know-how or control over productive assets. Patriarchal attitude and discriminatory social norms confine the sphere where women can operate and work within household and outside. Accordingly women are predominantly engaged in unpaid family work or low skilled wage employment and they also constitute about 78 of the country's economically inactive population (BBS, 2015). Women's low status relative to men within households is likely to affect the quality of the care that they provide for children and households, hence it is commonly believed that such low status of women is a leading cause of the higher incidence of child under-nutrition in the country. Apart from the higher incidence of child under-nutrition, about a quarter of the country's population is unable to meet the costs of maintaining basic needs, and there is a sharp rural dimension to the extent of poverty in Bangladesh (BBS, 2017). Therefore reducing child under-nutrition, food insecurity and hunger, and the pervasive gender inequality remains at the forefront of the country's national development agendas. In such a context, policy planners are keen on utilising women's potential to address those longstanding problems by raising their human capital and by engaging them in economic activities. Our purpose in this dissertation has been to provide evidence of the role that women's education and empowerment can play in achieving the country's core development goals.

Recognising the importance of utilising women's potential in the process of economic development, several pioneering policy measures were undertaken by the government of Bangladesh in the early 1990s mainly to increase the level of women's human capital. Notably policies such as food for education (FFE) and conditional cash transfer (CCT) programmes were implemented across the country to promote girls' enrolment in primary education, especially from poor households. Hence our study began in chapter 4 by exploring the impact of mothers' education on child health. We have considered three markers of child health: (i) a long-term nutritional status (height-for-age Z score), (ii) an overall nutritional indicator (weight-for-age Z score), and (iii) immunisation status—a common proxy for parents' health-seeking behaviour. Although various studies around the world have highlighted the positive association between mothers' education and child health indicators, there is doubt about the causality of this relationship. The concern is that mothers' education is likely to be associated with their unobserved innate attributes or their natal household's socioeconomic status or it may be even reflective of the community in which they live. While some studies have largely ignored the issue; others have reached varied conclusions after addressing such concern. Some researchers find a significant impact of mothers' education on child health; while others do not (explained in chapter 4). Apart from such inconclusive results, there is also a difficulty of how to deal with the issue because sophisticated econometric techniques are often infeasible if relevant data are absent. In this dissertation, we have tried to partially deal with the issue of potential endogeneity of mothers' education arising from omitted variable bias by means of controlling for as many characteristics of mothers as possible, given the availability of such information in the BIHS dataset. This approach helps us to consider the potential channels through which mothers' education might impact child health. We have considered seven potential pathways through which mother's education might have an impact: (i) mothers' engagement in income generating activities, (ii) mothers' autonomy in household expenditure decisions, (iii) exposure to media, (iv) access to healthcare information, (v) health knowledge, (vi) access to maternal health care, and (vii) dietary diversity. We have regressed the child health markers on mothers' education with controls for child, parents, household, and community level factors. The OLS regression estimates confirm that there is indeed a statistically significant and positive effect of mothers' education on child health markers, which is robust to potential confounders. In this way, our study finds evidence to suggest that mothers' education is a positive significant determinant of child health and that raising female education will indeed improve the nutritional status of children in rural Bangladesh. A plausible explanation of the positive effect is that education

provides mothers with knowledge and skill that eventually improve their choice and utilisation of health inputs. Also mothers' ability to comprehend health information, their attitude towards adopting good hygiene practice, and their choice of food for serving nutritious food in the household may be enhanced by education.

In the following two chapters (chapter 5 and 6), we shift our focus from education to more direct measures of women's capabilities i.e. empowerment. In chapter 5, we examine whether women's empowerment improves children's intake of calories and proteins—essential inputs of nutritional status. Rural women play an important role in agriculture in addition to their usual tasks of care and meal preparation. Hence their decision-making power within the household may be an important factor for the intra-household allocation of food. While carrying out the investigation, we had to deal with several issues. First, we had to deal with the issue of the measurement of women's empowerment because there is a lack of consensus about its implied meaning, let alone its measurement. Moreover, it is now established in the literature that empowerment is a multidimensional concept. The challenge posed for us was to find a measure that would effectively account for such multidimensionality, which we have effectively addressed by utilising a weighted multidimensional empowerment index. A particular advantage that we have been able to reap from the index is that it specifically measures the empowerment of women in agricultural households, and thereby fits well in the specific characteristics of our sample. This index takes into account whether the women have any input in decisions relating to agricultural production, in resource utilisation decisions, in controlling income, in group meetings, and in time management. The proposition that women tend to allocate resources in a way that would benefit household welfare suggests that if women in agricultural households are empowered then they would be able to exert a beneficial effect on the nutrition security of children and household food security in general. Our results confirm that there is a statistically significant and positive association between mothers' empowerment and children's intake of calories and protein. We then examined whether the effect of mothers' empowerment is different for other household members, and found that that mothers' empowerment is significant for the rest of the members' calorie intake as well. Our results also reveal that food allocation within the households is biased against children and female members. In particular, we find that it is young and adult daughters who are the most deprived group in respect of calorie intake, and generally female household members are getting significantly fewer calories than their male counterparts. The effect of mothers' empowerment is greater for sons' calorie intake as opposed to daughters'

calorie intake. We have also found that mothers' empowerment significantly improves households' dietary diversity, the lack of which is associated with the poor nutritional status of household members. Nevertheless, the relationship between mothers' empowerment and food security indicators has been challenged by the fact that mothers' empowerment does not necessarily capture any unobserved household norms that are likely to influence intra-household food allocation and household food preferences. Thus, our OLS estimates may have suffered from omitted variable bias which we have attempted to address by using the instrumental variables technique. We used information on the number of community activities a mother had participated in in the past 12 months as an instrument for the empowerment index. After correcting for potential endogeneity, we still find that the impact of mothers' empowerment is positive and significant.

Having found the evidence of a positive and statistically significant impact of mothers' education and empowerment on the objective indicators of development; chapter 6 looks into the relationship that empowerment may have with subjective well-being. Without gauging which direction the effect of empowerment would work in individuals' subjective well-being, strategies calling for empowerment-enhancing actions may be criticised on the ground that such strategies could bring additional burden and affect well-being. This may be especially true for the rural women of agricultural households who are already constrained in many respects. We used the life satisfaction score as a measure of subjective well-being, which was reported by household head and primary female member of the households surveyed in the BIHS. They ranked their satisfaction with life overall on a scale of 0 to 10. Our analysis was carried out specifically in the context of dual spouse led households. We regressed the life satisfaction score on empowerment along with controls for other correlates of life satisfaction. We estimated the model by both ordered probit regression and OLS, and the results showed that there is, in fact, a positive and statistically significant association between empowerment and life satisfaction. We have also found that women are significantly happier than men, which is striking because in the raw data we did not find any evidence of significant gender difference in life satisfaction. The higher life satisfaction among the rural Bangladeshi women may be attributed to the positive changes that took place in the country with regard to women over the past few decades. Policy interventions for women's human resource development and subsequently slowly expanding employment opportunities may have helped women to overcome the rigid social and cultural barriers to their pursuit of a life of their own interest. However, the estimated relationship between empowerment and life satisfaction has been

further challenged by the fact that it might be picking up the effect of unobservable relating to individual, household, community, religion, income class or regional factors. Although we have not been able to account for the bias stemming from unobservable personal characteristics; we managed to eliminate some biases caused by other factors through estimating the life satisfaction model with household and community fixed effects, and across subsamples based on gender, income class, religion, and region of economic integration. Across all of our models, we consistently find a positive and significant relationship between empowerment and life satisfaction. We further recognised that the relationship may suffer from reverse causation i.e. if a happy person proactively participates in household decision-making or vice-versa. We have addressed this concern by adopting the instrumental variables technique and the IV estimates confirm the significant and positive effect. Education seems to positively influence the life satisfaction of both men and women, but the magnitude of this effect is larger for women. We finally examined whether empowerment in certain domains is more important for life satisfaction. Our results indicate that the effect of empowerment on women's life satisfaction varies depending on domain: empowerment in some domains improves life satisfaction while it in other domains may, in fact, deteriorate women's life satisfaction. Empowerment in resource domain—whether owns assets or has a say in asset acquisition and dispense—is more important than empowerment in other domains for increasing women's life satisfaction. By contrast, if women are to take part in decisions relating to crop or enterprise selection or if they are to decide how to spend borrowed money, their subjective well-being actually declines perhaps because they find such decision-making burdensome. Alternatively, it may mean that women's subjective well-being would be higher if they could shift some decision-making responsibilities. This also underpins the fact that men and women differ in drawing satisfaction from empowerment.

In conclusion, our study has found a strong and positive impact of female education and empowerment on household and individual well-being indicators. Therefore eliminating gender inequality in human capital endowment can have a multiplier effect across development goals and may be an effective policy tool to reinforce economic well-being of the vast majority of the population, which in turn will certainly implicate the macroeconomic advancement of a country. To sum up, utilising women's potential can be crucial for a country's overall economic growth and development because women's enhanced capabilities are instrumental in achieving a wide range of objective development goals and are intrinsically important as well.

7.2 Policy implications

In Bangladesh, even though more women are becoming literate and participating in economic activities, concerns over ensuring gender equality remain because they still lack opportunities for realising their full potential, especially in rural areas. In such a context, our study may have some policy implications.

First, good health is a prerequisite for active and productive human resources; hence the widespread child under-nutrition in the country needs to be addressed. This may be effectively tackled by public policies that are intended to improve female education because education is likely to provide mothers' with knowledge and skills that are vital for appropriate childbearing practices and nutrition. Backed by the empirical findings, our study corroborates the evidence that mothers' education is a significant determinant of children's long-term and short-term nutritional status, and use of preventive care e.g. immunisation. If health equality among children is to be established, the country should remove all kinds of barriers to girls' education. Although the country has made important strides in eliminating gender inequality in primary school enrolment, much needs to be done for increasing educational attainment of women whose representation in tertiary education is inordinately low.

Second, in order that women can develop their human capital, they should be given opportunities for continuing education beyond the primary and secondary levels. Education provides the lifelong knowledge that helps to acquire necessary skills to escape poverty and pursue a better livelihood. Nevertheless a matter of obvious concern is that still a significant portion of girl dropout from the secondary or higher education, especially in the rural areas of Bangladesh. The continuation of schooling beyond primary level is especially crucial for girls because that may help in delaying marriage as well as motherhood. In rural Bangladesh, the greatest challenge towards girls' secondary education is perhaps early marriage which is strictly a violation of human rights. The State laws prohibit girls' marriage before 18 years; however, globally the country ranks fourth regarding the incidence of child marriage (UNICEF, 2015). Therefore a strict implementation of the early marriage prohibiting law needs to be in practice throughout the country to pave the ways for girls' accomplishment of higher education.

Third, to completely remove barriers to women's human capital development there needs to be a greater provision of employment for rural women. If women can work outside home and

earn income then they are more likely to receive recognition within household and in the society, and there may a positive change in the perception about girls and women. Parents may have incentive to investment in daughters' human capital development if they can see that women can earn and that girls are not liabilities. Since education and employment can improve women's position relative to men within household; efforts need to be in place to ensure that adequate provision of employment for women follows their educational attainment. Also a safe and non-violent working environment and adequate provision of child care centre may be required for increasing women's participation in economic activities.

Above all a strong commitment to removing barriers towards women's education, employment, and empowerment needs to come from all political, economic, social, religious, and cultural parties concerned. Such an environment will enable women to come forward to improve their human capital and to engage themselves in the mainstream economic activities; and thereby they can contribute to household welfare and to economic development of the country.

7.3 Limitations and scope for further research

Since our study is based on a cross-sectional dataset, we cannot be conclusive about the causality of the statistical relationships that have been found in this dissertation. Nonetheless our study and its findings may provide some useful insights for carrying out further in-depth research on the impact assessment of female education and empowerment. Our research will certainly be followed by several updated studies in the future, and we would like to present only a few thoughts about the probable areas of further inquiries in the following.

I. A good candidate for the extension of the inquiry into the impact of mothers' education on child health would be to examine whether or not the impact is causal. Such an exploration may be feasible in the case of Bangladesh if there becomes a dataset available that facilitates finding exogenous variation in mothers' education. This may help to estimate the child health regression by the instrumental variable method to account for potential endogeneity of mothers' education.

II. We have not accounted for in our study by how much women in different age groups need fewer calories and protein than their male counterparts in the same age. So our analysis can be redone if such a standardisation of calorie intake and protein intake is feasible by taking into account physical activity levels. The impact of women's

empowerment on the nutritional status of individual household members may also be analysed.

III. Whether or not empowerment leads to higher subjective well-being may not be adequately answered using a cross-sectional data as it does not allow capturing individual specific omitted personal characteristics. A further research on this can be undertaken by utilising the panel nature of the BIHS to account for unobserved personal characteristics. As the second wave of the BIHS became available towards the end of this research's study period, we were unable to utilise the panel nature of the BIHS in this dissertation due to time constraint.

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