Child stunting, resilience to health shocks, and maternal health-seeking behaviour: Empirical evidence from Bangladesh

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DECLARATION

i. This thesis is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the Preface and specified in the text.

ii. It is not substantially the same as any that I have submitted or is being concurrently submitted for a degree or diploma or other qualification at the University of Sheffield or any other University or similar institution except as declared in the preface and specified in the text.

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Mohammad Riaz Uddin

2024

ABSTRACT

This thesis aims to examine the factors associated with child and maternal health as well as health shocks and coping strategies. As such, it explores the issues of fish production and child malnutrition, health shocks and coping strategies, and the association of community clinics with women's healthcare-seeking behaviour for themselves and their children in terms of both illnesses and vaccination coverage- in each case using empirical evidence from Bangladesh.

In the first empirical chapter, I investigate whether household productive activities are associated with child health and nutrition. In particular, the first empirical chapter explores the association between household fish production and children's (under 5 years of age) height-for-age z-score (HAZ) as well as stunting. For the analysis, I use three rounds- 2011-12, 2015, and 2018-19- of the Bangladesh Integrated Household Survey (BIHS) panel dataset. After performing several robustness checks, I have found that children from fish-producing households have a higher height-for-age z-score (HAZ) and are less likely to be stunted compared to children from non-fish-producing households. This implies that households' self-production is beneficial to reducing child malnutrition.

The second empirical chapter examines the potential correlates of households facing health shocks and also the coping strategies that the households adopt to cope with the shocks. Using three rounds (2011-12, 2015, and 2018-19) of the BIHS panel dataset, I find that households, in general, are more likely to be affected by health shocks and are less likely to adopt coping strategies in 2018-19 as compared to 2011-12, which indicates a worsening of the situation. In addition, female-headed households are not more likely to be affected by health shocks than male-headed households. However, female-headed households are less likely to adopt coping strategies compared to male-headed households- arguably, this may be due to credit market imperfections and/or the fact that women are more prone to saving money in the process of preparing for unforeseen negative incidents.

The aim of the third chapter is to explore whether, and the extent to which, access to healthcare is associated with healthcare-seeking behaviour of women. Specifically, it explores the association of newly introduced community clinics (CCs) in Bangladesh- as primary healthcare providers mainly in remote areas- with reproductive-age women's healthcare-seeking behaviour for themselves and their children (under the age of 5). This chapter employs the latest three rounds of the Bangladesh Demographic and Health Survey (BDHS) 2011, 2014 and 2017-18. The descriptive statistics do not show any positive relationship between the availability of CCs in the locality and women's healthcare-seeking behaviour. However, regression results suggest that there are positive associations of CCs with women's contraceptive use, antenatal care visits, treatment seeking for children's diarrhoea, and treatment seeking for children's fever/cough. Moreover, I also find that rural women are less likely to seek treatments than urban women which indicates a rural-urban difference in healthcare availability, access, and utilization.

Keywords: Bangladesh, Community Clinics, Coping Strategies, Healthcare-seeking Behaviour, Health shocks, Fish production, Nutrition.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Abbreviations and Acronyms

2SLS- Two Stage Least Squares

BBS- Bangladesh Bureau of Statistics

BDHS- Bangladesh Demographic and Health Survey

BIHS- Bangladesh Integrated Household Survey

BMI- Body Mass Index

CC- Community Clinic

CDC- Centres for Disease Control and Prevention

CHC- Community Health Centre

CHCP- Community Healthcare Provider

CHPS- Community-based Health Services and Planning

CHU- Community Health Unit

DGHS- Directorate General of Health Services

DoF- Department of Fisheries

DSAP- Development of Sustainable Aquaculture Project

EA- Enumeration Area

EHFP- Enhanced Homestead Food Production

FE- Fixed Effects

FP- For-profit

GDP- Gross Domestic Product

GoB- Government of Bangladesh

HAZ- Height-for-age Z-score

HFA- Health for All

HIES- Household Income and Expenditure Survey

IFPRI- International Food Policy Research Institute

IV- Instrumental Variable

IVAI- Inadequate Vitamin-A Intake

LMIC- Low- and Middle-Income Country

LPM- Linear Probability Model

MPP- Mola Promotion Program

NFP- Not For-profit

NGO- Non-government Organization

NIPORT- National Institute of Population Research and Training

OLS- Ordinary Least Squares

ORS- Oral Rehydration Salts

PHC- Primary Health Centres

RCT- Randomized Control Trial

SD- Standard Deviation

SDG- Sustainable Development Goal

UHC- Universal Health Coverage

UHFWC- Union Health and Family Welfare Centres

UN- United Nations

UNDP- United Nations Development Programs

UNICEF- United Nations International Children's Emergency Fund

WAZ- Weight-for-age Z-score

WB- World Bank

WHO- World Health Organization

WHZ- Weight-for-height Z-score

CHAPTER 1: INTRODUCTION

1.1 Background and motivation

Maternal and child malnutrition have been two of the main public health issues and concerns for a long time, especially in low-income countries (Mamun & Mascie-Taylor, 2019). As such, child malnutrition is referred to as a 'triple burden[1]' across the globe, and one of the most acute adverse consequences that is created by malnutrition is stunting[2]. Significantly, stunting can hamper children's cognitive growth, learning in school and overall wellbeing and, in turn, has the potential to reduce overall economic growth and development. Globally, 144 million children under the age of 5 are stunted, and 91 percent of them are from low and middle-income countries (UNICEF, 2020). One of the most significant reasons behind malnutrition among children is poor diets, which may lead to deficiencies in vitamins and nutrients and, in turn, to a reduction in immunity and an increase in the risk of death from diseases (UNICEF, 2023). Accordingly, the United Nations (UN) Decade of Actions on Nutrition calls for the eradication of all types of malnutrition and especially prioritises reducing child malnutrition (UN, 2019).

Besides the problem of malnutrition, households from low- and middle-income countries (LMIC) frequently face negative shocks and uncertainties throughout their lifetime, and these negative phenomena often lead to these households falling into persistent poverty (Banerjee & Duflo, 2011). Among such negative shocks, the health shocks that come from either diseases or death have severe adverse implications for the affected households and also for the country as a whole (Alam & Mahal, 2014). Health shocks can make households destitute due to high out-of-pocket expenditures and other long-term effects, especially considering the fact that universal health coverage (UHC) is not available in many developing countries. Even if people do not seek medical treatment- hence perhaps avoiding the increment of immediate out-of-pocket expenditure- health shocks can still reduce individuals' productivity and potential to earn income, which in turn could

[1] Triple burden captures overnutrition (obesity), undernutrition (underweight), and malnutrition (hidden hunger) (UNICEF, 2020).

[2] Stunting is measured according to World Health Organisation (WHO) cut-offs, which is: height-for-age z-score (HAZ) <-2 SD of the WHO Child Growth Standards median.

lead to wider negative implications for economic growth and prosperity at the national level. Also, in times of economic crisis, households sometimes use children of school-going age- who are supposed to be in school- to generate additional income by sending them to work in the informal labour market. This also has negative consequences for both the formation of human capital as well as long-term household income and wealth (Duryea, Lam, & Levison, 2007). More importantly, health shocks have an adverse impact on the overall well-being of individuals who are affected (Mitra, Palmer, Mont, & Groce, 2016). Therefore, exploring the correlates of health shocks and also the coping strategies of health shock-affected individuals, across different countries and contexts is a necessary step in designing and implementing targeted social safety net programmes (Bonfrer & Gustafsson-Wright, 2017; Dercon, 2004).

Furthermore, due to the lack of UHC, formal health insurance and quality healthcare access- households from LMICs are less likely to seek treatment for illnesses. One of the reasons behind this is the high out-of-pocket healthcare expenditure in these countries as compared to developed countries where there is a formal insurance mechanism or UHC. For instance, the out-of-pocket healthcare expenditure in developing countries like Bangladesh, India, Pakistan, and China is respectively 74%, 51%, 55%, and 35% (in 2020). On the other hand, the out-of-pocket healthcare expenditure in developed countries such as UK, USA, and Germany is respectively 14%, 10%, and 13%. Therefore, higher healthcare expenditure can lead to individuals' reluctance to seek treatment for their illnesses, which in turn may create an adverse impact on individual productivity and growth as well as on the overall human capital formation of a country. One of the initiatives taken to deal with such issues is the Alma-Ata Declaration of 1978, which aimed to provide healthcare by introducing primary healthcare centres (PHC) in remote areas of LMICs (WHO, 1978).

Essentially, increasing the number of primary healthcare centres in an area may be particularly beneficial for women, especially for women of child-bearing age- explored in the final empirical chapter of this thesis- living in remote areas of low-income countries because these women often face persistent and recurring problems after childbirth. Around the world, a significant number of women experience various health concerns following childbirth. These include dyspareunia (35%), low back pain (32%), incontinence (19%), urinary depression (11-17%), perineal pain (11%), fear

of childbirth (tokophobia) (6-15%), and secondary infertility (11%) (Vogel, et al., 2023). Arguably, implementing primary healthcare interventions in LMICs has the potential to save 60 million people as well as increase life expectancy by around 4 years by 2030 (WHO, 2023). Adhering to this belief, Bangladesh- a densely populated lower-middle-income country situated in South Asia- is one of the countries that signed the Alma-Ata Declaration in 1978 and accordingly, the country introduced community clinics (CC) as PHC in 1998. Undoubtedly, examining the association of CCs with healthcare outcomes is crucial in the case of Bangladesh and other similar contexts.

With this background and considering these above-mentioned issues, this thesis aims to explore the factors associated with three aspects in the context of Bangladesh: (1) Children's nutritional status and whether fish production plays a role in the matter, (2) Health shocks and coping strategies, and (3) The impact of CCs on healthcare-seeking behaviour. In focusing on these issues, this thesis consists of three separate but interlinked papers, whereby the connecting thread is the focus on important aspects related to health outcomes, and overall development, in Bangladesh.

1.2 Country Context

Bangladesh is a relatively young country and gained independence in 1971. With a longstanding history of oppression from the times of British rule and as East Pakistan, the country struggled to provide food and nutritional security to its large populations after independence, and this struggle prolonged until after a few years of independence due to the lack of both resources and a stable political situation. Thus, Bangladesh was one of the poorest countries in the world at the time of its independence in 1971. Remarkably, the country has reduced extreme poverty from 34 percent to 13 percent between 2000 and 2016, increased life expectancy at birth from 50 years to 70 years between 1972 and 2023, and decreased fertility rates from 6.1 births to 2.1 births between 1971 to 2018 (World Bank, 2023). Additionally, it has been maintaining a good track record of GDP growth- the GDP growth has consistently been over 6 percent throughout the last two decades.
In terms of malnutrition statistics, child (under the age of 5) malnutrition has decreased over the last two decades as well. The stunting rate[3]- which is a good measure of child malnutrition as it

[3] Stunting, wasting, and underweight are each measured according to World Health Organisation (WHO) cut-offs. These are: Stunting - height-for-age <-2 SD of the WHO Child Growth Standards median; Wasting - weight-for-height

measures chronic illness- has declined from 51 percent in 2004 to 31 percent in 2017-18; the wasting rate has decreased from 15 percent in 2004 to 8 percent in 2017-18; and the percentage of underweight children below five years has declined from 43 percent in 2004 to 22 percent in 2017-18 (NIPORT, 2020). Furthermore, maternal mortality (per 100,000 live births) has declined from 441 to 172, infant mortality (per 1000 live births) has decreased from 63 to 27, and neonatal mortality (per 1000 live births) has decreased from 44 to 19 between 2000 and 2018 (World Bank, 2024). Therefore, it is reasonable to claim that Bangladesh has improved from its once-destitute position in terms of poverty and food security.

Yet, problems remain in the form of various socioeconomic issues, especially in the case of the healthcare sector and also in terms of nutrition especially in the case of children. For example, the rates of stunting and underweight in the country, despite the reduction over the years, are still in the high category as per the World Health Organization (WHO) cut-offs [4] (WHO, 2010). Additionally, healthcare service facilities in Bangladesh are not so good or developed or available compared to other developing countries, let alone developed countries. The following statistics provide a picture of the poor state of healthcare in Bangladesh- there were only 0.8 hospital beds per thousand people in 2016 as opposed to 1.7 in Bhutan in 2012 and 2.5 in the UK in 2019, and 0.6 registered physicians per thousand persons in 2019 as opposed to 0.9 in India and 5.8 in the UK in 2019 (The World Bank, 2022).

Solving these persisting healthcare and nutrition problems is important because it would not only improve the country's economic growth and overall development but would also positively contribute to individuals' overall well-being and quality of life. It is also vital that these problems are addressed as topmost priorities for the sake of reducing inequality. The Gini Index of inequality has increased in Bangladesh from 27.6 in 1991 to 32.4 in 2016 (World Bank, 2024). Also, in terms of equity, households with poor socioeconomic backgrounds in Bangladesh are more vulnerable

<-2 SD of the WHO Child Growth Standards median; and Underweight - weight-for-age <-2 standard deviations (SD) of the WHO Child Growth Standards median.

[4] The severity measures of a country's child malnutrition by type of malnutrition are as follows (WHO, 2016):
(1) Underweight: 0-9% is considered as low prevalence; 10-19% is medium; 20-29% is high; and over 30% is considered as very high prevalence;
(2) Stunting: 0-19% is considered as low; 20-29% is medium; 30-39% is high; and over 40% is considered as very high prevalence; and
(3) Wasting: 0-4% is considered as acceptable; 5-9% is poor; 10-14% is serious; and over 15% is considered as critical.

to health-related negative shocks because there is no UHC and there is high out-of-pocket healthcare expenditure. Strikingly, the out-of-pocket healthcare expenditure in the country is one of the highest in the world. In 2019, out-of-pocket payments accounted for about 72.6% of private health expenditure in Bangladesh, relative to 17.8% in Bhutan, 17% in the case of the UK, and 13% in the case of the USA (The World Bank, 2022).

Unquestionably, there is a need to conduct rigorous research on issues of healthcare and nutrition in the context of Bangladesh. This has merits not only for the health and well-being of the people of Bangladesh, but also has implications for the overall economy and development of the country, especially in terms of the health and agriculture sectors.

1.3 Thesis Contributions

In sum, this thesis aims to explore three overarching issues related to child malnutrition in rural fish-producing households, health shocks and coping strategies, and the healthcare-seeking behaviour of reproductive-aged women for themselves and their children in the context of CCs in Bangladesh. Each of the three empirical chapters of this thesis has distinct contributions. The contribution of the first empirical chapter is mainly twofold. First, this is the first study in the context of Bangladesh that explores the direct linkage between household fish production- with Bangladesh being one of the most fish-producing countries in the world- and child malnutrition. Second, it also contributes to the literature in terms of the empirical strategy used, because it discusses the association between fish production and child nutrition using a panel dataset which can provide less biased estimates as it can control for unobserved time-invariant heterogeneous factors. The second empirical chapter contributes to literature and policy by providing a detailed characterization of the households most vulnerable to health shocks, and the determinants of the coping strategies used by households in the face of health shocks. The evidence from this empirical work contributes to the debate around the provision of UHC in Bangladesh.

Finally, the third empirical chapter has two main contributions. Firstly, it uses the cluster-wise availability of CCs (the information is collected from the community survey instead of the household survey) as the main explanatory variable, and this is less endogenous than the variable

usually constructed from household surveys that target women- in which women are usually asked whether they know about CCs and whether they visit one in a reference period[5]. Secondly, it provides evidence of how a low-funded government-initiated healthcare provision can improve women's healthcare-seeking behaviour.

Overall, these three empirical chapters, combined together, provide important information in terms of how Bangladesh can achieve the SDGs. On a final note, there is also a gendered lens to the research conducted across the three empirical chapters of this thesis- while the third chapter focuses on the healthcare-seeking behaviour of women, the first two chapters reveal results that have important gender implications, and I highlight these in detail in the consequent empirical chapters. In sum, the first empirical chapter discusses the state of malnutrition across boys and girls, the second empirical chapter particularly highlights the health shocks and coping strategies of female-headed households, and the third empirical chapter deals with the healthcare-seeking behaviour of women.

1.4 Chapters Overview

Besides the introduction and conclusion chapters, this dissertation consists of three main empirical chapters. To reiterate, the three empirical chapters deal with three separate development issues relevant to child nutrition, health shocks, coping strategies, and primary healthcare providers in Bangladesh.

1.4.1 Overview of Chapter 2 (Fish production and child stunting)

Since Bangladesh is one of the highest fish-producing countries, and the stunting rate in the country is still high, I explore, in the first empirical chapter, how fish production may be a tool for reducing child stunting in the country. With this backdrop, the second chapter (empirical paper 1) explores the association between household fish production and children's heigh-for-age z-score (HAZ) and stunting in rural Bangladesh. To the best of my knowledge, this is the first paper in the context

[5] Enquiring about the availability of CC from women might be endogenous as it depends on factors that I cannot control for, such as the relationship of the women with CCs.

of Bangladesh that deals with the direct association between household fish production and child stunting using a panel dataset.

This chapter uses three rounds of the Bangladesh Integrated Household Survey (BIHS) longitudinal data from 2011-12, 2015, and 2018-19. In terms of estimation techniques, it employs two methods. Firstly, HAZ is used as the dependent variable, and both pooled Ordinary Least Square (OLS) and Fixed Effect (FE) models are employed in terms of the empirical approach. Secondly, stunting is used as the binary dependent variable, and pooled OLS/logit and FE Logit models are employed. Both methods are needed as OLS is the default method, and FE can provide less biased estimates by controlling for time-invariant unobservable heterogeneous factors.

In terms of results, the descriptive statistics suggest that the average fish consumption, calorie, protein and vitamin-B12 intake is significantly higher among fish-producing households as compared to non-fish-producing households. Correspondingly, fish-producing households are more likely to consume the recommended level of fish and more likely to intake the recommended level of calories, protein, iron, and vitamin B12. In addition, the children of fish-producing households have higher HAZ and are less stunted relative to children in non-fish-producing households. The regression results of the fixed effect (FE) models show that there is a negative association between household fish production and stunting only in the case of girls- between 10% to 11%.

The results from this chapter suggest that pursuing and encouraging the pursuit of fish production could be an effective tool in reducing child stunting across Bangladesh and other similar contexts. Therefore, policies such as encouraging fish farming, and homestead agricultural production, should be prioritised.

1.4.2 Overview of Chapter 3 (Health shocks and coping strategies)

Negative shocks are integral parts of many households living in low-income countries, and Bangladesh is no exception to this- countless households in the country face multiple negative shocks, both natural and otherwise, such as floods and health shocks. The third chapter (second

empirical paper) of this thesis, accordingly, explores the vulnerability of rural households to health shocks in Bangladesh. In particular, I examine which households are more likely to be affected by health shocks and how they cope with the negative financial shocks from bearing healthcare expenditure or death in households. This chapter is the first empirical evidence that explores both the determinants of health shocks and coping strategies in the context of Bangladesh using a panel dataset.

This chapter also uses the BIHS longitudinal survey data from 2011-12, 2015, and 2018-19. Employing the Linear Probability Model (LPM), logistic regression, and panel fixed effect regression to estimate the results. I find that vulnerable households such as households with female-headed heads are more likely to be associated with health shocks, and are less likely to adopt loan coping strategies in order to cope with health shocks. This might be an indication that either female household heads are more likely to save for unforeseen events or that they have fewer means of formal and informal financial support when it is needed. This chapter finds evidence that the latter case may be truer.

Therefore, maybe females should be more prioritised in the case of government social safety net programs, especially in terms of gaining access to the formal and informal credit markets so that they can develop better coping mechanisms against negative shocks in the future.

1.4.3 Overview of Chapter 4 (Community Clinics and healthcare-seeking behaviour)

The fourth chapter (third and final empirical paper) of this thesis focuses on estimating the association of newly introduced community clinics (CCs) as Primary Health Care (PHC) centres with healthcare-seeking behaviour in Bangladesh. The CCs were established in 1998 to provide healthcare at the doorsteps of remote households, especially for women and children. Due to a political regime change in 2001, the operation of CCs stopped between 2001 and 2008 and started again in 2009. Since CCs have been operating for a few years now, it is important to examine the impacts of CCs on healthcare outcomes. Thus, this chapter aims to explore the effects of these clinics on women's healthcare-seeking behaviour for themselves and their children, and polio vaccination coverage.

This chapter uses both the cluster-level information on the availability of healthcare providers along with the individual data from the Bangladesh Demographic and Health Survey (BDHS) 2011, 2014 and 2017-18 to estimate impacts as it would be less endogenous than using the individual level data alone. It also uses lagged health indicators to consider the factors of establishing CCs in a particular region. It uses both the Linear Probability Model (LPM) and Logistic regression (as robustness checks) to explore the impacts of CCs on health indicators.

According to the descriptive statistics of the chapter, there is no positive relationship between CCs and women's healthcare-seeking behaviour in most cases. However, regression results indicate that there are some positive associations of CCs with certain healthcare-seeking behaviours and vaccination coverage. For instance, women from the clusters with at least one CC are more likely to use contraceptives, do antenatal care visits, and seek treatments for children's recent diarrhoea and fever/cough. I also find that there are some rural-urban inequalities in the case of healthcare-seeking behaviour which might be due to the inequalities in healthcare access that exist between rural and urban areas.

With a view of decreasing the rural-urban healthcare divide in Bangladesh, policymakers can increase the establishment of CCs across Bangladesh. Also, CCs are a very good example of how a low-cost program can beneficially affect healthcare-seeking behaviour. Therefore, it can be scalable to other similar contexts.

1.5 Organization of the Thesis

The above-highlighted three chapters comprise the three main empirical papers of this thesis, respectively focusing on the association between household-level fish production and child nutritional status in the second chapter, the factors of health shocks and the ways households cope with those shocks in the third chapter, and the estimates of the associations of community clinics with women's healthcare-seeking behaviour for themselves and their children, as well as polio

vaccinations coverage, in the fourth chapter. The final chapter discusses the possible policy recommendations stemming from the results of the three empirical chapters and then concludes.

CHAPTER 2: DOES HOUSEHOLD FISH PRODUCTION REDUCE CHILD MALNUTRITION? EVIDENCE FROM RURAL BANGLADESH

2.1 Introduction

Child malnutrition is a major concern globally as it remains the primary cause of nearly half of all the deaths of children under the age of five worldwide, especially among poorer households in low-income countries (Frison, Kerac, Checchi, & Prudhon, 2016). Consequently, reducing child malnutrition has been- for a while- a major goal for the governments of low-income countries, especially due to the adverse impact of child malnutrition on human capital development, productivity, income, long-term health, economic growth, and development (Alderman, Hoddinott, & Kinsey, 2006; Shekar, Heaver, & Lee, 2005; Imai, Annim, Kulkarni, & Gaiha, 2014). This chapter aims to explore a particular potential mechanism, namely household fish production, in reducing child malnutrition, and I explore this in the context of Bangladesh - a South Asian lower-middle-income and developing country. In measuring child malnutrition, I use anthropometrics such as height-for-age z-score (HAZ) and a stunting categorical variable as the outcome variables, because, one, HAZ is now widely considered the single most important indicator of child nutrition, and two, reducing the rate of stunting is referred to as the standard metric of nutritional success for prescribing and achieving global goals (Headey, Hoddinott, Ali, Tesfaye, & Dereje, 2015; UNICEF, 2013).

Bangladesh has made substantial progress over the last two decades in many aspects. For instance, the country has maintained a steady economic growth rate of over 6%, has improved food security in terms of providing food to its large population, and has reduced both child and maternal malnutrition. However, a large number of children and adults remain malnourished (Belton, van Asseldonk, & Thilsted, 2014; Rahman & Salim, 2013). According to the latest Bangladesh Demographic and Health Survey (BDHS), the level of stunting among children below five years has declined from 51 percent in 2004 to 31 percent in 2017-18; wasting has decreased from 15 percent in 2004 to 8 percent in 2017-18; and the percentage of underweight children below five years has declined from 43 percent in 2004 to 22 percent in 2017-18.

Arguably, the progress in Bangladesh so far has been driven not solely by GDP growth but also by a concerted policy effort. For instance, Bangladesh developed policies targeting family planning in the 1980s and started large-scale campaigns for birth control which, in turn, may have played an important role in decreasing fertility and increasing immunization. Another key policy was the introduction, in the 1990s, of the secondary school stipend program for female students, which was, in essence, a conditional cash transfer - the first of its kind in the world- that led to higher enrolments of girls in education (The World Bank, 2016). Additionally, as a result of different policies, infant and maternal mortality also decreased, demographic transitions advanced, and access to clean water and sanitation increased (The World Bank, 2016).

Despite such improvements and development on multiple fronts, the prevalence of stunting and underweight in Bangladesh is still high as per the World Health Organization (WHO) cut-offs[6] (WHO, 2010). Thus, child malnutrition remains a concern for Bangladesh. In this chapter, I contend that to decrease malnutrition further- fish production may have an important role to play, especially in the context of an agriculture-dependent nation such as Bangladesh. Consider, for example, that fisheries in Bangladesh have experienced a steady growth of over 5% in the last 12 years (Department of Fisheries Bangladesh, DoF, 2018) and also that more than one-fourth of the contribution to agricultural GDP in Bangladesh comes from fisheries. In addition, Bangladesh is one of the highest fish-producing countries in the world - it ranks 3rd in terms of inland open-water fish production and 5th in terms of aquaculture production (Department of Fisheries Bangladesh, DoF, 2018). Further, Bangladesh has the highest per capita consumption of fish-based animal protein in the world, where almost 60% of animal protein comes from fish consumption (World Bank, 2016). Thus, aquaculture interventions may have an important role to play- in multiple ways- in the context of Bangladesh, including the role of protecting species that are facing extinction and the role of protecting the environment against rapid urbanization and climate change, especially since almost one-third of the inland fish species in Bangladesh are facing the threat of extinction (World Bank, 2016).

[6] The severity measures of a country's child malnutrition by type of malnutrition are as follows (WHO, 2016):
(1) Underweight: 0-9% is considered as low prevalence; 10-19% is medium; 20-29% is high; and over 30% is considered as very high prevalence;
(2) Stunting: 0-19% is considered as low; 20-29% is medium; 30-39% is high; and over 40% is considered as very high prevalence; and
(3) Wasting: 0-4% is considered as acceptable; 5-9% is poor; 10-14% is serious; and over 15% is considered as critical.

Moreover, and of specific interest to this research, both the Government of Bangladesh (GoB) and other non-government organizations, including World Fish Bangladesh, have implemented several fish production promotion programs over the years to improve the quality and quantity of fish production, as well as the livelihoods of fish farmers, such as community-based fisheries management, the establishment of *beel* nurseries, stocking of fingerlings[7] and other endangered species, introducing the production of small fish along with large fish etc. (Department of Fisheries (DoF), Bangladesh, 2017). Some benefits from the fish production promotion programs, which originally aimed to improve the livelihood of farmers, may also have, in turn, improved child nutritional status. For instance, households benefitting from these fish promotion programs, through an increase in productivity and income, may have consequently experienced an increase in nutrient intake among household members, which ultimately may also have led to better child nutrition.

This study plays an important role in providing evidence on whether or not aquaculture improves a child's nutritional status, and also strengthens the argument in favour of protecting, promoting and incentivizing aquaculture in Bangladesh. In such an agriculture-dependent context as Bangladesh, fish production could play multiple roles in addressing child malnutrition. First, fish production could directly influence household consumption by providing micronutrients and protein. Indeed, consumption from households' self-production of crops, poultry, livestock and fish is considered the most important source of food and nutritional security in rural areas (Haddad, 2000; Hawkes & Ruel, 2006). Second, fish production could indirectly influence households by creating an opportunity to increase income by selling the produced fish in the market. This could increase the household's purchasing power which, in turn, would facilitate the purchase and consumption of more diversified and micro-nutrient-enriched food. Lastly, fish production could also indirectly lead to an increased ability to spend more on commodities other than food, such as health care.

This paper uses three rounds of the Bangladesh Integrated Household Survey (BIHS)- a panel dataset- to examine the relationship between fish production and households' nutrient intake (such

[7] Fish fingerlings are baby fish when they are the size of a finger and this is the optimal size to release them into ponds or other designated water bodies to grow.

as calories, protein, iron, zinc, vitamin-B12, etc.), and anthropometric measures of children below five years of age. As such, the specific research question I ask is: Does fish production, at the household level, translate into better child nutritional status (as measured by height-for-age z-score and stunting)?

The rest of the chapter is structured as follows. In the following section, I discuss the relevant literature linking household fish production, income, dietary intake, and child nutrition. I then present the empirical approach and data before presenting the results of the descriptive analysis and the regression analysis. In the final section, I conclude by discussing the contributions and future scope of this research.

2.2 Literature Review

Fish is the most important source of animal protein among poor households in least developed and developing countries (Kawarazuka & Béné, 2011). However, there remains a lack of rigorous empirical evidence linking household fish production with food security and nutrition. Nonetheless, the limited number of studies conducted on the topic can be divided into three main strands: first, studies linking fish production to dietary intake at the household level; second, studies linking fish production and income; and third, studies linking fish production to child nutrition specifically.

2.2.1 Fish production and dietary intake

Several studies discuss how fish production can contribute to the better dietary intake of household members. For instance, employing a clustered randomized control trial, Verbowski et al. (2017) find a positive impact of aquaculture on the nutrient intake of women among 900 households from 10 villages in Cambodia. The study identified two treatment groups- households that are involved in the Enhanced Homestead Food Production (EHFP) program and households that are involved in EHFP and aquaculture. In terms of intervention, farmers were given basic agricultural inputs, training, and hygiene and nutrition education. On the other hand, control group households were those that were not involved in either the EHFP or aquaculture. The study shows that women from both EHFP and EHFP plus aquaculture households consume higher iron, vitamin-A, and riboflavin

as compared to women from the control group households. However, there are no significant differences in outcomes between the EHFP and EHFP plus aquaculture households, and also no significant impact on the intake of children across the treatment and control groups. This might mean that children were prioritized anyway across the treatment and control households. One point to note is that the study focuses only on a poverty-stricken region, and it very well may be the case that results would vary across regions, especially across regions with different levels of poverty.

In the context of Bangladesh, Karim et al. (2017) conducted a study in four districts of the Barisal Division in southern Bangladesh to evaluate the effect of Mola adoption with Carp[8] production on household fish consumption. As part of the project intervention, treatment farmers were provided inputs for Mola fish production as well as technical training on Carp-Mola polyculture. However, both control farmers (Carp polyculture) and treatment farmers (Carp-Mola polyculture) were given technical training on Carp polyculture and were provided with general nutrition knowledge and specific knowledge on the nutritional benefits of Mola fish. One year after the training, 344 Carp-Mola polyculture and 513 Carp polyculture households were randomly selected and surveyed. The study finds that both Mola fish production and obtaining knowledge on the benefits of consuming Mola fish have significantly increased fish consumption among the Mola adopter households. However, there is room to extend the scope of this study since it is based only in one region of Bangladesh and not the country as a whole. Moreover, the study is based only on descriptive statistics and does not control for several important individual and household characteristics.

Concerning the production of Mola fish, Fiedler et al. (2016) also conducted an impact evaluation of a fish production program called the 'Mola Promotion Program (MPP)'. Under the program, fish-producing households from seven divisions [9] of Bangladesh received training from agricultural extension agents on producing and consuming Mola fish. In the end, 30% of the households adopted the production of Mola fish alongside producing other types of fish. The study conducted a survey after the MPP and compared the results with national estimates- obtained

[8] Mola is a type of small fish that is very rich in micronutrients. On the other hand, Carp is a large fish and contains less micronutrients relative to Mola.

[9] Bangladesh had seven divisions at the time: Dhaka, Chittagong, Sylhet, Barisal, Khulna, Rajshahi, and Mymensingh. Dhaka had 13 districts, Chittagong had 11 districts, Barisal had 6 districts, Khulna had 10 districts, Rajshahi had 16 districts, Sylhet had 4 districts, and Mymensingh had 4 districts.

before the program- from the Household Income and Expenditure Survey (HIES). A random selection of 10,080 households (both from rural and urban areas) were interviewed to examine the outcome of the program. The study finds that the MPP increased vitamin-A intake, decreasing the prevalence of inadequate vitamin-A intake (IVAI) among the participating households.

2.2.2 Fish production and income

The second strand of studies analyzes the relationship between fish production and both dietary intake and income. One such study that highlights the impact of aquaculture on income and dietary intake was conducted by Jahan et al. (2010). In the study, the authors evaluate the 'Development of Sustainable Aquaculture Project (DSAP)'[10]. A total of 225 DSAP farmers and 123 control group farmers from four districts in four different divisions across Bangladesh (Mymensingh, Comilla, Magura, and Bogra districts) were surveyed both in the baseline and endline phases of the project. The control group farmers were selected from areas where no aquaculture development project had been implemented in the past. Based on results obtained from t-tests, the study finds that DSAP farmers have significantly higher income and consumption as compared to control group farmers. The main limitation of this study is that the control group farmers were selected only based on household size, farm size, and pond size, whereas there may be several other factors that could impact fish consumption and income, especially during the project implementation period, e.g., factors such as wealth, other programs which could impact fish production or income, and negative shocks from natural disasters.

In terms of research on the topic in the context of Bangladesh, there is an impact evaluation study conducted in the seasonal floodplain of Bangladesh that discusses the effect of community-based fish culture on food security and income of the communities in the project sites (Haque & Dey, 2017). Six floodplains from three districts were selected for the project. For each project site, there were control group sites that were similar to the project sites in terms of socio-economic characteristics and in terms of whether the site was a similar agroecological zone. There were three

[10] DSAP was undertaken by World Fish Bangladesh between June 2000 and July 2005. It was implemented in 42 districts out of 64 districts. Under this project, farmers- who are husband and wife- are given trainings for several years on low-cost pond management.

inventions under the project: (i) construction of enclosures for fish culture in the flood season, (ii) stocking of fish fingerling, and (iii) community-based fish culture in the rainy season. A total of 180 households from the project sites and 180 households from the control sites were surveyed quarterly, seasonally (six-month), and monthly for a total period of three years to generate panel data. The income and expenditure data were collected quarterly; the crop production and input use data were collected at six-month intervals; and the fish consumption data were collected every month. Using a random effect model and controlling for other household characteristics (age and education of head, religion, family size, pond area etc.), the study finds that the project households have significantly higher income and fish consumption as compared to control households, implying that involvement in community fish culture has a positive impact on both dietary intake and income. This study also only focused on a small region where fish production already contributes a lot to the livelihood of people due to being close to big rivers such as the Brahmaputra, Padma, and Teesta.

Then, the study by Belton et al. (2012)- another study from Bangladesh- is based on intensive qualitative interviews and participatory appraisal (PRA) exercises in two villages from two sub-districts in Bangladesh. In this study, higher or better consumption is measured based on whether or not any meal is skipped in a day. The study finds that aquaculture is related with higher income and consumption. However, the findings of this study may be influenced by the household's pre-existing socio-economic conditions such as the household's wealth and access to market. Moreover, the indicator that the authors used is limited because it cannot measure the quality of a meal.

Lastly, the most recent study on the linkage between fish production and household income and consumption in the context of Bangladesh is the study by Ahmed and Waibel (2019). Using two-stage least squares (2SLS) estimation, and data from 518 households (involved in homestead pond aquaculture) in Bangladesh, this study finds that aquaculture has a significant and positive impact on household income, food expenditure, calorie consumption, food consumption score, and dietary diversity. In the study, the value of fishing capital and the number of fisheries officers per household at the district level are used as instruments for aquaculture production. Although the study is based on an in-depth household survey, the evidence lacks generalization as the data is

only collected from six districts of Bangladesh, and only fish-producing households are part of the study. Moreover, the selected districts are different aquaculture concentrated zones in Bangladesh. Therefore, neither the districts nor the households are representative of all types of regions or households.

2.2.3 Fish production and child nutrition

The third strand of studies explores the direct relationship between household fish production and child nutritional status. The only study in this stream of research is an impact evaluation study for an aquaculture project in Cambodia (Michaux, et al., 2019). A total of 552 women (18-45 years of age) and 754 children (6-59 months of age) from ninety clusters are surveyed both in the baseline and endline phases of the project. There are three groups defined by the interventions, two are treatment groups and one is a control group. The treatment households are those that participate in the EHFP program as well as the households that participate in both the EHFP program and in the aquaculture program. The treatment households are given basic agricultural inputs, training, and hygiene and nutrition education. The study uses difference-in-differences estimation and shows that aquaculture households observe higher retinol-binding protein concentration in women and lower anaemia prevalence in children. However, involvement in aquaculture does not show any significant improvement in children's HAZ, weight-for-age z-score (WAZ), weight-for-height z-score (WHZ).

In essence, most of the literature exploring the relationship among fish production, fish consumption, income, food security and nutrition are impact evaluation studies of fish production programs. In addition, the direct linkage between fish production and child nutrition has been explored only in one study which does not find any significant impact of fish production on child anthropometrics. There is also a study (Ahmed & Waibel, 2019) that uses an instrumental variable (IV) approach to establish a causal link among fish production, income, and household level nutrient intake, but it is based on only one region within a country and thus, there is scope to expand the study to a wider national level. With these insights from existing literature, the study at hand aims to complement this particular topic of research in two ways. Firstly, it aims to provide evidence of a direct linkage between fish production and child nutrition in the context of

Bangladesh. Secondly, the study aims to explore the linkage using nationally representative data and panel data estimation techniques, which have not been used in any study yet. In particular, the panel fixed effects method provides estimates that allow controlling for unobserved individual-level time-invariant factors. As a result, it gives less biased estimates compared to Ordinary Least Squares (OLS) estimates.

2.3 Data and methodology

2.3.1 Data

The Bangladesh Integrated Household Survey (BIHS) data is used in this study. It is a three-round longitudinal survey conducted by the International Food Policy Research Institute (IFPRI) in 2011-12, 2015 and 2018-19. This BIHS survey data is statistically representative of the following levels:

i. Nationally representative of rural Bangladesh
ii. Representative of the rural areas of each of the seven divisions in Bangladesh

The BIHS is the only nationally representative panel survey in Bangladesh that captures detailed information on (1) plot-level agricultural production and practices, (2) consumption of household members, and (3) anthropometric measurements (height and weight) of all household members. There is also a community survey as a supplement to the BIHS data to provide information on area-specific contextual factors. It covers 6500 households in 325 primary sampling units. However, the nationally representative sample households and farm households[11] are respectively 4423 and 2202 in 2011-12, 4619 and 2200 in 2015, 4886 and 2358 in 2018-19.

The analysis sample for this study consists of children under the age of five in all the three rounds of BIHS data- once a child enters the analytical sample, he/she is retained in the sample even if in the subsequent rounds he/she is above the age of five. Thus, there are children above the age of 5 in the sample, as long as they were under five when they first entered the sample. In Table 2.1, the

[11] Farm households are those which use land for any cultivation such as the cultivation of paddy, vegetables, spices, fruits etc. regardless of whether they own the land or not.

number of children from farm households for whom anthropometrics data is available in the BIHS dataset is shown. There are anthropometric data of 951 children from 807 farm households in 2011-12, 1442 children from 920 farm households in 2015, and 2131 children from 1126 farm households in 2018-19. Furthermore, 627 common children from 429 farm households between the 2011-12 and 2015 surveys, 968 common children from 513 farm households between the 2015 and 2018-19 surveys, and 465 common children from 275 farms households of all the three surveys of BIHS.

2.3.2 Estimation strategy

In this study, the relationship between fish production and child nutrition is measured in two ways. Firstly, HAZ is used as the dependent variable, and both pooled Ordinary Least Square (OLS) estimation and fixed effect (FE) models are used as estimation techniques. Secondly, stunting is used as the binary dependent variable, and pooled logit and FE logit models are employed as estimation techniques. Stunting is defined at the standard cut-offs (below 2SD of the median for the reference population[12]) for moderately malnourished children; hence the binary indicator for stunting is defined as taking value 1 if the HAZ of the child is below -2 SD. The HAZ and stunting are relative measures as they are calculated compared to the WHO 2006 reference population. These measures have both strengths and weaknesses. The main strength is that they can capture the past and long-term measurement of nutrition, and the main weakness is that they cannot differentiate between past and continuing chronic malnutrition (Corsi, Subramanyam, & Subramanian, 2011). However, they can indicate longitudinal growth and nutritional status, and cumulative nutrition deficiency of children. Further, the continuous (HAZ) and binary (stunting) indicators each have advantages and disadvantages. The advantage of using the continuous variable is that it captures the actual growth of children (z-scores), and the disadvantage is that it cannot directly show whether it meets a certain threshold or not (e.g. whether a children is malnourished or not). The HAZ measures the z-score of children at a time and allows one to assess whether the measure has increased or decreased compared to other times. On the other hand, the advantage of using the binary indicator is that it captures whether the growth meets the threshold (e.g. -2SD) or not, and the disadvantage of using the binary indicator is that it cannot capture the

[12] Reference population is the WHO 2006 reference population.

actual growth of children. For example, if there are two children who have both obtained same z-scores in a certain period of time and one child meets the threshold but the other child does not, positive change is only considered for the first child when the binary indicator is used.

The reason why the fish production variable- the main variable of interest- could be endogenous is largely due to omitted variables. These omitted variables (time invariant or time variant) can be of two kinds. First, omitted variables, could include farmer's knowledge and skills about fishing, and ideally, this data would have been included in the analysis if the data were available. Unfortunately, since there is a lack of data even though fish production most likely depends on farmer's knowledge- the estimated coefficient on fish production will be biased. Second, there could be other variables (unobserved) that impact both fish production and children's health, which I was not able to control for due to the lack of availability of data. An example of such time variant factors could be weather and price shocks. These unobservable factors could be correlated with the outcomes of interest. In this case, the estimated coefficient would be biased (underestimated/overestimated). Some of this bias- which is from time-invariant unobservable factors- could be accounted for by using the FE model. Therefore, the following models are used in this study:

Model 1: $$H_{it} = \alpha_0 + \alpha_1 F_{it} + \alpha_2 X_{it} + t + \varepsilon_{it} \quad (1)$$

Model 2: $$Pr(N_{it} = 1 | X_{it}, F_{it}) = \delta_0 + \delta_1 F_{it} + \delta_2 X_{it} + t + \mu_{it} \quad (2)$$

Here, H_{it} is the HAZ of child i at time t; F_{it} is the dummy variable taking value 1 if child i at time t is from a fish-producing household, and 0 otherwise. I also consider an alternative measure where F_{it} is a continuous variable of the quantity of fish produced by the household (with the variable taking value 0 for non-fish producing households, and which assumes that fish-producing households always have a positive quantity of fish produced). Finally, X_{it} is the vector of observable child and household characteristics at time t; N_{it} is the dummy variable for whether child i is stunted or not at time t; and ε_{it} and u_{it} are the random error terms for child i at time t.

2.3.3 Variables of interest

The main variable of interest is the household fish production dummy variable. The variable 'fish production' is not generated from the occupation question. It is generated from a household module where respondents are asked about whether their household is involved with fish farming or not in a reference period. If a household produces fish within the last year, it is defined as a fish-producing household. The respondents are given a list of fish (the respondents are also allowed to include fish type if it is not already included in the list) and asked whether they farmed the fish in the last year and the follow up questions include the quantity of fish they farmed, the value of fish etc. Essentially, a fish farming household is defined as a household that produces at least one type of fish in the last one year. A household can be both fish-producing and farming other things on their land. In addition, the household's quantity of fish production- a continuous variable- is also used in some models along with the fish production dummies. A set of households', child's, mothers', household heads', and regional characteristics are used in this study in addition to the main explanatory variable(s).

The household fish production decision is constrained by the absence of a few important aspects which are necessary in the case of entering fish farming. For example, initial investment (e.g. ownership of a pond or water plots, and fishing nets) and necessary skills (e.g. knowledge of how to do fishing and how to feed the fish, and what type of fish should be farmed in a particular water plot) are some aspects that are necessary to begin fish farming. On the other hand, fishing households may sometimes be forced to exit fish farming due to several reasons such as losing working household members (may be due to migration, marriage or death) and water plots, and when they think that fish farming is no longer profitable for them.

The control variables that I incorporate are those used in previous literature and are predictors of child nutritional status in Bangladesh so that less biased estimates of fish production can be estimated. The control variables and the corresponding studies that use these controls are given as follows: child's age, household's livestock activities, whether a household is poor or not, land size, number of children below 5, number of elderly household members (Lovo & Veronesi, 2019), household size, education of the household head (Chegere & Stage, 2020), gender of the child,

mother's education, regional characteristics (Shively & Sununtnasuk, 2015) such as district, rich district dummy, and high fish-producing district, household head's age (Kumar, Harris, & Rawat, 2015), mother's BMI, household's wealth (Prasad, Pezhhan, & Patil, 2021), and mother's age (Wemakor, Garti, Azongo, Garti, & Atosona, 2018). Among these variables, household expenditure is calculated by summing the value of food consumption (7-day recall), non-food expenditure (monthly recall), and house rent/imputed house rent. The wealth index is calculated using principal component analysis and considers both household agricultural and non-agricultural assets[13].

The summary statistics of the main explanatory variables and other covariates are given by year in Table 2.2. The dependent variable 'HAZ' shows an increase, whereas the other dependent variable 'stunting' shows a decrease between 2011-12 and 2018-19. In addition, the main variables of interest- fish production and the number of fish types produced- also indicate a positive change between the first round of the survey and the third round of the survey. Also, mothers' BMI, household electricity connection, number of working age members in households, household size, and per capita household expenditure have increased between 2011-12 and 2018-19.

2.4 Descriptive statistics

This section highlights and discusses some descriptive statistics to provide an overview of fish production, fish consumption, nutrient intake, and child nutrition in the context of rural Bangladesh. In some cases, I use household-level characteristics to infer about child's status in terms of fish consumption and nutrient intake. The reason behind this is that the survey used in this study does not include detailed consumption information for children which would have been ideal to analyse. Nonetheless, the household-level per capita adult equivalent consumption may be a good indicator of child consumption as well.

[13] A long list of agricultural and non-agricultural assets of the households are considered such as trunk, stove, table/chair, radio, television, cow, hammer, electric fan, electric iron, bed, camera, jewellery, van, motorcycle, fishing net, axe, shovel, goat/sheep, etc.

Tables A1 and A2, in Appendix A, present the distribution (in percentage) of the fish produced and consumed by farm households in a given time period by type of fish. Evidently, in terms of the highest produced fish type, there has not been much change between 2011-12 and 2018-19 (Table A1). One striking change is that two particular types of fish- Shingi and Mola/Dhela/Kachki/Chapila- are among the ten highest produced fish in 2018-19 whereas these fish types were not among the ten highest produced fish in 2011-12. Out of these two types of fish, Mola/Dhela/Kachki/Chapila is a variety of small, micronutrient-rich fish. Similarly, there is not much change over time in the most consumed fish types (Table A2). Dried small fish is consistently the most consumed fish in each of the three years, whereby consumption is slightly higher in 2018-19 compared to 2015 and 2011-12. However, fresh small fish which was among the ten most consumed fish in 2011-12 did not make it into the 'top ten' list in 2015 and 2018-19.

Figure 2.1, Figure 2.2, and Figure 2.3 respectively show the distribution of households according to how many types of fish are produced (in the last year), how many types of fish are consumed (last 7 days), and the quantity of fish (in kg) produced in a given year separately for the three rounds of the survey. It is evident from Figure 2.1 that the number of fish types produced by households varies between 0 and 17 but most of the fish-producing households produce only one type of fish. Moreover, the proportion of households producing less than or equal to 10 kg of fish decreased between 2011-12 and 2015 but increased afterwards with the 2018-19 proportions being higher than that of 2011-12 (Figure 2.3). More than 70% of the households consume a minimum of two types of fish per 7-day period in all the three survey rounds. Finally, it is evident from Figure 2.4 that there is no particular pattern between a household's fish production and consumption. Thus, household fish production does not necessarily increase household fish consumption[14].

Furthermore, the descriptive statistics indicate that the availability of fish, through own fish production, does not lead to increased fish consumption in households. This implies that whether a household is involved with fish production or not does not matter much in terms of fish consumption. I next explore whether there are any significant regional variations in fish

[14] It is not surprising as fish is a staple part of the diet in Bangladesh. The people mainly eat rice and fish in an ideal regular meal.

consumption among households across high and low fish-producing regions, and across rich and poor regions. The reason behind this is that it is important to explore how income or purchasing power and the availability of fish in a region each influence the likelihood of higher fish consumption among households. The regional differences across Bangladesh in terms of fish consumption and nutrient intake are given in Tables A3 and A4.

In the survey, consumption of food is reported as a list of food items consumed by a household in the 7 days before the survey and includes both the quantity and value of consumption (in Bangladeshi taka). From these lists and using the quantity of consumption, I calculate the value of nutrients (calories, protein, iron, zinc, vitamin-A, and vitamin-B12) based on a reference conversion file collected from the International Food Policy Research Institute (IFPRI). All these values are then converted to adult equivalent per capita terms for comparison. The four divisions in the top panel produce the most fish[15] (Table A3) or have the lowest poverty rates[16] (Table A4), and the four divisions in the lower panel produce lesser amounts of fish (Table A3) or have higher poverty rates (Table A4). There is no clear distinction between these two types of divisions; for example, divisions like Dhaka are high fish-producing regions and have low poverty rates, whereas Sylhet is both low fish-producing and has a low poverty rate. However, high fish-producing divisions and low poverty rate divisions, on average, consume more fish, and intake more calories, protein, zinc, vitamin-A, and vitamin-B12. The exceptions are the Sylhet, Khulna and Mymensingh divisions, whereby Sylhet produces less fish but consumes more fish and nutrients, whereas the other two divisions have higher poverty but consume more fish and nutrients. The reason behind this is that these divisions are either rich or produce more fish than other divisions.

To explore this further, households in my sample are divided into high and low fish-producing districts, and high and low poverty districts[17]. Table A5 shows that the households from high fish-producing districts consume significantly more fish, protein, iron, zinc, vitamin-A and vitamin-B12 compared to low fish-producing districts. On the other hand, households from low-poverty

[15] The fish production data are taken from the Fisheries Statistical Yearbook (2011-12, 2014-15 and 2018-19).
[16] The division-wise poverty rates are taken from the Household Income and Expenditure Survey (HIES) 2010 and 2016 conducted by the Bangladesh Bureau of Statistics.
[17] In this case, high fish-producing districts are those which produce above the median fish production level and vice versa. On the other hand, low poverty districts are those which have a poverty rate lower than or equal to 15% and high poverty districts are those which have a poverty rate higher than 15%.

districts consume significantly more fish, vitamin-A and vitamin-B12 as compared to high-poverty districts. Therefore, household dietary intake is better if the households are either in high fish-producing districts, where fish availability is higher, or in low-poverty districts, where the households have higher purchasing power.

To disaggregate further by focusing on the household level rather than on regional fish production or poverty rates, I compare the average consumption of nutrients (adult equivalent per day) between households involved in fish production and households not involved in fish production (Table 2.4), and also between rich and poor households[18] (Table 2.5). Before exploring this, the proportion of rich and poor households according to the fishing status is shown in Table 2.3, and it is observed that the proportion of rich and poor across fish-producing and fish non-producing households are almost the same. It is observed that households involved in fish production consume a significantly higher quantity of fish, and have higher calories, protein, and vitamin-B12 intake (Table 2.4). In particular, fish-producing households consume, on average, 9.5 grams more fish, 74.6 kcal more energy, 1.6 grams more protein, and 0.1 micrograms more vitamin-B12 than households that do not produce fish. Additionally, poor households consume, on average, 50.4 grams less fish, 512 kcal less energy, 19 grams less protein, 3.8 mg less iron, 2.3 mg less zinc 93 RAE less vitamin-A, and 0.75 micrograms less vitamin-B12 than rich households (Table 2.5).

Since the households involved in fish production consume more or equal amounts of fish and nutrients as compared to the households not involved in fish production, it might be the case that fish-producing households are more likely to be fulfilling the recommended level of fish and nutrient intake. As such, Table 2.6 shows the percentage of the households that meet the recommended level of nutrient intake per day disaggregated across fish-producing and fish-non-producing households. The percentage of fish-producing households that consume the recommended levels of fish, energy, protein, iron, zinc, Vitamin-A, and vitamin-B12 are respectively 60%, 87%, 80%, 15%, 95%, 15%, and 30%. On the other hand, the percentage of fish-non-producing households that consume the recommended levels of energy, protein, iron, zinc,

[18] Consumption expenditure estimates for the poor (lower poverty line) are taken from the Household Income and Expenditure Survey (HIES) 2010 and adjusted for BIHS 2011-12, 2015 and 2018-19 using consumer price index (CPI) data from World Bank.

Vitamin-A, and vitamin-B12 are, respectively, 53%, 85%, 78%, 12%, 95%, 14%, and 26%. It is evident that fish-producing households as compared to fish-non-producing households are significantly more likely to meet the recommended level of fish, energy, protein (only 10%), iron (only 10%)), and vitamin-B12. However, there is no significant difference in the intake of zinc and vitamin-A between fish-producing and fish-non-producing households.

What is the direct linkage between fish production and child malnutrition? Figure 2.5 shows the relationship between the quantity of fish production at the household level and children's height-for-age z-score (HAZ) conditional on the household having at least one child. There is a positive correlation between a household's fish production and children's HAZ. Therefore, higher the household's fish production, higher the HAZ of the children in the household. I also explore the relationship between child malnutrition and household's involvement with fish production. Table 2.7 shows children's HAZ scores and stunting rates between fish-producing and fish-non-producing households. It is observed that the HAZ score is significantly higher, and the prevalence of stunted children is significantly lower among fish-producing households as compared to fish-non-producing households. In particular, 29% of the children from fish-non-producing households are stunted, while the percentage is 26% in the case of fish-producing households.

Additionally, Table 2.7 also shows the children's HAZ and stunting rates between high fish-producing districts and low fish-producing districts. The reason behind looking into high and low fish-producing districts is that people from high fish-producing districts may have a higher availability of fish which may lead to better intake of fish, and other nutrients, in the case of children. This indicates that households from high fish-producing districts have a significantly higher number of stunted children compared to the households from low fish-producing districts. Therefore, it is the household-level fish production that is important, and not the regional availability of fish, in the case of children's nutritional outcomes.

In summary, households involved in fish production consume more fish, energy, protein, iron, and vitamin-B12 as compared to households not involved in fish production. These higher nutrient intakes reflect better child nutrition outcomes in the case of fish-producing households. Additionally, households from high fish-producing districts, as compared to low fish-producing

districts, consume more fish and intake more nutrients as the availability of fish is higher in these regions. Accordingly, due to higher purchasing power, households from rich districts, as compared to those from poor districts, consume more fish and intake more nutrients.

2.5 Results and discussion

2.5.1 Results from the regression analysis

In the previous section, I have discussed the correlation between household's fish production, fish consumption, nutrient intake, and child nutritional outcomes without controlling for other factors. In this section, I control for several factors and examine the association, if any, between fish production and children's HAZ and stunting. The control variables used in the regression models are shown as disaggregated across fish-producing and fish-non-producing households (pooled across years) to explore whether these two groups of households are different or not in terms of observable characteristics (Table 2.8). It is seen that fish-producing households and fish-non-producing households are significantly different from each other as per most of the control variables. Fish-producing households are positively selected with older household heads, higher educated household heads, higher agricultural and non-agricultural asset indices, and higher expenditure per capita. In contrast, fish-producing households are negatively selected with female household heads and household electricity connection. This implies that the fish-producing and fish-non-producing households are not similar in terms of several observable characteristics. For instance, households from higher socio-economic backgrounds seem to be more involved with fish production. However, these two groups of households are not significantly different in terms of mothers' years of education, and the number of children (below 5 years of age) in the households.

In Table 2.9, there are separate regressions for all children, boys, and girls. Additionally, for each group- two different models are used: with and without the quantity of fish production as the explanatory variable. I explore the association across gender because patriarchy is still prevalent in Bangladesh especially in rural areas. Adding the quantity of fish production along with the fish production dummy does not change the significance level for the coefficient of the fish production dummy. According to the pooled OLS (POLS) estimates (Table 2.9), the pooled model (for all

children) and the separate regressions for girls and boys- there is a positive association between a household's fish production and children's HAZ. In addition, the quantity of fish production is also significant in the case of all children and weakly significant for boys[19]. As per the estimates in the first row of Table 2.9, it is evident that children from fish-producing households have a 0.16 SD to 0.17 SD higher HAZ than children from fish-non-producing households, and these coefficients are 0.13 SD to 0.15 SD and 0.21 SD to 0.22 SD respectively in the case of boys and girls. These coefficients are slightly lower than the estimates of the impact of the aggregate women empowerment index (5 domains) on children's HAZ, and higher than the estimates of the individual women empowerment domain in rural Bangladesh (Holland & Rammohan, 2019).

Moving on, adding the quantity of fish production alongside the fish production dummies in the regression does not change the coefficient for the dummy variable, and the quantity of fish production itself reveals a positive association with HAZ but is significant only in the case of all children and particularly boys. According to the estimates in the second row of Table 2.9, a 100 kg increase in household's fish production per capita is associated with a 0.04 SD increase in children's HAZ; a 0.06 SD increase in boys' HAZ; and a 0.02 SD increase in girls' HAZ. No other main variables of interest such as the number of the types of livestock and the number of crops produced by households have any significant association with HAZ. These two variables are considered of interest due to the possibility that agricultural production or agricultural diversification may be associated with child nutritional status. Interestingly, poor household dummies do not have any significant association with children's HAZ, and HAZ shows an increase in 2015 and 2018-19 compared to 2011-12. Moreover, the age of children, mother's age being above 49, mother's education and the value of household's livestock each have a positive and significant association with children's HAZ in some models. In contrast, the presence of a working mother and the number of children below 5 years of age in households each have a negative association with children's HAZ.

As per the pooled logit average marginal effect estimates of Table 2.10, the pooled model (all children) and the separate regressions for boys each do not show any significant association

[19] In this study, a coefficient is interpreted as strong if it is significant at either the 5% or 1% level and as weak if it is only significant at the 10% level.

between household fish production and children's stunting. In contrast, the average marginal effects for girls reveal a significant association. In particular, the average marginal effect estimates of Table 2.10 show that girls from fish-producing households are 4.6 to 5.2 percentage points less likely to be stunted as compared to children from fish-non-producing households. Adding the quantity of fish production to the main model does not change (as is evident from the second row of Table 2.10) the significance of the coefficient for the fish production dummy variable, but rather reveals a significant association between the quantity of fish production and all children's stunting status. The quantity of fish production shows a negative average marginal effect only for the sample of all children, not for the sample of boys or girls- this is perhaps due to the reduced sample size when estimating the models separately. No other main variables of interest have any significant association with child's stunting. Furthermore, the age of children and mother's education each have a negative and significant association with a child's likelihood of being stunted in some models. Also, the stunting rate has significantly decreased in 2015 and 2018-19 compared to 2011-12. In contrast, mother's working status has a positive association with a child's probability of being stunted, which is similar to the results found in the literature which suggest that mother's employment decreases children's HAZ in Bangladesh (Jakaria, Bakshi, & Hasan, 2022).

All in all, after controlling for household's, children's, and regional characteristics, it is evident that household fish production has a positive and significant association with children's HAZ and a negative association with girls' likelihood of being stunted. Thus, there is a positive association between household fish production and child nutritional status.

2.5.2 Robustness checks

According to the pooled OLS and logit regression results above, household fish production has a significant association with both children's HAZ and stunting status. Following these results, I perform a few steps to check the robustness of the POLS and logit results. First, since household heads' characteristics are not added in the main model due to the consideration that mothers' and heads' characteristics may, in some cases, overlap (as there is a probability that a woman in a household could be the mother of the children and also the household head), the household head's

characteristics are added to separate models to explore the responsiveness of the coefficients (see Table A6 and Table A7). These results show almost similar results for the variable of interest as that of the main model and the household head characteristics do not show any significant results for any models.

Second, to examine how the characteristics of fish availability and the economic situation in the regions matter- regional characteristics such as rich or poor and high or low fish-producing districts, and interactions between these two variables are added in the regressions (see Table A8 and Table A9). Still, the fish production dummy variable shows a positive association with children's HAZ and a negative association with girls' stunting- and the magnitude of the estimated coefficients also does not change much. In addition, the low poverty district shows a negative association with boys' stunting, which might imply that household income has positive implications for child nutritional status. Children from low-poverty districts are around 27 percentage points less likely to be stunted as compared to children from high poverty districts, which implies that economic status is a strong determinant of children's nutritional status.

Third, exploiting the panel feature of the data, a FE model is used to control for children's and households' time-invariant heterogeneous characteristics (Table 2.12 and Table 2.13). One point to be noted here is that there are enough changes in households' fish production decisions across the different rounds of the BIHS survey (see Table 2.11). It shows that 35% of the fish-non-producing households became fish-producing households and 38% of the fish-producing households became fish-non-producing households between the first and third wave. Thus, to correct the bias arising from children's and household's time invariant heterogeneous unobservable characteristics, panel FE regressions are performed. The fish production dummy variable from the FE regressions (first row in Table 2.12) shows a positive but not significant relationship with child's and boys' HAZ and a negative and significant relationship with girls' HAZ. On the other hand, the fish production dummy (first row in Table 2.13) shows a negative and significant relationship with girls' stunting. Particularly, girls from fish-producing households are 10 to 11 percentage points less likely to be stunted than girls from non-fish-producing households.

The FE estimates have lower sample sizes than the POLS estimates which implies low statistical power of the estimates. There may be several reasons why there is lower sample size in panel models. First, children were perhaps absent during the anthropometric measurement. Second, some children may have become a part of another household due to the splitting of households between waves. Finally, some children may have been born after the second wave and, therefore, it would not have been possible to attain their anthropometrics data for at least two rounds of the survey. Furthermore, the sample size is much lower in the case of the stunting model as sample sizes have dropped due to the lack of variation in the stunting dummies across different waves.

Subsequently, to compare the results between two similar samples, I run POLS regression only for the panel sample to juxtapose the results between POLS and FE (see Table 2.14 and Table 2.15). Both in the case of children's HAZ and stunting status variables, FE estimates show higher standard errors (SEs) that lead to higher confidence intervals (CIs) as compared to POLS estimates (Table 2.14, Table 2.15, Figure 2.6, and Figure 2.7). Particularly, the SEs of the fish production dummies range between 0.028 to 0.082 for the POLS estimates, and between 0.039 to 0.091 for the FE estimates. Consequently, in the case of the HAZ dependent variable, CIs for fish production dummy variables from POLS regressions (Table 2.14, last two columns of the rows 1, 3, and 5) are 0.057 to 0.284, 0.0001 to 0.297, and 0.054 to 0.376 respectively for all children, boys and girls, and CIs for fish production dummy variables from FE regressions (Table 2.14, last two columns of the rows 2, 4, and 6) are -0.121 to 0.130, -0.098 to 0.261 and -0.259 to 0.099 respectively for all children, boys and girls.

Furthermore, CIs of the fish production between POLS and FE in the case of the HAZ dependent variable do not overlap much in the case of all children- the overlap is only around 50% (Figure 2.6). Thus, the POLS and FE indicate that the estimates are different. However, the proportion of the overlapped CIs are much higher in the case of the boys' sample and much lower in case of the girls' sample. On the other hand, in the case of children's stunting status as the dependent variable, CIs for fish production dummy variables from the POLS regressions (Table 2.15, last two columns of the rows 1, 3, and 5) are -0.057 to 0.052, -0.034 to 0.130, and -0.166 to 0.009 respectively for all children, boys and girls, and CIs for fish production dummy variables from the FE regressions (Table 2.15, last two columns of the rows 2, 4, and 6) are -0.090 to 0.069, -0.056 to 0.095 and -

0.213 to -0.002 respectively for all children, boys and girls. Further, CIs of the fish production between POLS and FE overlap a lot- CIs for all children and girls from POLS fall within that of FE- and the non-overlapped portion is also lower in the case of the boys' samples (Figure 2.7). Therefore, the estimates of the fish production coefficient between POLS and FE do not indicate different results, after all, in estimating the relationship of fish production with children's stunting status.

2.5.3 Discussion

The pooled OLS estimates of the household fish production dummy variable are always positive and significant in the case of the HAZ, but only negatively and significantly associated with girls' being stunted. In addition, household fish production only shows a negative association with girls' being stunted and this may be explained in a couple of ways. First, the findings seem to suggest that girls are being prioritized in terms of being provided a higher quantity of fish from households' farming. This is, however, not very likely as patriarchy is still quite dominant in rural Bangladesh. Second, boys maybe prioritized by being provided with bigger size fishes (that have higher market prices) that come from the households' farming and girls are provided small fishes (that also have lower market price) which are rich in micronutrients. Eventually, consuming higher micronutrients from small fish allows the girls to have better nutrition relative to the boys.

The fish production dummies do not appear to be significantly associated with HAZ but are significantly associated with girls' stunting once I incorporate the child FE to control for child-specific heterogeneous characteristics (which is not possible in the POLS). However, the FE estimates have both advantages and disadvantages. The disadvantages include higher standard errors leading to a lack of statistical power possibly due to small sample size, and a short panel. In addition, the FE estimates especially need more observations i.e., a higher sample size, as one has to estimate more parameters with lower degrees of freedom.

On the other hand, the main advantage of using FE over POLS is that it can control for household or child-specific heterogenous time-invariant factors, such as: the inherent natural ability of some children to grow faster or slower than other children, and household's capability that can help

children's growth as well as the management of fisheries. FE estimates can control for these types of measures- children's natural ability and household's capability- if it is constant over time. Additionally, fish-producing and non-fish-producing households seem to be different in terms of observables, so it would not be surprising if they are different in terms of unobservable characteristics as well.

In addition, there is also a drawback of the FE estimates that it cannot control for time-variant factors which are associated with both the main explanatory and outcome variables. For instance, in the case of this paper, such time-variant factors could be program interventions, household's time-variant resource allocation capabilities, and households time-variant ability to manage fisheries that might affect both fish production and child nutritional status. As a result, FE estimates of the relationship between fish production and child nutritional status may be biased. These factors could not be controlled for in this paper due to the lack of information in the survey. Even though both the OLS and FE estimates have both advantages and disadvantages, the FE estimates can provide less biased estimates than OLS.

Moreover, to overcome the limitations of the FE estimates, time-variant instrumental variables (IV)- which are exogenous, can be used to strongly explain fish production and are only associated with child nutritional status through fish production- can be used in future research. Thus, to estimate a less biased relationship between fish production and child nutritional status, an IV is required- which, one, must be time-variant; two, which is strongly associated with household fish production; and three, which is also not associated with the error term in the equation where child nutritional status is a dependent variable and fish production is the main explanatory variable. Additionally, quite a large sample size for the IV regression is required- especially when the IV is not very strong- to obtain a significant result, and it is very difficult to find an IV that satisfies all these conditions.

2.6 Conclusion and Policy Implications

This chapter aims to provide evidence on how fish production at the household level can be associated with child nutritional status, and it is one of the very few papers that explores the association between household fish production and child nutritional status in the context of Bangladesh where-despite steady growth- child undernutrition remains prevalent and high. This study also contributes to existing evidence using nationally rurally representative panel data, whereby most of the previous studies are based on cross-sectional data and/or are only focused on a small region.

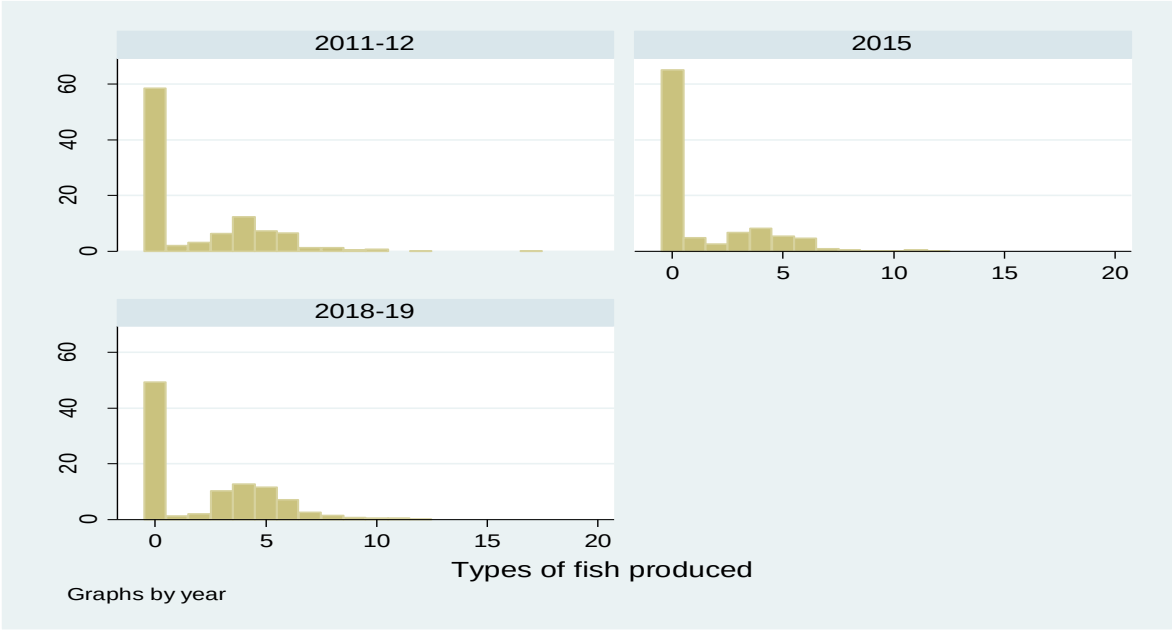
The descriptive statistics of the study find that there is a positive correlation between household fish production and fish consumption and nutrient intake, and between household fish production and child nutritional status (such as HAZ and stunting). Also, households from high-fish-producing/low-poverty districts are better off than low-fish-producing/high-poverty districts in terms of consuming higher amounts of fish and better nutrient intake. The regression results from the POLS estimation show that household fish production is positively associated with children's HAZ (both boys and girls) and negatively associated with stunting only in the case of girls. However, FE estimates of the fish production variable are only significant (negatively) in the case of girls' stunting. To strengthen our understanding of the association between fish production and children's nutritional status, future research could explore the causal relationship employing a long panel (as it would have more frequent observations for each child from birth to 5 years) and reliable instrumental variables. This was not possible in this study- despite effort- due to the lack of data.

Moreover, based on the findings from this chapter some policies that may be pursued include encouraging fish production and other homestead gardening in the country which, in turn, could result in better nutritional status of children and higher well-being and economic growth as well. Furthermore, exploring the relationship between fish production and child nutrition in the context of Bangladesh provides several valuable insights, especially for policymakers and practitioners in their goal of achieving Sustainable Development Goals (SDG) no. 2 (Zero Hunger) and no. 3 (Good health and well-being) (UNDP, 2015). It also provides support to incentivizing increased aquaculture so that the environment and natural resources are protected- and as such, the

significance of this research is especially high for lower-middle-income countries such as Bangladesh.

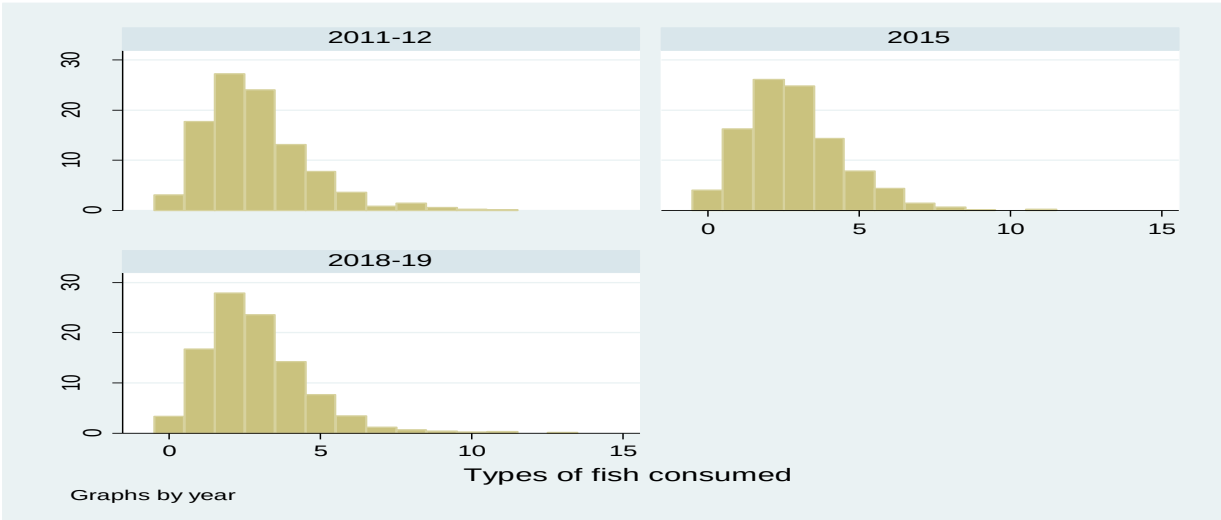
2.7 Tables and Figures

Figure 2.1: Distribution of households according to how many types of fish are produced.



Note: These figures show the distribution of households according to the number of the different types of fish produced by households in a one-year period in each of the three rounds of the BIHS survey. The number of the types of fish produced are in the horizontal axis and the percentage of households are in the vertical axis. The number of observations (N) in 2011-12, 2015 and 2018-19 is respectively 6503, 6715 and 6011.

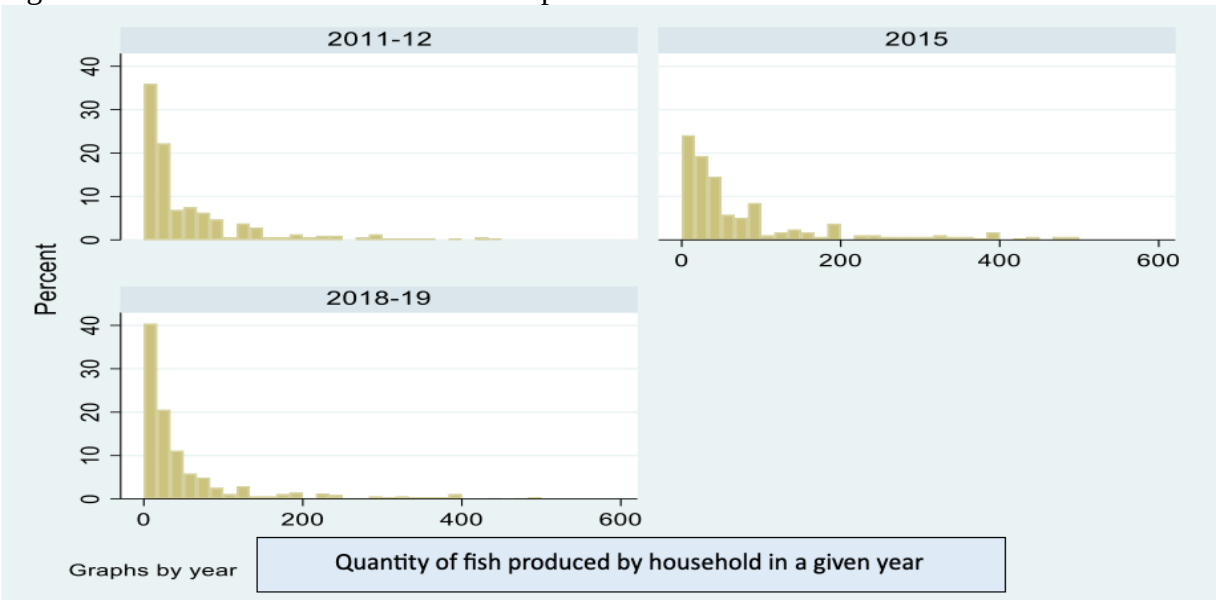
Figure 2.2: Distribution of households according to how many types of fish are consumed.



Note: These figures show the distribution of households according to the number of different types of fish consumed by households in last seven days in each of the three rounds of the BIHS survey. The number of the types of fish

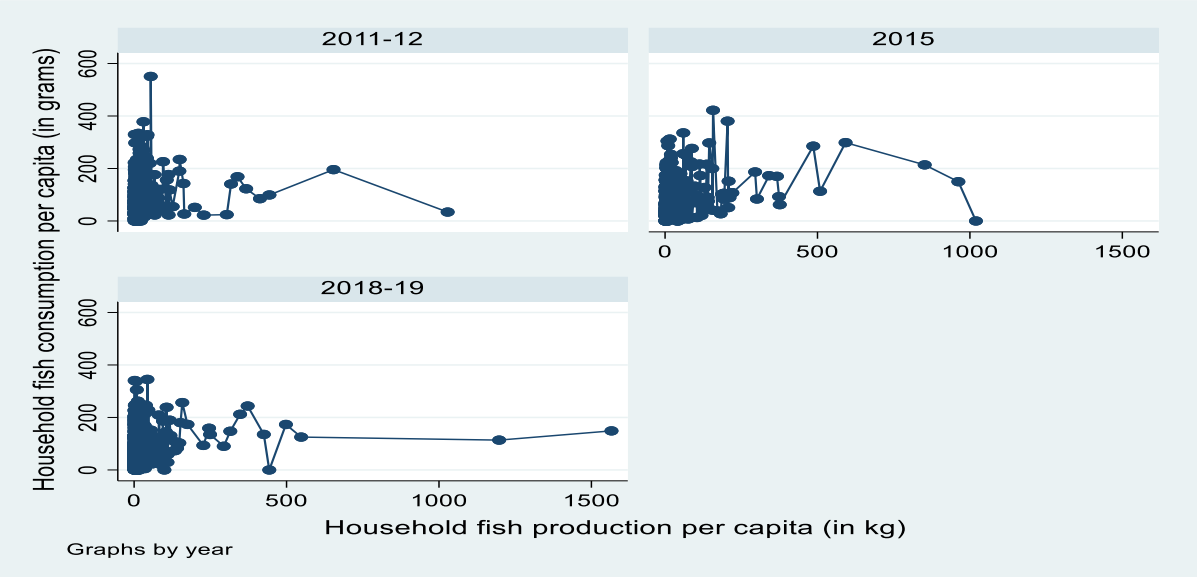
consumed are in the horizontal axis and the percentage of households are in the vertical axis. The number of observations (N) in 2011-12, 2015 and 2018-19 is respectively 6503, 6715 and 6011.

Figure 2.3: Distribution of household fish production.



Note: These figures show the distribution of households according to the quantity of fish (in kg) produced by households in a one-year period in each of the three rounds of the BIHS survey. The quantity of fish produced is in the horizontal axis and the percentage of households is in the vertical axis. The number of observations (N) in 2011-12, 2015 and 2018-19 is respectively 6503, 6715 and 6011.

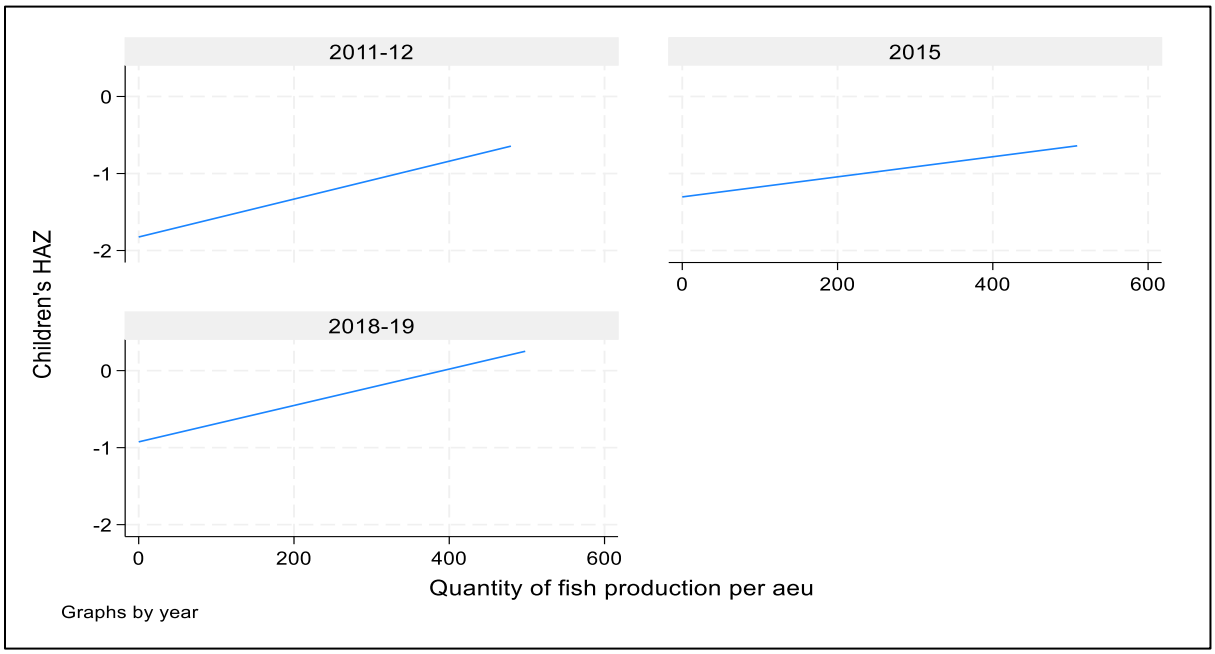
Figure 2.4: Relationship between households' quantity of fish production and fish consumption.



Note: These figures present the relationship between household fish production and fish consumption. Both the production and consumption of fish are converted into per capita units in all cases- later estimates as well. The vertical axis shows the per capita per day adult equivalent fish consumption (gram) and the horizontal axis shows the

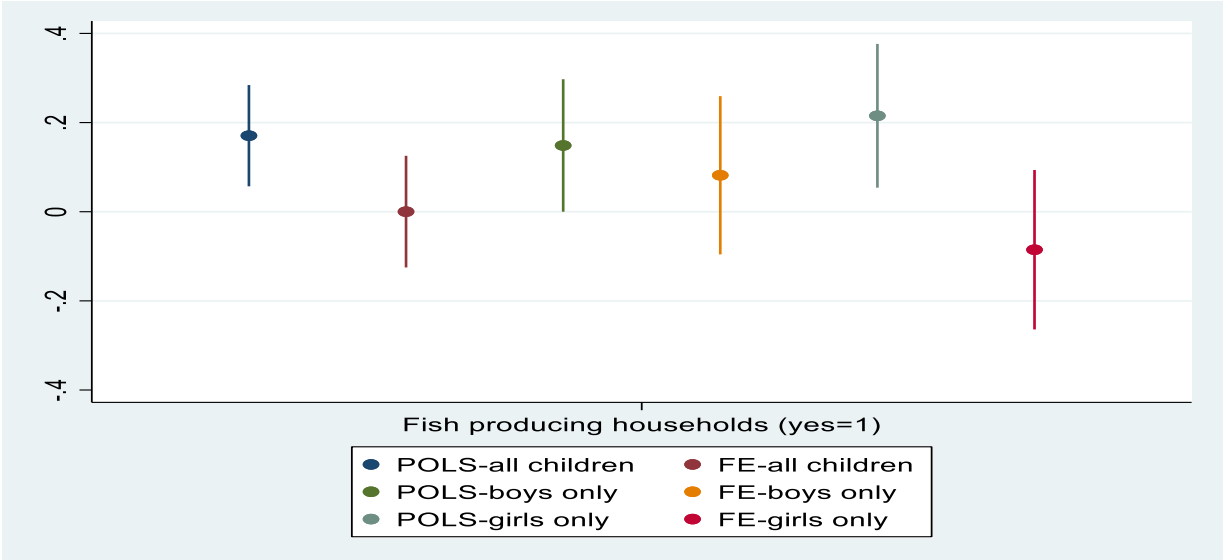
household fish production per capita (in a given year). Each dot shows a household combination of fish production and consumption. The number of observations (N) in 2011-12, 2015 and 2018-19 is respectively 6503, 6715 and 6011.

Figure 2.5: Relationship between households' quantity of fish production (kg) per aeu, and children's HAZ.



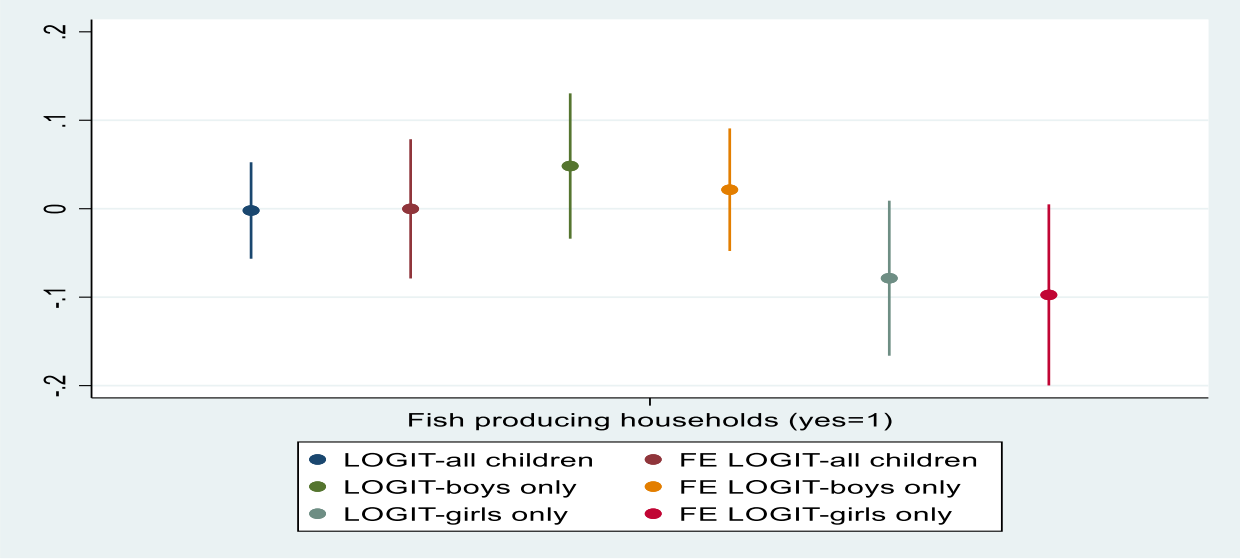
Note: These figures present the relationship between fish production and children's height-for-age z-score (HAZ). Fish production is converted into per capita adult equivalent unit (aeu). The horizontal axis shows fish production and the vertical axis shows the fitted values for children's HAZ. The number of observations (N) in 2011-12, 2015 and 2018-19 is respectively 6503, 6715 and 6011.

Figure 2.6*:* Confidence intervals for the fish production coefficients from different regressions, dependent variable: HAZ



Note: This table delineates the regression coefficients from different models and samples. Each line represents 95% confidence intervals of the fish production estimates on children's HAZ for different samples across pooled OLS and fixed effects models. The number of observations (N) is 2573 for all children, 1347 for boys, and 1231 for girls.

Figure 2.7*:* Confidence intervals for the fish production coefficients from different regressions, dependent variable: stunted



Note: This table shows the regression coefficients from different models and samples. Each line represents 95% confidence intervals of average marginal effect estimates of the fish production on children's stunting for different samples across pooled OLS and fixed effects models. The number of observations (N) is 811 for all children, 405 for boys, and 401 for girls.

Table 2.1*:* Number of children, in farm households, for whom anthropometric information is available in the BIHS data.

Year of survey/wave	No. of children	No. of households
2011-12	951	807
2015	1442	920
2018-19	2131	1126
Common between 2011-12 and 2015	627	429
Common between 2015 and 2018-19	968	513
Common children among all three waves	465	275

Note: The table shows the number of children and households from BIHS datasets that are used in this study.

Table 2.2: Summary statistics of the variables of interest and other covariates.

Variables	2011-12			2015			2018-19			P-value
Dependent variables	N	Mean	SD	N	Mean	SD	N	Mean	SD	
Height-for-age z-score (HAZ)	941	-1.81	1.467	1438	-1.25	1.378	2131	-0.86	1.357	0.000
Stunted dummy (HAZ<-2SD)	941	0.46	0.499	1438	0.29	0.453	2131	0.19	0.395	0.000
Main explanatory variables										
Quantity of household fish production (kg)	951	46.87	175.98	1442	68.04	355.86	2131	76.87	634.19	0.152
Fish producing households (yes=1)	951	0.417	0.493	1442	0.335	0.472	2131	0.525	0.499	0.000
No. of fish types produced	951	1.91	2.622	1442	1.32	2.201	2131	2.48	2.725	0.000
No. of livestock types produced	951	2.87	1.741	1442	3.40	2.108	2131	5.02	1.251	0.000
No. of crop produced	951	1.70	1.271	1442	1.80	1.295	2131	1.63	1.129	0.041
Child characteristics										
Age	951	1.97	1.395	1442	3.50	2.318	2131	4.98	3.224	0.000
Female dummy	951	0.49	0.500	1442	0.48	0.500	2131	0.48	0.500	0.601
Mother's characteristics										
Age of mother	942	27.71	7.096	1400	28.86	6.596	2049	30.40	6.854	0.000
Years of education of mother	942	4.73	3.568	1400	5.21	3.565	2049	5.36	3.615	0.000
Mother's Body Mass Index (BMI)	941	19.88	2.904	1395	20.96	3.398	2038	22.23	3.799	0.000
Household characteristics										
Years of education of HH head	951	3.51	3.942	1439	3.57	3.936	2131	3.57	3.900	0.686
Electricity connection	951	0.46	0.498	1442	0.57	0.495	2131	0.85	0.356	0.000
Asset index (PCA)	951	0.29	0.997	1442	0.30	1.017	2131	0.33	0.926	0.269
Agricultural asset index (PCA)	951	0.44	1.042	1442	0.46	1.081	2131	0.43	1.138	0.813
Non-agricultural asset index (PCA)	951	0.17	0.981	1442	0.15	0.984	2131	0.13	0.869	0.215
No. of children below 5 in the HH	951	1.34	0.560	1442	1.04	0.769	2131	0.94	0.825	0.000
No. of working age people in the HH	951	2.75	1.240	1442	2.91	1.415	2131	2.91	1.440	0.003
Household size	951	5.40	2.046	1442	5.60	2.162	2131	5.69	2.238	0.001
Land holding (decimal)	951	156.7	154.1	1442	156.4	166.8	2131	143.9	164.2	0.192
Household's value of livestock pc ('000 BDT)	951	3.37	4.763	1442	3.56	5.436	2131	6.15	10.022	0.000
Per capita food consumption (in BDT)	951	1436.7	659.0	1442	1842.6	951.3	2131	2147.7	938.5	0.000
Per capita consumption expenditure (BDT)	951	2359.4	1318.2	1442	3040.1	1580.5	2131	3809.2	1653.3	0.000

Note: This table shows the summary statistics of the variables that are used in the regression analysis. The statistics are disaggregated by the three rounds of the survey so that changes can been seen over time. P-values in the last column are the p-values from the significance test of the means/ratios of the difference between the survey year 2011-12 and 2018-19.

Table 2.3: Distribution of rich and poor households according to their fish production status.

	Rich or poor			
Fish-producing households	Rich	Poor	Total	No. of observations
No	43.18	56.82	100	1628
Yes	41.96	58.04	100	1225

Note: This table shows the percentage of rich and poor households by household's fish production status.

Table 2.4: Comparison of average fish consumption and nutrient intake between fish-producing and fish-non-producing households.

Indicator	Fish-non-producing Households (N=1628)	Fish-producing Households (N=1225)	Difference	P-values
Energy (Kcal)	3112.7	3187.3	74.6	0.000
Protein (gram)	82.7	84.3	1.6	0.013
Iron (mg)	14.7	14.6	0.0	0.845
Zinc (mg)	9.8	9.9	0.1	0.304
Vitamin-A (rae[20])	356.8	364.2	7.4	0.249
Vitamin-B12 (ug)	2.2	2.3	0.1	0.028
Fish consumption (gram)	77.5	86.9	9.4	0.000

Note: This table presents the average difference in per adult equivalent fish consumption and nutrient intake between households involved in fish production and households not involved in fish production. The p-values are obtained from statistical significance tests conducted between fish-producing households and fish-non-producing households.

Table 2.5: Comparison of average fish consumption and nutrient intake between rich and poor households.

Indicator	Rich (N=2017)	Poor (N=836)	Difference	P-value
Energy (Kcal)	3242.9	2730.9	511.99	0.000
Protein (gram)	86.6	67.4	19.12	0.000
Iron (mg)	15.4	11.5	3.84	0.000
Zinc (mg)	10.2	8.0	2.25	0.000
Vitamin-A (rae)	369.7	276.8	92.90	0.000
Vitamin-B12 (ug)	2.4	1.6	0.75	0.000
Fish consumption (gram)	89.9	39.5	50.41	0.000

Note: This table presents the average difference in per adult equivalent fish consumption and nutrient intake between poor and non-poor households. Consumption expenditure estimates for the poor are taken from HIES 2010 and adjusted for BIHS 2011-12, 2015, and 2018-19 using the consumer price index (CPI) from the World Bank. The p-values are obtained from statistical significance tests conducted between rich and poor households.

[20] RAE: Retinol activity equivalents

Table 2.6: Percentage of households consuming at least the recommended level of fish and nutrient.

Indicator	Fish-non-producing Households (N=1628)	Fish-producing Households (N=1225)	Difference	P-values
Fish consumption (grams)	0.530	0.603	0.073	0.000
Energy (Kcal)	0.846	0.870	0.024	0.073
Protein (grams)	0.776	0.804	0.028	0.067
Iron (mg)	0.124	0.149	0.024	0.058
Zinc (mg)	0.951	0.953	0.003	0.747
Vitamin-A (rae)	0.139	0.147	0.008	0.539
Vitamin-B12 (ug)	0.262	0.302	0.040	0.017

Note: This table shows the proportion of households that consume at least the recommended level of fish and nutrient across fish-producing and fish-non-producing households. The p-values are obtained from statistical significance tests conducted between fish-producing households and fish non-producing households. The recommended level of fish is taken from the Bangladesh Department of Fisheries (2018) and the recommended levels of nutrients are taken from Nahar et al. (2013). The recommended levels per day are: fish- 60grams, energy- 2430 kilocalorie, protein- 66 grams, iron- 19.75 mg, zinc- 6mg, vitamin-A- 600 rae, and vitamin-B12- 2.4 ug.

Table 2.7: Children's height-for-age z-scores (HAZ) and stunting rates across (1) fish-producing and fish-non-producing households, and (2) high fish-producing regions and low fish-producing regions.

	Children's HAZ	Percentage of stunting children	N
Fish-non-producing households	-1.23	0.29	2512
	(-0.028)	(0.009)	
Fish-producing households	-1.12	0.26	1991
	(0.032	0.01)	
Difference	-0.11	-0.03	
P-value	0.010	0.040	
Lower fish-producing districts	-1.05	0.25	1418
	(0.036)	(0.011)	
Higher fish-producing districts	-1.24	0.29	3085
	(0.026)	(0.008)	
Difference	-0.19	0.05	
P-value	0.000	0.002	

Note: This table shows children's HAZ and stunting status across fish-producing households and fish-non-producing households, and also across lower fish-producing districts and higher fish-producing districts. The p-values are obtained from statistical significance tests between fish-producing households and fish-non-producing households, and between lower fish-producing districts and higher fish-producing districts.

Table 2.8*:* Summary statistics of the control variables across fish-producing and fish-non-producing households.

Variable	Fish-non-producing household			Fish-producing households			Mean difference	P-value
Children's characteristics	N	Mean	SD	N	Mean	SD		
Gender (girls=1)	2525	0.49	0.50	1999	0.48	0.50	-0.004	0.790
Age of children	2525	3.77	2.81	1999	4.01	2.99	0.236	0.007
Mother's characteristics								
Mother's age	2447	29.11	7.05	1944	29.60	6.72	0.491	0.019
Mother's BMI	2436	21.40	3.57	1938	21.21	3.68	-0.194	0.078
Mother's years of education	2447	5.19	3.53	1944	5.16	3.68	-0.025	0.818
Household head's characteristics								
Female head (yes=-1)	2524	0.09	0.28	1997	0.04	0.21	-0.044	0.000
Age of the head	2524	42.41	13.04	1997	43.33	12.78	0.923	0.017
Years of education of the head	2524	3.44	3.83	1997	3.71	4.03	0.265	0.024
Household composition								
Household size	2525	5.39	2.03	1999	5.87	2.32	0.481	0.000
No. of children below 5	2525	1.25	0.85	1999	1.27	0.86	0.012	0.629
Working age member (between 16 and 65)	2525	2.74	1.26	1999	2.94	1.49	0.201	0.000
No. of dependent people	2525	0.18	0.42	1999	0.23	0.47	0.046	0.001
Household resources								
Electricity connection (yes=1)	2525	0.69	0.46	1999	0.67	0.47	-0.023	0.099
Agricultural asset index	2525	0.32	0.94	1999	0.60	1.26	0.288	0.000
Non-agricultural asset index	2525	0.10	0.88	1999	0.20	0.98	0.097	0.001
Food expenditure per capita	2525	1853.3	945.2	1999	1961.3	912.7	108.03	0.000
Expenditure per capita	2525	3190.0	1700.3	1999	3346.8	1618.2	156.77	0.002

Note: This table shows the summary statistics of the variables that are used in the regression analysis as control variables. The statistics are disaggregated by the fish-producing households and fish-non-producing households. P-values in the last column are the p-values from the significance test of the means/ratios of the difference between the fish-producing and fish-non-producing households.

Table 2.9: Pooled OLS regression results; dependent variable: height-for-age z-score (HAZ)

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Variable of interest(s)						
Fish-producing household (yes=1)	0.171***	0.160***	0.149**	0.134*	0.215***	0.209**
	(0.058)	(0.058)	(0.076)	(0.076)	(0.082)	(0.084)
	0.003	0.006	0.050	0.079	0.009	0.013
Fish production (100kg) per aeu		0.041**		0.063*		0.019
		(0.018)		(0.038)		(0.018)
		0.025		0.098		0.304
Number of crops produced	-0.014	-0.012	0.010	0.014	-0.022	-0.021
	(0.036)	(0.036)	(0.053)	(0.053)	(0.046)	(0.046)
	0.697	0.731	0.845	0.786	0.634	0.639
No. of livestock and livestock product produced	-0.036	-0.036	0.040	0.041	-0.096	-0.098
	(0.064)	(0.064)	(0.081)	(0.081)	(0.091)	(0.091)
	0.581	0.571	0.627	0.614	0.291	0.285
Child characteristics						
Gender (female=1)	0.039	0.037				
	(0.054)	(0.054)				
	0.471	0.488				
Age	0.070***	0.070***	0.066***	0.066***	0.073***	0.073***
	(0.010)	(0.010)	(0.015)	(0.015)	(0.014)	(0.014)
	0.000	0.000	0.000	0.000	0.000	0.000
Mother's characteristics						
Mother's age between 18 and 49	0.216	0.218	0.025	0.025	0.353	0.355
	(0.251)	(0.252)	(0.500)	(0.501)	(0.241)	(0.241)
	0.390	0.386	0.960	0.960	0.143	0.141
Mother's age above 49	0.406	0.412	-0.488	-0.480	1.090***	1.095***
	(0.330)	(0.331)	(0.553)	(0.555)	(0.304)	(0.304)
	0.218	0.213	0.378	0.388	0.000	0.000
Mother's education: below primary	0.123	0.121	0.078	0.079	0.171	0.168
	(0.096)	(0.096)	(0.123)	(0.123)	(0.129)	(0.129)
	0.199	0.208	0.524	0.519	0.185	0.193
Mother's education: primary complete	0.209**	0.208**	0.241**	0.243**	0.193	0.193
	(0.086)	(0.086)	(0.107)	(0.107)	(0.121)	(0.121)
	0.015	0.016	0.024	0.023	0.110	0.111
Mother's education: secondary complete	0.487***	0.483***	0.437***	0.436***	0.635***	0.631***
	(0.130)	(0.129)	(0.154)	(0.153)	(0.202)	(0.201)
	0.000	0.000	0.005	0.005	0.002	0.002
Mother's education: higher secondary complete	0.480***	0.476***	0.545**	0.540**	0.452*	0.449*
	(0.179)	(0.179)	(0.244)	(0.244)	(0.232)	(0.232)
	0.007	0.008	0.025	0.027	0.051	0.053
Mother's BMI: normal	0.040	0.039	0.049	0.045	0.005	0.005
	(0.073)	(0.073)	(0.096)	(0.096)	(0.093)	(0.093)
	0.579	0.590	0.608	0.640	0.960	0.957
Mother's BMI: overweight	0.171*	0.165*	0.209*	0.198	0.125	0.123
	(0.097)	(0.096)	(0.122)	(0.123)	(0.129)	(0.129)
	0.077	0.087	0.088	0.106	0.336	0.341
Mother's BMI: obese	0.329**	0.328**	0.622**	0.618**	0.056	0.055
	(0.165)	(0.165)	(0.248)	(0.248)	(0.194)	(0.194)
	0.047	0.047	0.012	0.013	0.775	0.776
Working mother (yes=1)	-	-	-0.127	-0.128	-0.239**	-0.240**
	0.190***	0.191***				
	(0.066)	(0.066)	(0.089)	(0.088)	(0.098)	(0.098)
	0.004	0.004	0.151	0.149	0.015	0.015
Household head's characteristics						

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Gender head (female=1)	0.117	0.119	-0.014	-0.013	0.217	0.219
	(0.123)	(0.123)	(0.154)	(0.155)	(0.171)	(0.170)
	0.342	0.333	0.928	0.931	0.205	0.200
Household composition						
Household size	-0.022	-0.022	-0.012	-0.011	-0.028	-0.028
	(0.028)	(0.028)	(0.038)	(0.038)	(0.039)	(0.040)
	0.434	0.442	0.760	0.766	0.473	0.479
No. of children below 5 years	-0.095**	-0.096**	-0.080	-0.081	-0.114*	-0.115*
	(0.043)	(0.043)	(0.057)	(0.057)	(0.058)	(0.059)
	0.027	0.026	0.161	0.160	0.051	0.050
Number of household members between 16 and 65 years	0.082**	0.083**	0.021	0.023	0.111*	0.111*
	(0.041)	(0.042)	(0.052)	(0.053)	(0.060)	(0.060)
	0.049	0.047	0.685	0.655	0.064	0.064
Number of household members above 65 years	0.007	0.007	-0.136	-0.137	0.132	0.133
	(0.067)	(0.067)	(0.093)	(0.092)	(0.094)	(0.094)
	0.921	0.912	0.142	0.140	0.161	0.160
Household resources						
Having electricity connection	-0.055	-0.055	-0.002	0.000	-0.141	-0.142
	(0.071)	(0.071)	(0.100)	(0.100)	(0.095)	(0.095)
	0.440	0.441	0.985	0.999	0.139	0.138
Value of livestock pc ('000)	0.008*	0.007*	0.002	0.001	0.012*	0.012*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)
	0.062	0.062	0.702	0.767	0.072	0.072
Agricultural asset index (PCA)	-	-	-0.049	-0.050	-	-
	0.082***	0.081***			0.120***	0.119***
	(0.028)	(0.028)	(0.034)	(0.034)	(0.039)	(0.039)
	0.004	0.004	0.147	0.143	0.002	0.002
Non-agricultural asset index (PCA)	0.062	0.059	0.105**	0.099*	0.051	0.049
	(0.044)	(0.044)	(0.053)	(0.053)	(0.064)	(0.064)
	0.160	0.183	0.048	0.065	0.426	0.438
Poor household (yes=1)	-0.049	-0.048	0.105	0.104	-0.165	-0.164
	(0.086)	(0.086)	(0.119)	(0.119)	(0.105)	(0.105)
	0.567	0.574	0.381	0.384	0.117	0.119
Log of land holding	0.051	0.051	0.066	0.065	0.041	0.041
	(0.037)	(0.037)	(0.045)	(0.045)	(0.055)	(0.055)
	0.168	0.173	0.137	0.146	0.454	0.458
Survey year						
2015	0.276***	0.274***	0.235**	0.234**	0.341***	0.340***
	(0.078)	(0.078)	(0.109)	(0.109)	(0.114)	(0.114)
	0.000	0.000	0.031	0.031	0.003	0.003
2018-19	0.528***	0.531***	0.345*	0.346*	0.694***	0.696***
	(0.146)	(0.146)	(0.196)	(0.196)	(0.208)	(0.208)
	0.000	0.000	0.078	0.077	0.001	0.001
Constant	-	-	-	-	-	-
	2.674***	2.698***	2.701***	2.751***	2.401***	2.410***
	(0.389)	(0.388)	(0.698)	(0.699)	(0.551)	(0.553)
	0.000	0.000	0.000	0.000	0.000	0.000
No. of observations	3,793	3,793	1,950	1,950	1,843	1,843
R-squared	0.136	0.136	0.133	0.133	0.189	0.189

Note: This table shows the results of the OLS regression where children's HAZ- a continuous variable- is the dependent variable. The first two coefficient columns respectively represent results from the main model and adding quantity of fish production with the main model in the case of the entire sample, while the later four columns represent results from the main model and adding quantity of fish production separately for boys and girls. Clustered (over household) robust standard errors are reported in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1. Also, regions (districts) are controlled for across all the models and children's survey weights are employed. The

reference categories are as follows- Mother's age below 18 years; Mother's education: no formal education; Mother's BMI: underweight; Survey year: 2011-12.

Table 2.10: Pooled Logit regression results (average marginal effects); dependent variable: children's stunting (HAZ<-2SD).

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Variable of interest(s)						
Fish-producing household (yes=1)	-0.018	-0.014	0.008	0.010	-0.052**	-0.046**
	(0.016)	(0.016)	(0.022)	(0.022)	(0.022)	(0.023)
	0.242	0.385	0.706	0.639	0.017	0.042
Fish production (100kg) per aeu		-0.026*		-0.013		-0.043
		(0.016)		(0.016)		(0.030)
		0.093		0.435		0.162
Number of crops produced	0.010	0.010	0.010	0.009	0.006	0.006
	(0.010)	(0.010)	(0.014)	(0.014)	(0.014)	(0.014)
	0.306	0.306	0.490	0.501	0.641	0.637
No. of livestock and livestock product produced	0.005	0.005	0.007	0.007	-0.001	0.001
	(0.016)	(0.016)	(0.022)	(0.022)	(0.023)	(0.023)
	0.745	0.752	0.744	0.767	0.964	0.965
Child characteristics						
Gender (female=1)	-0.009	-0.009				
	(0.015)	(0.015)				
	0.539	0.556				
Age	-	-	-	-	-	-
	0.020***	0.020***	0.018***	0.018***	0.022***	0.022***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
	0.000	0.000	0.000	0.000	0.000	0.000
Mother's characteristics						
Mother's age between 18 and 49	-0.021	-0.020	-0.017	-0.016	0.003	0.002
	(0.068)	(0.068)	(0.092)	(0.092)	(0.108)	(0.107)
	0.760	0.767	0.853	0.859	0.974	0.987
Mother's age above 49	-0.009	-0.009	0.153	0.152	-0.261	-0.263
	(0.105)	(0.105)	(0.127)	(0.127)	(0.211)	(0.210)
	0.931	0.929	0.228	0.231	0.215	0.212
Mother's education: below primary	-0.051**	-0.050*	-0.048	-0.048	-0.056	-0.054
	(0.026)	(0.026)	(0.035)	(0.035)	(0.035)	(0.035)
	0.046	0.050	0.170	0.167	0.108	0.119
Mother's education: primary complete	-	-	-0.056*	-0.056*	-0.066**	-0.065**
	0.061***	0.061***				
	(0.022)	(0.022)	(0.030)	(0.030)	(0.030)	(0.030)
	0.006	0.006	0.065	0.064	0.027	0.029
Mother's education: secondary complete	-0.072*	-0.071*	-0.034	-0.034	-0.127**	-0.122**
	(0.040)	(0.039)	(0.048)	(0.048)	(0.061)	(0.061)
	0.071	0.074	0.488	0.480	0.038	0.046
Mother's education: higher secondary complete	-0.130**	-0.127**	-0.115	-0.113	-0.135**	-0.129**
	(0.053)	(0.053)	(0.075)	(0.074)	(0.066)	(0.065)
	0.014	0.016	0.122	0.128	0.040	0.048
Mother's BMI: normal	0.004	0.005	-0.003	-0.002	0.024	0.024
	(0.018)	(0.018)	(0.024)	(0.024)	(0.026)	(0.026)
	0.824	0.799	0.908	0.925	0.369	0.359
Mother's BMI: overweight	-0.032	-0.032	-0.060	-0.059	0.010	0.010
	(0.028)	(0.028)	(0.037)	(0.037)	(0.038)	(0.038)
	0.243	0.254	0.106	0.113	0.794	0.797
Mother's BMI: obese	-0.061	-0.060	-0.113	-0.113	-0.015	-0.011

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	(0.056)	(0.056)	(0.077)	(0.077)	(0.079)	(0.078)
	0.276	0.279	0.139	0.140	0.854	0.886
Working mother (yes=1)	0.025	0.025	0.003	0.002	0.046*	0.046*
	(0.018)	(0.018)	(0.026)	(0.026)	(0.024)	(0.024)
	0.150	0.149	0.921	0.925	0.058	0.056
Household head's characteristics						
Gender head (female=1)	-0.014	-0.014	0.010	0.010	-0.040	-0.040
	(0.030)	(0.030)	(0.041)	(0.041)	(0.044)	(0.044)
	0.646	0.632	0.807	0.810	0.362	0.356
Household composition						
Household size	0.003	0.002	0.001	0.001	0.004	0.003
	(0.008)	(0.008)	(0.011)	(0.011)	(0.011)	(0.011)
	0.730	0.764	0.891	0.904	0.734	0.756
No. of children below 5 years	0.019	0.019	0.018	0.018	0.021	0.021
	(0.012)	(0.012)	(0.015)	(0.015)	(0.017)	(0.017)
	0.115	0.118	0.232	0.235	0.225	0.232
Number of household members between 16 and 65 years	-0.018*	-0.018*	-0.021	-0.021	-0.007	-0.007
	(0.010)	(0.010)	(0.015)	(0.015)	(0.014)	(0.014)
	0.088	0.085	0.151	0.146	0.624	0.614
Number of household members above 65 years	-0.007	-0.007	0.023	0.023	-0.046	-0.047
	(0.020)	(0.020)	(0.026)	(0.026)	(0.030)	(0.030)
	0.719	0.728	0.378	0.371	0.124	0.119
Household resources						
Having electricity connection	0.004	0.004	-0.005	-0.005	0.022	0.023
	(0.020)	(0.020)	(0.028)	(0.028)	(0.026)	(0.026)
	0.832	0.834	0.862	0.853	0.397	0.385
Value of livestock pc ('000)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.227	0.288	0.286	0.320	0.324	0.356
Agricultural asset index (PCA)	0.004	0.004	-0.002	-0.002	0.013	0.012
	(0.008)	(0.008)	(0.011)	(0.011)	(0.012)	(0.012)
	0.592	0.599	0.840	0.861	0.304	0.331
Non-agricultural asset index (PCA)	-0.021*	-0.019*	-0.025	-0.024	-0.022	-0.020
	(0.011)	(0.011)	(0.015)	(0.016)	(0.016)	(0.016)
	0.060	0.084	0.104	0.126	0.171	0.215
Poor household (yes=1)	0.015	0.014	-0.007	-0.007	0.034	0.033
	(0.020)	(0.020)	(0.029)	(0.029)	(0.027)	(0.027)
	0.472	0.479	0.813	0.821	0.217	0.229
Log of land holding	-0.012	-0.012	-0.016	-0.015	-0.008	-0.008
	(0.010)	(0.010)	(0.013)	(0.013)	(0.013)	(0.013)
	0.197	0.204	0.220	0.224	0.524	0.547
Survey year						
2015	-	-	-	-	-	-
	0.088***	0.087***	0.087***	0.086***	0.101***	0.099***
	(0.020)	(0.020)	(0.028)	(0.028)	(0.027)	(0.027)
	0.000	0.000	0.002	0.002	0.000	0.000
2018-19	-	-	-	-	-0.123**	-0.127**
	0.140***	0.141***	0.159***	0.158***		
	(0.038)	(0.038)	(0.054)	(0.054)	(0.054)	(0.054)
	0.000	0.000	0.003	0.003	0.023	0.019
No. of observations	3,790	3,790	1,946	1,946	1,822	1,822

Note: This table shows the average marginal effect results from the logit regression where children's stunting status (HAZ<-2SD)- a dummy variable- is the dependent variable. The first two coefficient columns respectively represent results from the main model and adding quantity of fish production with the main model in the case of the entire sample, while the later four columns represent results from the main model and adding quantity of fish production separately for boys and girls. Clustered (over household) robust standard errors are reported in the

parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1. Also, regions (districts) are controlled for across all the models and children's survey weights are employed. The reference categories are as follows- Mother's age below 18 years; Mother's education: no formal education; Mother's BMI: underweight; Survey year: 2011-12.

Table 2.11: Transitions of fish-producing households across different rounds of the survey.

	Involved in fish production (last round)		
Involved in fish production (first round)	No	Yes	Total
No	65.37	34.63	100
Yes	37.9	62.1	100
Total	55.02	44.98	100

Note: This table shows the transition of fish-producing households across panel survey years. The column yes/no shows the household fish production decision in the first round and the row yes/no shows the household fish production decision in the last round of the survey.

Table 2.12: Fixed Effects (FE) regression results; dependent variable: children's HAZ.

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Variable of interest(s)						
Fish-producing household (yes=1)	0.0001	0.004	0.082	0.082	-0.085	-0.080
	(0.064)	(0.064)	(0.090)	(0.091)	(0.091)	(0.091)
	0.998	0.946	0.366	0.371	0.350	0.379
Fish production (100kg) per aeu		-0.038		-0.001		-0.058*
		(0.034)		(0.060)		(0.033)
		0.256		0.986		0.081
Number of crops produced	-0.042	-0.039	-0.074	-0.074	-0.014	-0.008
	(0.046)	(0.046)	(0.077)	(0.077)	(0.044)	(0.044)
	0.363	0.396	0.335	0.336	0.742	0.850
No. of livestock and livestock product produced	-0.015	-0.016	0.028	0.028	-0.053	-0.051
	(0.057)	(0.057)	(0.088)	(0.088)	(0.074)	(0.074)
	0.789	0.787	0.747	0.747	0.473	0.490
Mother's BMI: normal						
	-0.022	-0.022	0.145	0.145	-0.148	-0.147
	(0.091)	(0.091)	(0.131)	(0.131)	(0.113)	(0.113)
Mother's BMI: overweight	0.806	0.810	0.268	0.269	0.190	0.191
	0.020	0.017	0.173	0.173	-0.094	-0.098
	(0.152)	(0.152)	(0.207)	(0.207)	(0.211)	(0.210)
Mother's BMI: obese	0.894	0.911	0.403	0.404	0.656	0.640
	-0.001	-0.005	0.268	0.267	-0.279	-0.291
	(0.250)	(0.250)	(0.348)	(0.348)	(0.337)	(0.337)
Working mother (yes=1)	0.996	0.984	0.443	0.443	0.408	0.387
	-0.086	-0.088	-0.082	-0.083	-0.113	-0.117
	(0.066)	(0.066)	(0.099)	(0.099)	(0.089)	(0.089)
	0.191	0.180	0.403	0.407	0.206	0.189
Household composition						
Household size	0.127***	0.126***	0.157**	0.157**	0.113*	0.111*
	(0.047)	(0.047)	(0.066)	(0.066)	(0.061)	(0.061)
	0.008	0.008	0.017	0.017	0.064	0.068
No. of children below 5 years	-	-	-0.046	-0.046	-	-
	0.150***	0.149***			0.268***	0.265***
	(0.056)	(0.056)	(0.081)	(0.081)	(0.071)	(0.071)
	0.008	0.008	0.571	0.571	0.000	0.000
Number of household members between 16 and 65 years	-0.057	-0.058	-0.194**	-0.194**	0.053	0.053

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	(0.060)	(0.060)	(0.088)	(0.088)	(0.078)	(0.077)
	0.342	0.337	0.027	0.027	0.492	0.493
Number of household members above 65 years	-0.066	-0.067	-0.369**	-0.369**	0.190	0.192
	(0.114)	(0.114)	(0.151)	(0.151)	(0.158)	(0.158)
	0.561	0.559	0.015	0.015	0.228	0.225
Household resources						
Poor household (yes=1)	-0.091	-0.090	-0.192	-0.192	-0.015	-0.013
	(0.095)	(0.095)	(0.156)	(0.156)	(0.112)	(0.112)
	0.341	0.347	0.219	0.220	0.897	0.904
Survey year						
2015	0.523***	0.526***	0.588***	0.588***	0.459***	0.466***
	(0.070)	(0.070)	(0.110)	(0.109)	(0.094)	(0.094)
	0.000	0.000	0.000	0.000	0.000	0.000
2018-19	1.198***	1.200***	1.141***	1.141***	1.215***	1.217***
	(0.142)	(0.142)	(0.231)	(0.230)	(0.165)	(0.166)
	0.000	0.000	0.000	0.000	0.000	0.000
Constant	-	-	-	-	-	-
	2.110***	2.109***	2.165***	2.165***	2.053***	2.058***
	(0.185)	(0.185)	(0.269)	(0.269)	(0.248)	(0.248)
	0.000	0.000	0.000	0.000	0.000	0.000
No. of observations	2,573	2,573	1,347	1,347	1,231	1,231
R-squared	0.328	0.328	0.299	0.299	0.383	0.385

Note: This table shows the results of the FE regression where children's HAZ- a continuous variable- is the dependent variable. The first two coefficient columns respectively represent results from the main model and adding quantity of fish production with the main model in the case of the entire sample, while the later four columns represent results from the main model and adding quantity of fish production separately for boys and girls. Robust standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1. The reference categories are as follows- Mother's BMI: underweight; Survey year: 2011-12.

Table 2.13: Fixed Effects (FE) regression results (average marginal effects); dependent variable: children's stunting (HAZ<-2SD).

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Variable of interest(s)						
Fish-producing household (yes=1)	-0.0001	-0.010	0.021	0.019	-0.097*	-0.108**
	(0.040)	(0.041)	(0.035)	(0.039)	(0.052)	(0.054)
	0.997	0.801	0.543	0.615	0.062	0.046
Fish production (100kg) per aeu		0.150**		0.089		0.204
		(0.073)		(0.074)		(0.267)
		0.041		0.226		0.444
Number of crops produced	0.020	0.022	0.018	0.023	0.009	0.011
	(0.026)	(0.027)	(0.025)	(0.029)	(0.033)	(0.034)
	0.456	0.410	0.484	0.429	0.782	0.737
No. of livestock and livestock product produced	0.026	0.025	-0.022	-0.024	0.128**	0.124**
	(0.036)	(0.036)	(0.023)	(0.026)	(0.052)	(0.054)
	0.481	0.495	0.339	0.354	0.014	0.021
Mother's BMI: normal						
	0.055	0.050	-0.029	-0.040	0.182***	0.184***
	(0.053)	(0.052)	(0.040)	(0.046)	(0.067)	(0.068)
Mother's BMI: overweight	0.292	0.342	0.458	0.380	0.006	0.007
	-0.158	-0.164	-1.349	-1.427	0.166	0.168
	(0.126)	(0.126)	(128.504)	(91.826)	(0.139)	(0.140)

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Mother's BMI: obese	0.210	0.193	0.992	0.988	0.232	0.229
	-0.020	-0.013	-2.572	-2.686	0.481**	0.498**
	(0.190)	(0.189)	(383.554)	(244.659)	(0.197)	(0.203)
Working mother (yes=1)	0.917	0.944	0.995	0.991	0.015	0.014
	-0.018	-0.024	0.001	-0.002	-0.026	-0.033
	(0.038)	(0.039)	(0.029)	(0.033)	(0.053)	(0.054)
	0.628	0.541	0.967	0.942	0.626	0.546
Household composition						
Household size	0.003	0.001	-0.044*	-0.050*	0.077*	0.076*
	(0.029)	(0.030)	(0.025)	(0.027)	(0.040)	(0.041)
	0.923	0.971	0.080	0.062	0.055	0.066
No. of children below 5 years	0.031	0.034	0.039	0.047	-0.001	-0.003
	(0.030)	(0.031)	(0.031)	(0.034)	(0.045)	(0.046)
	0.312	0.273	0.202	0.164	0.980	0.949
Number of household members between 16 and 65 years	-0.017	-0.013	0.036	0.048	-0.114**	-0.110**
	(0.037)	(0.037)	(0.035)	(0.042)	(0.053)	(0.053)
	0.641	0.730	0.316	0.252	0.032	0.038
Number of household members above 65 years	-0.121	-0.105	0.026	0.042	-0.582***	-0.573***
	(0.077)	(0.077)	(0.050)	(0.060)	(0.151)	(0.150)
	0.117	0.170	0.607	0.483	0.000	0.000
Household resources						
Poor household (yes=1)	-0.023	-0.029	0.053	0.049	-0.087	-0.084
	(0.048)	(0.048)	(0.058)	(0.060)	(0.060)	(0.060)
	0.634	0.543	0.359	0.414	0.152	0.165
Survey year						
2015	-0.230***	-0.236***	-0.094	-0.114	-0.326***	-0.332***
	(0.058)	(0.057)	(0.069)	(0.077)	(0.054)	(0.057)
	0.000	0.000	0.175	0.140	0.000	0.000
2018-19	-0.503***	-0.511***	-0.166	-0.202	-0.801***	-0.800***
	(0.141)	(0.136)	(0.140)	(0.157)	(0.112)	(0.119)
	0.000	0.000	0.235	0.199	0.000	0.000
No. of observations	811	811	405	405	401	401

Note: This table shows the average marginal effect results from FE Logit regression where children's stunting- a dummy variable- is the dependent variable. The first two coefficient columns respectively represent results from the main model and adding quantity of fish production with the main model in the case of the entire sample, while the later four columns represent results from the main model and adding quantity of fish production separately for boys and girls. Robust standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1. The reference categories are as follows- Mother's BMI: underweight; Survey year: 2011-12.

Table 2.14: Summary of Regression results; dependent variable: HAZ, explanatory variable: fish-producing household (yes=1).

Sample	Method	N	Coefficient	SE	P>t	95% Confidence Interval	
All	POLS	2573	0.171	0.058	0.003	0.057	0.284
	FE	2573	0.004	0.064	0.946	-0.121	0.130
Boys	POLS	1347	0.149	0.076	0.05	0.000	0.297
	FE	1347	0.082	0.091	0.371	-0.098	0.261
Girls	POLS	1231	0.215	0.082	0.009	0.054	0.376
	FE	1231	-0.080	0.091	0.379	-0.259	0.099

Note: This table shows coefficients of the fish production dummy variable and its standard error, p-values and confidence intervals from the pooled OLS (with panel sample) and FE regression results in case of children's HAZ dependent variable.

Table 2.15: Summary of Regression results; dependent variable: stunted, explanatory variable: fish-producing household (yes=1).

Sample	Method	N	Coefficient	SE	P>t	95% Confidence Interval	
All	POLS	811	-0.002	0.028	0.942	-0.057	0.052
	FE	811	-0.010	0.041	0.801	-0.090	0.069
Boys	POLS	405	0.048	0.042	0.250	-0.034	0.130
	FE	405	0.019	0.039	0.615	-0.056	0.095
Girls	POLS	401	-0.079	0.045	0.079	-0.166	0.009
	FE	401	-0.108	0.054	0.046	-0.213	-0.002

Note: This table shows average marginal effect estimates of the fish production dummy variable and its standard error, p-values and confidence intervals from the pooled OLS (with panel sample) and FE regression results in case of children's stunting status dependent variable.

2.8 Appendix A: Chapter two

Table A1: Fish type and percentage of households that produced each type of fish in a given time period.

Sl.	2011-12 (N=951)		2015 (N=1442)		2018-19 (N=2131)	
	Name	Percent	Name	Percent	Name	Percent
1.	Puti/Swarputi	16.3	Puti/Swarputi	11.9	Puti/Swarputi	15.2
2.	Shol/Gajar/Taki	11.8	Rui	11.6	Shol/Gajar/Taki	14.2
3.	Tengra/Baim	7.8	Silver carp	9.4	Tengra/Baim	9.5
4.	Other Small fish	7.8	Other Small fish	8.2	Koi	8.7
5.	Rui	7.7	Telapia/Nailotica	7.9	Shingi	7.6
6.	Silver carp	6.1	Mrigel	7.7	Other Small fish	6.2
7.	Koi	5.9	Katla	7.2	Rui	5.9
8.	Katla	5.0	Shol/Gajar/Taki	5.8	Silver carp	4.1
9.	Mrigel	4.6	Karfu	4.0	Mola/Dhela/Kachki/Chapila	4.1
10.	Telapia/Nailotica	4.2	Tengra/Baim	4.0	Telapia/Nailotica	4.0

Note: This table presents the 'top ten' types of fish produced in one year as reported by households in all three rounds of the BIHS survey. This 'top ten' ranking comprises the fish that are produced by the highest number of households irrespective of the quantity of the fish. Essentially, it shows the percentage of households that produce a particular type of fish.

Table A2: Fish type and percentage of households that consumed each type of fish in a week.

Sl.	2011-12 (N=6503)		2015 (N=6715)		2018-19 (N=6011)	
	Name	Percent	Name	Percent	Name	Percent
1.	Dried small fish	13.2	Dried small fish	13.8	Dried small fish	14.20
2.	Pangash	7.8	Pangash	10.1	Telapia	11.02
3.	Silver Carp	7.7	Telapia	9.3	Silver Carp	7.44
4.	Rui	6.4	Silver Carp	7.1	Pangash	7.26
5.	Panch mishali	6.4	Rui	5.8	Rui	7.10
6.	Puti	6.4	Panch mishali	4.3	Panch mishali	3.64
7.	Telapia	5.4	Gura mach	4.3	Puti	3.39
8.	Taki	5.0	Jatka	3.9	Taki	3.27
9.	Small fish	4.4	Puti	3.6	Mrigel	2.99
10.	Mrigel	4.1	Taki	2.7	Bata	2.93

Note: This table presents the 'top ten' types of fish consumed in a week as reported by households in all three rounds of the BIHS survey. When surveyed, respondents were asked to recall their fish consumption in the previous seven days. In this case, the 'top ten' ranking consists of the fish that are consumed by the highest number of households irrespective of the quantity of the fish. Basically, it shows the percentage of households that consume a particular type of fish.

Table A3: Average fish consumption and nutrient intake by division and divisional fish production.

Division	Fish (grams)	Energy (Kcal)	Protein (gram)	Iron (mg)	Zinc (mg)	Vitamin-A (rae)	Vitamin-B12 (ug)
Chattogram	96.9	2979.1	83.5	14.4	9.8	402.1	2.5
Khulna	80.4	3124.6	81.4	14.2	9.3	336.3	2.3
Mymensing	83.3	3204.6	84.0	14.1	9.7	324.1	2.2
Dhaka	88.1	3193.8	85.6	15.5	10.1	371.8	2.4
Rajshahi	68.3	3151.7	81.7	14.7	9.9	325.7	2.1
Barishal	67.1	2870.7	76.3	13.4	8.7	296.5	2.2
Sylhet	98.1	3216.6	85.1	14.8	10.1	396.0	2.3
Rangpur	47.9	3144.6	80.5	14.3	9.5	331.8	2.0

Note: This table presents the average per adult equivalent unit (AEU) fish consumption and nutrient intakes by division, whereby the divisions are sorted according to fish production and ranked from the highest fish-producing division to the lowest fish-producing division. The fish production data are taken from the Fisheries Statistical Yearbook (2011-12, 2014-15 and 2018-19).

Table A4: Average fish consumption and nutrient intake by division and poverty rate.

Division	Fish (grams)	Energy (Kcal)	Protein (gram)	Iron (mg)	Zinc (mg)	Vitamin-A (rae)	Vitamin-B12 (ug)
Dhaka	88.1	3193.8	85.6	15.5	10.1	371.8	2.4
Sylhet	98.1	3216.6	85.1	14.8	10.1	396.0	2.3
Chattogram	96.9	2979.1	83.5	14.4	9.8	402.1	2.5
Barishal	67.1	2870.7	76.3	13.4	8.7	296.5	2.2
Khulna	80.4	3124.6	81.4	14.2	9.3	336.3	2.3
Rajshahi	68.3	3151.7	81.7	14.7	9.9	325.7	2.1
Mymensing	83.3	3204.6	84.0	14.1	9.7	324.1	2.2
Rangpur	47.9	3144.6	80.5	14.3	9.5	331.8	2.0

Note: This table delineates the average per AEU fish consumption and nutrient intakes by division, whereby the divisions are sorted according to poverty rate, and ranked from the division with the lowest poverty rate to the division with the highest poverty rate. The division-wise poverty rates are taken from the Household Income and Expenditure Survey (HIES) conducted by the Bangladesh Bureau of Statistics.

Table A5: Comparison of average fish and nutrient intake between households from high fish-producing/poverty districts and low fish-producing/poverty districts.

Households from:	Fish (grams)	Energy (Kcal)	Protein (gram)	Iron (mg)	Zinc (mg)	Vitamin-A (rae)	Vitamin-B12 (ug)
Low fish-producing district (n=1432)	66.2	3140.1	81.8	14.5	9.7	336.4	2.1
High fish-producing districts (n=3092)	89.6	3170.2	84.3	14.9	10.0	363.8	2.3
Difference	23.4	30.1	2.5	0.4	0.3	27.4	0.2
P-value	0.000	0.280	0.003	0.050	0.008	0.001	0.003
High poverty district (n=2720)	78.4	3177.8	83.7	14.7	9.9	347.8	2.2
Low poverty district (n=1804)	92.3	3039.6	82.6	14.4	9.7	400.7	2.3
Difference	13.9	-138.2	-1.0	-0.4	-0.1	53.0	0.1
P-value	0.000	0.000	0.614	0.252	0.707	0.000	0.006

Note: In this case, high fish-producing districts are those that produce above the median fish production level and low fish-producing districts are those that produce below the median fish production level. On the other hand, low poverty districts are those which have a poverty rate lower than or equal to 15%. The p-values are obtained from statistical significance tests conducted between high and low fish-producing/ poverty districts.

Table A6: Pooled OLS regression results after adding household head's characteristics; dependent variable: children's HAZ.

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Variable of interest(s)						
Fish-producing household (yes=1)	0.168***	0.157***	0.144*	0.130*	0.213***	0.207**
	(0.058)	(0.058)	(0.075)	(0.075)	(0.082)	(0.084)
	0.004	0.007	0.054	0.085	0.010	0.014
Fish production (100kg) per aeu		0.041**		0.062		0.020
		(0.019)		(0.039)		(0.019)
		0.025		0.112		0.293
Number of crops produced	-0.016	-0.015	0.009	0.013	-0.026	-0.026
	(0.036)	(0.035)	(0.052)	(0.052)	(0.046)	(0.046)
	0.649	0.679	0.861	0.802	0.576	0.580
No. of livestock and livestock product produced	-0.037	-0.038	0.039	0.040	-0.095	-0.097
	(0.064)	(0.064)	(0.082)	(0.082)	(0.091)	(0.091)
	0.564	0.551	0.638	0.625	0.297	0.289
Child characteristics						
Gender (female=1)	0.038	0.037				
	(0.054)	(0.054)				
	0.481	0.499				
Age	0.070***	0.070***	0.066***	0.066***	0.072***	0.071***
	(0.010)	(0.010)	(0.015)	(0.015)	(0.015)	(0.015)
	0.000	0.000	0.000	0.000	0.000	0.000
Mother's characteristics						
Mother's age between 18 and 49	0.199	0.200	0.009	0.009	0.352	0.353

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	(0.253)	(0.253)	(0.502)	(0.504)	(0.244)	(0.244)
	0.432	0.430	0.986	0.986	0.149	0.148
Mother's age above 49	0.400	0.404	-0.471	-0.464	1.101***	1.103***
	(0.331)	(0.332)	(0.559)	(0.561)	(0.316)	(0.316)
	0.227	0.224	0.400	0.409	0.001	0.000
Mother's education: below primary	0.109	0.106	0.059	0.059	0.173	0.169
	(0.097)	(0.097)	(0.125)	(0.125)	(0.131)	(0.132)
	0.262	0.276	0.641	0.637	0.188	0.199
Mother's education: primary complete	0.177**	0.176**	0.200*	0.201*	0.180	0.178
	(0.085)	(0.085)	(0.110)	(0.110)	(0.120)	(0.120)
	0.038	0.040	0.070	0.068	0.134	0.139
Mother's education: secondary complete	0.444***	0.439***	0.380**	0.379**	0.618***	0.612***
	(0.130)	(0.130)	(0.160)	(0.160)	(0.203)	(0.203)
	0.001	0.001	0.018	0.018	0.002	0.003
Mother's education: higher secondary complete	0.388**	0.382**	0.452*	0.448*	0.367	0.362
	(0.185)	(0.185)	(0.254)	(0.254)	(0.239)	(0.240)
	0.037	0.039	0.075	0.078	0.125	0.131
Mother's BMI: normal	0.041	0.040	0.052	0.048	0.005	0.005
	(0.073)	(0.073)	(0.097)	(0.097)	(0.093)	(0.093)
	0.578	0.587	0.590	0.618	0.957	0.954
Mother's BMI: overweight	0.164*	0.158	0.206*	0.196	0.114	0.112
	(0.097)	(0.097)	(0.123)	(0.123)	(0.128)	(0.128)
	0.090	0.102	0.094	0.112	0.373	0.381
Mother's BMI: obese	0.337**	0.337**	0.639***	0.637***	0.062	0.062
	(0.163)	(0.163)	(0.244)	(0.244)	(0.194)	(0.194)
	0.039	0.039	0.009	0.009	0.751	0.751
Working mother (yes=1)	-	-	-0.122	-0.123	-0.239**	-0.240**
	0.188***	0.188***				
	(0.066)	(0.066)	(0.089)	(0.089)	(0.099)	(0.099)
	0.004	0.004	0.171	0.167	0.015	0.015
Household head's characteristics						
Gender head (female=1)	0.116	0.119	-0.023	-0.022	0.226	0.229
	(0.123)	(0.123)	(0.154)	(0.154)	(0.171)	(0.170)
	0.345	0.334	0.882	0.884	0.185	0.179
Age of head (logarithm)	-0.055	-0.048	-0.094	-0.089	-0.050	-0.046
	(0.112)	(0.113)	(0.149)	(0.149)	(0.157)	(0.158)
	0.624	0.667	0.527	0.551	0.748	0.771
Head's education: below primary	0.008	0.015	0.015	0.020	-0.025	-0.019
	(0.081)	(0.081)	(0.103)	(0.102)	(0.111)	(0.112)
	0.920	0.853	0.886	0.846	0.823	0.862
Head's education: primary complete	0.059	0.063	0.101	0.104	-0.008	-0.005
	(0.072)	(0.072)	(0.092)	(0.092)	(0.104)	(0.104)
	0.416	0.386	0.269	0.258	0.939	0.962
Head's education: secondary complete	0.045	0.047	0.116	0.116	-0.010	-0.007
	(0.169)	(0.169)	(0.235)	(0.234)	(0.197)	(0.197)
	0.793	0.779	0.622	0.621	0.961	0.972
Head's education: higher secondary complete	0.235	0.240	0.244	0.242	0.262	0.268
	(0.172)	(0.172)	(0.272)	(0.272)	(0.201)	(0.202)
	0.172	0.163	0.370	0.374	0.193	0.184
Household composition						
Household size	-0.024	-0.024	-0.010	-0.010	-0.034	-0.034
	(0.028)	(0.028)	(0.038)	(0.038)	(0.039)	(0.039)
	0.393	0.398	0.791	0.794	0.381	0.384
No. of children below 5 years	-0.093**	-0.094**	-0.082	-0.082	-0.113*	-0.113*
	(0.043)	(0.043)	(0.057)	(0.057)	(0.058)	(0.058)
	0.028	0.028	0.150	0.151	0.053	0.052
Number of household members between 16	0.094**	0.095**	0.032	0.034	0.125**	0.126**

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
and 65 years						
	(0.042)	(0.042)	(0.054)	(0.054)	(0.060)	(0.060)
	0.024	0.023	0.552	0.528	0.036	0.035
Number of household members above 65 years	0.016	0.016	-0.127	-0.128	0.143	0.143
	(0.067)	(0.067)	(0.095)	(0.095)	(0.093)	(0.093)
	0.809	0.807	0.180	0.176	0.124	0.124
Household resources						
Having electricity connection	-0.052	-0.052	-0.007	-0.004	-0.139	-0.139
	(0.071)	(0.071)	(0.100)	(0.100)	(0.096)	(0.096)
	0.466	0.467	0.948	0.964	0.148	0.147
Value of livestock pc ('000)	0.008*	0.007*	0.002	0.002	0.012*	0.012*
	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)
	0.058	0.059	0.677	0.739	0.060	0.061
Agricultural asset index (PCA)	-	-	-0.049	-0.049	-	-
	0.081***	0.080***			0.119***	0.118***
	(0.028)	(0.028)	(0.035)	(0.034)	(0.039)	(0.039)
	0.004	0.004	0.157	0.153	0.003	0.003
Non-agricultural asset index (PCA)	0.052	0.048	0.098*	0.091*	0.038	0.037
	(0.044)	(0.044)	(0.053)	(0.053)	(0.064)	(0.064)
	0.238	0.273	0.065	0.087	0.547	0.564
Poor household (yes=1)	-0.044	-0.043	0.114	0.114	-0.169*	-0.167
	(0.086)	(0.086)	(0.119)	(0.119)	(0.102)	(0.102)
	0.603	0.616	0.337	0.339	0.099	0.103
Log of land holding	0.053	0.053	0.065	0.064	0.043	0.042
	(0.037)	(0.037)	(0.044)	(0.044)	(0.054)	(0.054)
	0.150	0.155	0.141	0.149	0.426	0.430
Survey year						
2015	0.278***	0.276***	0.243**	0.242**	0.342***	0.340***
	(0.078)	(0.078)	(0.109)	(0.109)	(0.113)	(0.113)
	0.000	0.000	0.027	0.027	0.003	0.003
2018-19	0.539***	0.542***	0.362*	0.362*	0.701***	0.704***
	(0.146)	(0.146)	(0.197)	(0.197)	(0.208)	(0.208)
	0.000	0.000	0.067	0.066	0.001	0.001
Constant	-	-	-	-	-	-
	2.472***	2.522***	2.348***	2.417***	2.242***	2.267***
	(0.551)	(0.553)	(0.858)	(0.864)	(0.765)	(0.769)
	0.000	0.000	0.006	0.005	0.003	0.003
No. of observations	3,793	3,793	1,950	1,950	1,843	1,843
R-squared	0.137	0.137	0.134	0.135	0.190	0.191

Note: This table shows the results of the regression where children's HAZ- a continuous variable- is the dependent variable. The first two coefficient columns respectively represent results from the main model and adding quantity of fish production with the main model in the case of the entire sample, while the later four columns represent results from the main model and adding quantity of fish production separately for boys and girls. Clustered (over household) robust standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1. Also, regions (districts) are controlled for across all the models and children's survey weights are employed. The reference categories are as follows- Mother's age below 18 years; Mother's education: no formal education; Mother's BMI: underweight; Survey year: 2011-12; Household head's education: no formal education.

Table A7: Pooled Logit regression results (average marginal effects) after adding household head's characteristics; dependent variable: children's stunting (HAZ<-2SD).

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Variable of interest(s)						
Fish-producing household (yes=1)	-0.018	-0.013	0.009	0.011	-0.052**	-0.045**
	(0.016)	(0.016)	(0.022)	(0.022)	(0.022)	(0.022)
	0.258	0.408	0.685	0.623	0.018	0.046
Fish production (100kg) per aeu		-0.027*		-0.012		-0.044
		(0.016)		(0.016)		(0.031)
		0.097		0.456		0.161
Number of crops produced	0.010	0.010	0.009	0.009	0.007	0.007
	(0.010)	(0.010)	(0.014)	(0.014)	(0.014)	(0.014)
	0.324	0.325	0.518	0.530	0.628	0.624
No. of livestock and livestock product produced	0.005	0.005	0.006	0.005	-0.000	0.002
	(0.016)	(0.016)	(0.022)	(0.022)	(0.024)	(0.024)
	0.767	0.773	0.789	0.810	0.998	0.929
Child characteristics						
Gender (female=1)	-0.009	-0.008				
	(0.015)	(0.015)				
	0.555	0.573				
Age	-	-	-	-	-	-
	0.020***	0.020***	0.017***	0.017***	0.022***	0.022***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000	0.000	0.000
Mother's characteristics						
Mother's age between 18 and 49	-0.018	-0.017	-0.018	-0.017	0.009	0.007
	(0.068)	(0.068)	(0.092)	(0.092)	(0.108)	(0.108)
	0.790	0.797	0.847	0.852	0.935	0.948
Mother's age above 49	-0.019	-0.019	0.142	0.141	-0.261	-0.263
	(0.105)	(0.105)	(0.128)	(0.128)	(0.208)	(0.208)
	0.858	0.857	0.266	0.269	0.210	0.206
Mother's education: below primary	-0.046*	-0.045*	-0.044	-0.044	-0.051	-0.050
	(0.026)	(0.026)	(0.035)	(0.035)	(0.035)	(0.035)
	0.075	0.081	0.205	0.202	0.142	0.156
Mother's education: primary complete	-	-	-0.059*	-0.059*	-0.067**	-0.067**
	0.060***	0.060***				
	(0.023)	(0.023)	(0.031)	(0.031)	(0.031)	(0.031)
	0.008	0.008	0.060	0.058	0.030	0.032
Mother's education: secondary complete	-0.070*	-0.069*	-0.033	-0.034	-0.127**	-0.122*
	(0.041)	(0.041)	(0.050)	(0.050)	(0.063)	(0.062)
	0.085	0.088	0.507	0.497	0.043	0.052
Mother's education: higher secondary complete	-0.126**	-0.122**	-0.106	-0.105	-0.136**	-0.130*
	(0.054)	(0.054)	(0.076)	(0.076)	(0.069)	(0.068)
	0.021	0.023	0.165	0.169	0.048	0.056
Mother's BMI: normal	0.003	0.004	-0.001	-0.001	0.022	0.022
	(0.018)	(0.018)	(0.024)	(0.024)	(0.026)	(0.026)
	0.850	0.825	0.963	0.978	0.407	0.397
Mother's BMI: overweight	-0.032	-0.031	-0.059	-0.058	0.010	0.010
	(0.028)	(0.028)	(0.037)	(0.037)	(0.038)	(0.038)
	0.256	0.265	0.113	0.119	0.797	0.802
Mother's BMI: obese	-0.064	-0.064	-0.114	-0.114	-0.020	-0.017
	(0.056)	(0.056)	(0.077)	(0.077)	(0.080)	(0.079)
	0.251	0.253	0.136	0.137	0.806	0.835
Working mother (yes=1)	0.027	0.027	0.003	0.003	0.047*	0.047*
	(0.018)	(0.018)	(0.026)	(0.026)	(0.024)	(0.024)
	0.132	0.130	0.915	0.917	0.054	0.052

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Household head's characteristics						
Gender head (female=1)	-0.014	-0.014	0.007	0.007	-0.040	-0.041
	(0.030)	(0.030)	(0.041)	(0.041)	(0.044)	(0.044)
	0.646	0.631	0.867	0.869	0.365	0.355
Age of head (logarithm)	0.047	0.046	0.056	0.056	0.016	0.015
	(0.033)	(0.033)	(0.044)	(0.044)	(0.045)	(0.045)
	0.149	0.157	0.203	0.204	0.727	0.745
Head's education: below primary	-0.017	-0.018	0.003	0.003	-0.024	-0.025
	(0.023)	(0.023)	(0.031)	(0.031)	(0.034)	(0.034)
	0.463	0.439	0.927	0.932	0.474	0.453
Head's education: primary complete	0.015	0.015	0.027	0.027	0.012	0.013
	(0.020)	(0.020)	(0.027)	(0.027)	(0.028)	(0.028)
	0.453	0.448	0.327	0.326	0.673	0.649
Head's education: secondary complete	0.010	0.010	0.004	0.004	0.017	0.017
	(0.043)	(0.043)	(0.058)	(0.058)	(0.055)	(0.055)
	0.809	0.818	0.948	0.944	0.760	0.761
Head's education: higher secondary complete	-0.017	-0.016	-0.022	-0.020	-0.006	-0.006
	(0.050)	(0.050)	(0.075)	(0.075)	(0.057)	(0.057)
	0.731	0.751	0.769	0.787	0.916	0.912
Household composition						
Household size	0.001	0.001	-0.000	-0.000	0.003	0.003
	(0.008)	(0.008)	(0.011)	(0.011)	(0.011)	(0.011)
	0.852	0.885	0.989	0.978	0.756	0.776
No. of children below 5 years	0.020*	0.020*	0.020	0.020	0.022	0.021
	(0.012)	(0.012)	(0.015)	(0.015)	(0.017)	(0.017)
	0.090	0.093	0.184	0.186	0.216	0.224
Number of household members between 16 and 65 years	-0.020*	-0.020*	-0.023	-0.023	-0.008	-0.008
	(0.010)	(0.010)	(0.015)	(0.015)	(0.014)	(0.014)
	0.060	0.058	0.125	0.121	0.583	0.578
Number of household members above 65 years	-0.012	-0.012	0.017	0.017	-0.047	-0.048
	(0.020)	(0.020)	(0.027)	(0.027)	(0.030)	(0.030)
	0.535	0.547	0.528	0.520	0.115	0.112
Household resources						
Having electricity connection	0.006	0.006	-0.005	-0.005	0.025	0.025
	(0.020)	(0.020)	(0.028)	(0.028)	(0.026)	(0.026)
	0.775	0.775	0.857	0.848	0.347	0.332
Value of livestock pc ('000)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.232	0.294	0.289	0.319	0.361	0.400
Agricultural asset index (PCA)	0.004	0.004	-0.002	-0.002	0.012	0.011
	(0.008)	(0.008)	(0.011)	(0.011)	(0.012)	(0.012)
	0.607	0.616	0.833	0.851	0.319	0.350
Non-agricultural asset index (PCA)	-0.022**	-0.020*	-0.027*	-0.026	-0.023	-0.021
	(0.011)	(0.011)	(0.015)	(0.016)	(0.016)	(0.016)
	0.046	0.064	0.083	0.100	0.158	0.198
Poor household (yes=1)	0.015	0.014	-0.007	-0.006	0.034	0.033
	(0.020)	(0.020)	(0.029)	(0.029)	(0.027)	(0.027)
	0.474	0.481	0.815	0.823	0.213	0.225
Log of land holding	-0.013	-0.012	-0.016	-0.016	-0.008	-0.008
	(0.010)	(0.010)	(0.013)	(0.013)	(0.013)	(0.013)
	0.190	0.199	0.212	0.217	0.538	0.565
Survey year						
2015	-0.088***	-0.087***	-0.086***	-0.085***	-0.102***	-0.100***
	(0.020)	(0.020)	(0.029)	(0.029)	(0.027)	(0.027)
	0.000	0.000	0.003	0.003	0.000	0.000

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
2018-19	-	-	-	-	-0.126**	-0.131**
	0.141***	0.142***	0.157***	0.156***		
	(0.038)	(0.038)	(0.054)	(0.054)	(0.055)	(0.055)
	0.000	0.000	0.003	0.004	0.021	0.017
No. of observations	3,790	3,790	1,946	1,946	1,822	1,822

Note: This table shows the average marginal effect results from the Logit regression where children's stunting status (HAZ<-2SD)- a dummy variable- is the dependent variable. The first two coefficient columns respectively represent results from the main model and adding quantity of fish production with the main model in the case of the entire sample, while the later four columns represent results from the main model and adding quantity of fish production separately for boys and girls. Clustered (over household) robust standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1. Also, regions (districts) are controlled for across all the models and children's survey weights are employed. The reference categories are as follows- Mother's age below 18 years; Mother's education: no formal education; Mother's BMI: underweight; Survey year: 2011-12; Household head's education: no formal education.

Table A8: Pooled OLS regression results after adding regional characteristics; dependent variable: children's HAZ.

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Variable of interest(s)						
Fish-producing household (yes=1)	0.171***	0.160***	0.150**	0.135*	0.213***	0.208**
	(0.058)	(0.058)	(0.076)	(0.077)	(0.082)	(0.084)
	0.003	0.006	0.049	0.078	0.009	0.013
Fish production (100kg) per aeu		0.041**		0.064*		0.019
		(0.018)		(0.038)		(0.018)
		0.024		0.096		0.306
Number of crops produced	-0.015	-0.013	0.010	0.014	-0.024	-0.024
	(0.036)	(0.036)	(0.053)	(0.053)	(0.046)	(0.046)
	0.679	0.712	0.850	0.791	0.604	0.609
No. of livestock and livestock product produced	-0.039	-0.040	0.037	0.039	-0.100	-0.101
	(0.064)	(0.064)	(0.082)	(0.082)	(0.092)	(0.092)
	0.549	0.539	0.647	0.634	0.281	0.275
Child characteristics						
Gender (female=1)	0.037	0.036				
	(0.054)	(0.054)				
	0.492	0.509				
Age	0.070***	0.070***	0.066***	0.066***	0.073***	0.073***
	(0.010)	(0.010)	(0.015)	(0.015)	(0.014)	(0.014)
	0.000	0.000	0.000	0.000	0.000	0.000
Mother's characteristics						
Mother's age between 18 and 49	0.219	0.221	0.028	0.029	0.353	0.355
	(0.254)	(0.254)	(0.503)	(0.505)	(0.241)	(0.241)
	0.389	0.385	0.955	0.955	0.143	0.141
Mother's age above 49	0.395	0.401	-0.505	-0.497	1.078***	1.083***
	(0.331)	(0.332)	(0.552)	(0.555)	(0.304)	(0.304)
	0.233	0.227	0.361	0.370	0.000	0.000
Mother's education: below primary	0.116	0.114	0.073	0.074	0.166	0.164
	(0.096)	(0.096)	(0.123)	(0.123)	(0.128)	(0.129)
	0.226	0.236	0.553	0.549	0.196	0.205
Mother's education: primary complete	0.202**	0.201**	0.240**	0.241**	0.181	0.181
	(0.086)	(0.086)	(0.107)	(0.107)	(0.121)	(0.121)
	0.019	0.019	0.025	0.024	0.134	0.136
Mother's education: secondary complete	0.481***	0.477***	0.437***	0.436***	0.626***	0.621***
	(0.130)	(0.129)	(0.153)	(0.153)	(0.203)	(0.202)
	0.000	0.000	0.004	0.005	0.002	0.002
Mother's education: higher secondary complete	0.477***	0.473***	0.540**	0.535**	0.448*	0.446*
	(0.179)	(0.179)	(0.244)	(0.244)	(0.231)	(0.231)
	0.008	0.008	0.027	0.029	0.053	0.054

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Mother's BMI: normal	0.039	0.037	0.049	0.045	0.000	0.000
	(0.073)	(0.073)	(0.096)	(0.096)	(0.093)	(0.093)
	0.596	0.608	0.609	0.641	0.999	0.996
Mother's BMI: overweight	0.165*	0.159*	0.208*	0.197	0.116	0.115
	(0.097)	(0.097)	(0.123)	(0.123)	(0.130)	(0.130)
	0.088	0.099	0.091	0.109	0.370	0.376
Mother's BMI: obese	0.326**	0.326**	0.621**	0.618**	0.054	0.053
	(0.164)	(0.165)	(0.248)	(0.248)	(0.195)	(0.195)
	0.048	0.048	0.012	0.013	0.784	0.785
Working mother (yes=1)	-	-	-0.128	-0.129	-	-
	0.204***	0.205***			0.266***	0.267***
	(0.067)	(0.067)	(0.089)	(0.089)	(0.101)	(0.101)
	0.002	0.002	0.151	0.147	0.008	0.008
Household head's characteristics						
Gender head (female=1)	0.121	0.123	-0.011	-0.010	0.221	0.223
	(0.123)	(0.123)	(0.154)	(0.155)	(0.171)	(0.171)
	0.326	0.317	0.943	0.947	0.197	0.192
Household composition						
Household size	-0.021	-0.021	-0.012	-0.012	-0.025	-0.025
	(0.028)	(0.028)	(0.038)	(0.038)	(0.040)	(0.040)
	0.449	0.457	0.752	0.757	0.525	0.531
No. of children below 5 years	-0.094**	-0.095**	-0.080	-0.080	-0.113*	-0.114*
	(0.043)	(0.043)	(0.057)	(0.057)	(0.059)	(0.059)
	0.029	0.027	0.165	0.164	0.054	0.053
Number of household members between 16 and 65 years	0.081*	0.082**	0.022	0.024	0.108*	0.109*
	(0.042)	(0.042)	(0.052)	(0.053)	(0.060)	(0.060)
	0.052	0.049	0.677	0.647	0.073	0.072
Number of household members above 65 years	0.010	0.011	-0.131	-0.132	0.129	0.130
	(0.067)	(0.066)	(0.093)	(0.093)	(0.094)	(0.094)
	0.883	0.873	0.157	0.155	0.170	0.168
Household resources						
Having electricity connection	-0.055	-0.055	-0.004	-0.002	-0.142	-0.143
	(0.071)	(0.071)	(0.100)	(0.100)	(0.095)	(0.095)
	0.433	0.435	0.972	0.988	0.135	0.134
Value of livestock pc ('000)	0.007*	0.007*	0.002	0.001	0.012*	0.011*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)
	0.066	0.066	0.711	0.778	0.075	0.075
Agricultural asset index (PCA)	-	-	-0.051	-0.051	-	-
	0.083***	0.082***			0.120***	0.119***
	(0.028)	(0.028)	(0.034)	(0.034)	(0.039)	(0.039)
	0.003	0.004	0.140	0.136	0.002	0.002
Non-agricultural asset index (PCA)	0.063	0.060	0.106**	0.100*	0.054	0.053
	(0.044)	(0.044)	(0.053)	(0.054)	(0.064)	(0.064)
	0.151	0.174	0.046	0.062	0.398	0.409
Poor household (yes=1)	-0.052	-0.051	0.103	0.103	-0.168	-0.167
	(0.086)	(0.086)	(0.119)	(0.120)	(0.104)	(0.104)
	0.546	0.555	0.388	0.390	0.108	0.111
Log of land holding	0.054	0.054	0.068	0.066	0.045	0.045
	(0.037)	(0.037)	(0.045)	(0.045)	(0.055)	(0.055)
	0.147	0.152	0.130	0.139	0.407	0.411
Survey year						
2015	0.221***	0.219***	0.210*	0.208*	0.267**	0.265**
	(0.085)	(0.085)	(0.114)	(0.114)	(0.127)	(0.127)
	0.009	0.010	0.067	0.068	0.036	0.038
2018-19	0.475***	0.478***	0.323	0.323	0.617***	0.619***
	(0.151)	(0.151)	(0.198)	(0.198)	(0.223)	(0.223)
	0.002	0.002	0.103	0.103	0.006	0.006
Regional characteristics						
Low poverty district (high poverty=0)	0.112	0.109	0.360	0.354	0.087	0.085
	(0.209)	(0.209)	(0.385)	(0.386)	(0.290)	(0.290)
	0.590	0.603	0.351	0.358	0.763	0.770
High fish producing district (low fish producing district=0)	0.343	0.334	0.239	0.237	0.470	0.463
	(0.253)	(0.254)	(0.238)	(0.238)	(0.473)	(0.474)

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	0.176	0.188	0.315	0.321	0.321	0.330
Low poverty and high fish producing district (yes=1)	0.155	0.163	-0.226	-0.216	0.294	0.298
	(0.257)	(0.256)	(0.439)	(0.439)	(0.351)	(0.351)
	0.545	0.524	0.606	0.623	0.403	0.396
Constant	-	-	-	-	-	-
	2.961***	2.977***	2.920***	2.967***	2.795***	2.797***
	(0.465)	(0.465)	(0.735)	(0.735)	(0.723)	(0.724)
	0.000	0.000	0.000	0.000	0.000	0.000
No. of observations	3,793	3,793	1,950	1,950	1,843	1,843
R-squared	0.137	0.137	0.133	0.134	0.191	0.192

Note: This table shows the results of the regression where children's HAZ- a continuous variable- is the dependent variable. The first two coefficient columns respectively represent results from the main model and adding quantity of fish production with the main model in the case of the entire sample, while the later four columns represent results from the main model and adding quantity of fish production separately for boys and girls. Clustered (over household) robust standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1. Also, regions (districts) are controlled for across all the models and children's survey weights are employed. The reference categories are as follows- Mother's age below 18 years; Mother's education: no formal education; Mother's BMI: underweight; Survey year: 2011-12; regional characteristics interactions: high poverty and low fish-producing district.

Table A9: Pooled Logit regression results (average marginal effects) after adding regional characteristics; dependent variable: child's stunting (HAZ<-2SD)

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Variable of interest(s)						
Fish-producing household (yes=1)	-0.018	-0.014	0.008	0.010	-0.052**	-0.045**
	(0.016)	(0.016)	(0.022)	(0.022)	(0.022)	(0.023)
	0.241	0.379	0.712	0.647	0.020	0.046
Fish production (100kg) per aeu		-0.026*		-0.012		-0.043
		(0.016)		(0.016)		(0.031)
		0.093		0.443		0.172
Number of crops produced	0.011	0.011	0.010	0.010	0.007	0.008
	(0.010)	(0.010)	(0.014)	(0.014)	(0.014)	(0.014)
	0.265	0.264	0.475	0.485	0.589	0.586
No. of livestock and livestock product produced	0.006	0.006	0.009	0.008	-0.001	0.001
	(0.016)	(0.016)	(0.022)	(0.023)	(0.023)	(0.023)
	0.712	0.721	0.700	0.722	0.967	0.970
Child characteristics						
Gender (female=1)	-0.008	-0.008				
	(0.015)	(0.015)				
	0.589	0.606				
Age	-	-	-	-	-	-
	0.020***	0.020***	0.017***	0.017***	0.022***	0.022***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
	0.000	0.000	0.000	0.000	0.000	0.000
Mother's characteristics						
Mother's age between 18 and 49	-0.021	-0.020	-0.017	-0.016	0.004	0.002
	(0.068)	(0.067)	(0.092)	(0.092)	(0.106)	(0.106)
	0.761	0.767	0.853	0.858	0.968	0.981
Mother's age above 49	-0.004	-0.004	0.167	0.166	-0.257	-0.259
	(0.104)	(0.104)	(0.125)	(0.125)	(0.209)	(0.209)
	0.973	0.970	0.181	0.183	0.218	0.214
Mother's education: below primary	-0.048*	-0.047*	-0.046	-0.047	-0.054	-0.053
	(0.025)	(0.025)	(0.034)	(0.034)	(0.034)	(0.034)
	0.058	0.063	0.178	0.175	0.116	0.127
Mother's education: primary complete	-	-	-0.058*	-0.058*	-0.064**	-0.063**
	0.060***	0.059***				

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	(0.022)	(0.022)	(0.030)	(0.030)	(0.030)	(0.030)
	0.007	0.007	0.057	0.055	0.033	0.036
Mother's education: secondary complete	-0.070*	-0.069*	-0.036	-0.036	-0.124**	-0.119*
	(0.040)	(0.039)	(0.048)	(0.048)	(0.062)	(0.061)
	0.075	0.079	0.464	0.456	0.044	0.053
Mother's education: higher secondary complete	-0.128**	-0.124**	-0.112	-0.110	-0.134**	-0.127**
	(0.053)	(0.052)	(0.074)	(0.074)	(0.065)	(0.065)
	0.015	0.017	0.130	0.135	0.041	0.050
Mother's BMI: normal	0.004	0.005	-0.003	-0.002	0.024	0.025
	(0.018)	(0.018)	(0.024)	(0.024)	(0.026)	(0.026)
	0.808	0.782	0.910	0.927	0.361	0.351
Mother's BMI: overweight	-0.030	-0.030	-0.060	-0.059	0.012	0.012
	(0.028)	(0.028)	(0.037)	(0.037)	(0.039)	(0.039)
	0.275	0.286	0.107	0.114	0.759	0.765
Mother's BMI: obese	-0.059	-0.059	-0.112	-0.111	-0.015	-0.012
	(0.056)	(0.055)	(0.077)	(0.077)	(0.079)	(0.078)
	0.284	0.288	0.146	0.147	0.844	0.876
Working mother (yes=1)	0.027	0.028	-0.001	-0.001	0.054**	0.055**
	(0.018)	(0.018)	(0.027)	(0.027)	(0.025)	(0.025)
	0.133	0.128	0.961	0.959	0.030	0.028
Household head's characteristics						
Gender head (female=1)	-0.014	-0.015	0.008	0.008	-0.040	-0.040
	(0.030)	(0.030)	(0.041)	(0.041)	(0.044)	(0.044)
	0.632	0.618	0.844	0.846	0.363	0.356
Household composition						
Household size	0.002	0.002	0.001	0.001	0.003	0.003
	(0.008)	(0.008)	(0.011)	(0.011)	(0.011)	(0.011)
	0.743	0.776	0.901	0.913	0.776	0.795
No. of children below 5 years	0.018	0.018	0.018	0.018	0.021	0.021
	(0.012)	(0.012)	(0.015)	(0.015)	(0.017)	(0.017)
	0.120	0.123	0.234	0.237	0.229	0.235
Number of household members between 16 and 65 years	-0.017*	-0.018*	-0.021	-0.021	-0.007	-0.007
	(0.010)	(0.010)	(0.015)	(0.015)	(0.014)	(0.014)
	0.089	0.085	0.151	0.146	0.643	0.629
Number of household members above 65 years	-0.008	-0.008	0.021	0.022	-0.046	-0.046
	(0.020)	(0.020)	(0.026)	(0.026)	(0.030)	(0.030)
	0.675	0.684	0.408	0.400	0.123	0.119
Household resources						
Having electricity connection	0.005	0.005	-0.004	-0.005	0.023	0.024
	(0.019)	(0.019)	(0.028)	(0.028)	(0.026)	(0.026)
	0.805	0.809	0.880	0.871	0.371	0.362
Value of livestock pc ('000)	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.226	0.284	0.275	0.307	0.340	0.371
Agricultural asset index (PCA)	0.005	0.005	-0.001	-0.001	0.013	0.012
	(0.008)	(0.008)	(0.011)	(0.011)	(0.012)	(0.012)
	0.536	0.547	0.893	0.914	0.280	0.310
Non-agricultural asset index (PCA)	-0.021*	-0.020*	-0.026*	-0.025	-0.022	-0.020
	(0.011)	(0.011)	(0.015)	(0.016)	(0.016)	(0.016)
	0.051	0.072	0.086	0.105	0.154	0.201
Poor household (yes=1)	0.015	0.015	-0.006	-0.006	0.033	0.032
	(0.020)	(0.020)	(0.029)	(0.029)	(0.027)	(0.027)
	0.462	0.470	0.828	0.836	0.220	0.233
Log of land holding	-0.013	-0.013	-0.016	-0.016	-0.010	-0.009
	(0.010)	(0.010)	(0.013)	(0.013)	(0.013)	(0.013)
	0.163	0.171	0.196	0.199	0.453	0.479
Survey year						
2015	-0.079***	-0.078***	-0.088***	-0.088***	-0.085***	-0.083***
	(0.021)	(0.021)	(0.031)	(0.031)	(0.029)	(0.029)

	All		Boys		Girls	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	0.000	0.000	0.004	0.005	0.004	0.005
2018-19	-	-	-	-	-0.105*	-0.108*
	0.132***	0.132***	0.163***	0.162***		
	(0.039)	(0.039)	(0.055)	(0.055)	(0.056)	(0.056)
	0.001	0.001	0.003	0.003	0.062	0.054
Regional characteristics						
Low poverty district (high poverty=0)	-0.116	-0.114	-0.275**	-0.274**	-0.049	-0.046
	(0.072)	(0.072)	(0.126)	(0.126)	(0.091)	(0.091)
	0.104	0.110	0.029	0.029	0.591	0.613
High fish producing district (low fish producing district=0)	-0.078	-0.073	-0.051	-0.051	-0.083	-0.071
	(0.073)	(0.073)	(0.099)	(0.099)	(0.126)	(0.126)
	0.286	0.315	0.607	0.605	0.510	0.573
Low poverty and high fish producing district (yes=1)	0.054	0.051	0.255*	0.254*	-0.045	-0.049
	(0.082)	(0.082)	(0.137)	(0.137)	(0.109)	(0.109)
	0.512	0.534	0.063	0.064	0.679	0.651
No. of observations	3,790	3,790	1,946	1,946	1,822	1,822

Note: This table shows the average marginal effect results from the Logit regression where children's stunting status (HAZ<-2SD)- a dummy variable- is the dependent variable. The first two coefficient columns respectively represent results from the main model and adding quantity of fish production with the main model in the case of the entire sample, while the later four columns represent results from the main model and adding quantity of fish production separately for boys and girls. Clustered (over household) robust standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1. Also, regions (districts) are controlled for across all the models and children's survey weights are employed. The reference categories are as follows- Mother's age below 18 years; Mother's education: no formal education; Mother's BMI: underweight; Survey year: 2011-12; regional characteristics interactions: high poverty and low fish-producing district.

CHAPTER 3: HEALTH SHOCKS AND COPING STRATEGIES AMONG RURAL HOUSEHOLDS: EVIDENCE FROM BANGLADESH

3.1 Introduction

Negative shocks and uncertainties play an integral role in the lives of households from low and middle-income countries and are often associated with the high incidence of transient and chronic poverty among these households (Banerjee & Duflo, 2011). These shocks can be of many types: health, economic, social, and natural, among others. Each of these shocks has both short and long-term implications for the households; for example, the shocks often trigger a reduction of consumption and income in the short run which, in turn, may lead to malnutrition and poverty in the long run (Heltberg & Lund, 2009). Amidst these different shocks or uncertainties, this paper focuses on health shocks.

In this chapter, a household is considered to be facing a health shock if it reports the death, injury, or illness of a household member which, in turn, leads to the household experiencing unexpected financial hardship. The question in the survey is designed in such a way that a shock is only considered as a health shock if households suffer financially after the health shock. So, any death or injury that does not cause financial hardship is not considered as a health shock. A health shock is often influenced by the socioeconomic and demographic background of a household. As such, a similar illness or even death might be a shock- or a certain magnitude of shock- for one family but not for others depending on their composition and socioeconomic status. Health shocks have several adverse impacts on households' well-being which include the days that someone might miss work and the subsequent loss of productivity and the loss of income (García-Gómez, van Kippersluis, O'Donnell, & van Doorslaer, 2013; Wagstaff, 2007), in addition to health care costs. These shocks are not only detrimental at the micro level- i.e., to the individual and the household under consideration - but can also adversely impact the overall economy and even lead to lower economic growth (Wang, Lee, Lin, & Tsai, 2018). The focus of this paper is to explore the characteristics of the households affected by health shocks, and to examine the ways that households cope with the financial losses that are caused by illness or death, or in other words, the mechanisms that are adopted to cope with health shocks.

This paper focuses on health shocks for several reasons. First, health shocks are widespread and are a huge burden, especially on poor households in developing countries, as these households are less resilient to negative shocks (Heltberg & Lund, 2009; Wagstaff & Lindelow, 2014). Evidently, more than half of the negative shocks reported by households in Pakistan were health-related shocks, while 30% of the households in Laos that reported health shocks in a one-year period were mainly concentrated among poor households (Heltberg & Lund, 2009; Wagstaff & Lindelow, 2014). Also, due to lower access to quality healthcare, low purchasing power and the lack of education, poor households are more prone to facing health shocks (Atake, 2018). Second, health shocks often make non-poor households poor- approximately 100 million people fall into poverty every year due to health shocks (World Bank, 2014).

The question remains: Why are poor households affected more by health shocks, especially in developing and least developed countries? There may be several answers to this- for example, lack of universal health coverage (UHC), lower overall health associated with poverty, and formal private insurance mechanisms, to mention a few. Evidently, poor people are less likely to have health insurance which makes them more vulnerable to facing health shocks (Bhusal & Sapkota, 2021). Thus, it may be the case that it is not only a problem of quality but an issue of overall access. Additionally, healthcare expenditure statistics are often a reflection of the disparity between the poor and the rich in terms of facing health shocks. According to the World Bank, out-of-pocket healthcare expenditures were 48.17% and 43.21% of the total healthcare expenditure, respectively, for lower-middle-income and low-income countries, while they were only 13.63% for high-income countries in 2019 (The World Bank, 2022). Accordingly, many low and middle-income countries (LMIC) are trying to achieve universal health coverage (Giedion, Alfonso, & Diaz, 2013). Essentially, since health shocks have the potential to impact some households adversely- more likely households with low socioeconomic background-, for example, by making households poorer- governments need to understand how the shocks affect households and also how the households cope with these shocks, especially if governments aim to achieve Sustainable Development Goals (SDG), e.g., goal number 3 of ‘Good Health and Wellbeing’ (UNDP, 2022).

With this backdrop, identifying the households that are more likely to be exposed to health shocks and the subsequent coping mechanisms that these households adopt are both necessary steps in driving the design and implementation of social safety net programs that can be helpful for such households, especially in the context of developing countries (Bonfrer & Gustafsson-

Wright, 2017). This is especially important, as effective efforts to implement better social safety net programs and insurance schemes are often dependent on country-specific and context-specific factors (Dercon, 2004).

There is little evidence on this important topic in the context of developing countries, and evidence is especially scarce in the case of Bangladesh- a lower-middle-income South Asian nation. This paper aims to contribute to this gap in the literature and addresses two fundamental questions in the context of Bangladesh: (i) Which households are more likely to be associated with health shocks? Are vulnerable households[21] more prone to facing health shocks? (ii) What coping mechanisms do households use in the face of health shocks? The coping strategies I consider are asset coping, loan coping, and any coping at all (which includes the previous two coping strategies as well). Asset coping happens when a household sells any asset to cope with health shocks, loan coping is when households take financial help from any institutions or individual, and other coping includes eating less food, changing jobs, and sending children to work. The motivation behind focusing on the coping strategies adopted by households in the face of health shocks stems from the assumption that the coping strategies may provide some valuable insights into how severely people suffer from health shocks, and thus, into the potential adverse impacts of the health shocks in both the short-run and long-run.

The context of Bangladesh is an apt setting for the focus of this paper for two key reasons. First, despite being an emerging economy that has been maintaining a steady GDP growth rate of over 6% since 2000, public health care services in Bangladesh remain of low quality and have not improved much, which adversely affects especially vulnerable households. The public health expenditure, in Bangladesh, was 2.48% of GDP in 2019 and 2.07% of GDP in 2000, which is low compared to the public health expenditure in other developing countries with a good track record of GDP growth- India 3.01%, Malaysia 3.83%, Bhutan 3.61%, and Vietnam 5.25% of GDP (The World Bank, 2022). In the absence of good public healthcare services and with the lack of increasing public healthcare expenditure, it may be difficult for any nation to achieve, and maintain, its path towards better economic growth (Bidani & Ravallion, 1997;

[21] Household vulnerability has multiple definitions and is measured differently in different studies. For instance, Garikipati (2008) includes indicators of vulnerability such as drought-related, livelihood diversity, entrepreneurial behavior, and investment in and access to social capital. On the other hand, McCormack et al. (2020) use low household income, at least one uninsured household member, and the availability of at least one person aged 65 or above as vulnerability factors. In addition, Ali et al. (2020) generate a financial vulnerability index using household income, consumption, physical wealth and rental payments. This chapter considers low household income and female-headed households as measures of household vulnerability.

Gupta, Verhoeven, & Tiongson, 2002; Bhalotra, 2007; Farahani, Subramanian, & Canning, 2010).

Second, Bangladesh is densely populated and this, coupled with poor access to health care services, increases the risk, magnitude, and potential for the incidence of health problems[22]. According to the World Population Review, Bangladesh was the 6th most densely populated country in the world in 2020. Further, in terms of the ratio of healthcare provisions to population, healthcare facilities in Bangladesh are limited with only 0.8 hospital beds per thousand people in 2016 as opposed to 1.7 in Bhutan in 2012 and 2.5 in the UK in 2019, and 0.6 registered physicians per thousand persons in 2019 as opposed to 0.9 in India and 5.8 in the UK in 2019. Also, in 2019, out-of-pocket payments accounted for about 72.6% of private health expenditure in Bangladesh, relative to 17.8% in Bhutan, 17% in the case of the UK, and 13% in the case of the USA (The World Bank, 2022).

In this paper, I use data from the Bangladesh Integrated Household Survey (BIHS), which is nationally representative of rural Bangladesh. My analysis focuses on rural households in Bangladesh as they have comparatively poorer infrastructure, a lower number of hospitals per capita, and most importantly, a lower number of physicians and nurses per capita- thus, lower access to healthcare services (Islam M. T., 2019). For instance, there are only 11 doctors per 100,000 population in rural Bangladesh as compared to 182 doctors per 100,000 population in urban Bangladesh (Ahmed, Evans, Standing, & Mahmud, 2013). Further, according to the Bangladesh Population and Housing Census 2022, 68% of the population in Bangladesh live in rural areas. This makes exploring the health shocks and coping strategies among rural households in Bangladesh even more important considering the fact that a much larger share of the population faces limited access to health care in rural areas compared to urban areas in Bangladesh.

The main findings of this paper suggest that households, in general, are more likely to be associated with health shocks and less likely to adopt coping strategies in the face of the shocks in 2018-19 as compared to 2011-12. This increase in health shocks could be a reflection of an increase in chronic illnesses among households (Saquib, Saquib, Ahmed, Khanam, & Cullen,

[22] One example of how population density might increase health shocks is the rampant presence of colds and flu in the winter seasons, and the spread of other infectious diseases, as was evidenced during the Covid-19 epidemic (Diao et al., 2021).

2012), and the decreasing adoption of coping strategies could be due to the potential increase in savings due to recent GDP growth in the country (Liu & Ma, 2022). Additionally, there is no significant difference between male-headed and female-headed households in terms of facing health shocks. However, female-headed households are less likely to adopt coping strategies compared to male-headed households. The reason behind this may be that, due to credit market constraints, female-headed households save more money in the process of preparing for unforeseen negative incidents or they might not have any means to cope with the shocks. It may also simply mean that female-headed households falls further into poverty.

The rest of the paper is structured as follows. In the following section, I discuss the relevant literature on health shocks and coping strategies. I then present the empirical approach and data before presenting the results of the descriptive analysis and the regression analysis. In the final section, I conclude by discussing the contributions and future scope of this study.

3.2 Relevant literature

The studies that focus on health shocks and their adverse effects can be divided into three strands: (1) Severity of health shocks in terms of different types of shocks, (2) Coping strategies related to health shocks, and (3) Nature of the effects of coping strategies (whether short-run or long-run).

The first strand of studies focus on the fact that health shocks are the most important negative shock[23] out of many shocks both in terms of frequency and adverse impacts. The study by Wagstaff & Lindelow (2014), for instance, finds that health shock is the most common negative shock, and it mainly affects poor households. Based on data from three provinces in Laos with different topographic, demographic, and socio-economic conditions, the authors state that more than 30% of households are affected by health shocks, and nearly 40% are affected by agricultural shocks such as drought, crop loss, and livestock diseases. Similarly, according to Kenjiro (2005), health shocks are not only the most common, but also, economically, they cause more damage than crop failure in the case of agricultural households in Cambodia. Using household data from two villages, the author concludes that households can cope with crop

[23] Throughout this paper, negative shocks mean unexpected financial hardships faced by households.

failure by earning additional income, but they cannot bear the lump-sum cost of illness with any additional income in a short time.

Several more studies find that health shocks are the most important types of shocks in the lives of people in low and middle-income countries (Asfaw & von Braun, 2004; Gertler & Gruber, 2002; Lindelow & Wagstaff, 2005). For instance, four rounds of the Ethiopian Rural Household Survey 1993, 1994, 1995, and 1997 suggest that illness has a significant negative impact on household consumption (Asfaw & von Braun, 2004). Using four rounds of the China Health and Nutrition Survey- a longitudinal survey conducted in 1991, 1993, 1997, and 2000- Lindelow & Wagstaff (2005) find that health shocks decrease income by 12.4% and increase medical expenditures by 17.6%. The study covered both rural and urban households in nine out of 33 provinces in China. Also, health shocks are found to be the most frequent and prevalent among all negative shocks in someone's life (Heltberg & Lund, 2009; Bonfrer & Gustafsson-Wright, 2017).

The second strand of studies investigate the coping strategies adopted in the face of health shocks. For example, a meta-analysis study based on 62 papers (including 3 papers on Bangladesh) by McIntyre et. al. (2006) finds that households are forced to adopt coping strategies such as selling assets, reducing food consumption, and taking loans, after health shocks. The most immediate response due to a health shock is using cash and savings. However, it is observed that only a small proportion of households have access to cash or savings, as the majority of the households affected by health shocks have to rely on other coping strategies. Accordingly, employing data from two villages in Cambodia, Kenjiro (2005) concludes that households are bound to sell their assets and borrow money so that they can cope with medical expenditures. In addition, another study based on 15 African countries by Leive & Xu (2008), employing World Health Survey data 2002-2003 and a series of logit regressions for different coping strategies, shows that 23% of Zambian households, 68% of households in Burkina Faso, 45% of Kenyan households in the lowest income quintile, and 22% of Kenyan households in the highest income quintile depend on borrowing and selling assets for bearing their health expenditure. This indicates that, often, not only poor/vulnerable households but also rich households face difficulties in coping with health shocks. Interestingly, there is no evidence of a significant difference in coping strategies between the rich and poor in Cote d'Ivoire, Mauritania, and Senegal. However, female-headed households as compared to male-headed

households, and urban households as compared to rural households are less likely to adopt coping strategies.

Importantly, not adopting a coping strategy does not always mean that a household has high access to savings. It could be that they are the most vulnerable and have no savings, no assets to sell, and nobody from whom they can borrow. For instance, Bonfrer & Gustafsson-Wright (2017) show that Kenyan households (1226 agricultural households) often use coping strategies such as using savings and selling assets which have some long-term implications but that poorer households are less likely to use savings as a coping strategy and more likely to do nothing in the case of a health shock. This might imply that the most vulnerable households are the ones who are more affected by health shocks.

The third and final strand of studies shed light on whether the effects of coping strategies in the face of health shocks have short-term or long-term implications. Under this strand, Flores et al. (2008), using a nationally representative cross-sectional survey data from India, show that the coping strategies adopted by households to tackle health shocks might ensure short-term basic needs but might also have long-term adverse consequences. For instance, selling livestock or productive assets- especially those which are a part of the livelihood of households- as a coping strategy in the case of a health shock may lead to the reduction of households' future income and this may, in turn, increase future economic vulnerability.

On the other hand, pulling children out of school and forcing them to enter the labour force to earn money can harm the human capital development of children and can lead to low earnings for them in the future. For example, a set of logit regressions with longitudinal data of 100,000 children in Brazil shows that household heads becoming unemployed during a four-month recall period leads to an increase in the employment of sixteen-year-old girls in the households (Duryea, Lam, & Levison, 2007). Additionally, borrowing money from relatives as a coping strategy forces households in Cambodia to remain in debt for a long time even after a health shock is over (Damme, Leemput, Hardeman, & Meessen, 2004). Using a follow-up survey one year after the health shocks, the study finds that 62% of households who have borrowed money to cope with health shocks are still in debt. Also, donations- not only lending- during a health shock can also harm the donating households as revealed by Grimm et al. (2011). The authors, using a sample of small entrepreneurs in Burkina Faso, find that donations to the extended

family for health expenditure purposes make the donating household trade-off with profitable investments, which has a long-term adverse impact on business progress and future income.

Among the above-mentioned three strands of literature, there is a gap in evidence in terms of health shocks and coping strategies in the case of Bangladesh and particularly a lack of using panel methods to account for time-invariant heterogeneous factors. Thus, this study aims to fill this gap by providing empirical evidence using a panel dataset.

3.3 Data and methodology

3.3.1 Data

In this study, I use data from three rounds of the Bangladesh Integrated Household Survey (BIHS) 2011-12, 2015, and 2018-19. BIHS is a longitudinal survey conducted by the International Food Policy Research Institute (IFPRI) and it is statistically representative at the following levels:

i. Nationally representative of rural Bangladesh
ii. Representative of the rural areas of each of the seven divisions in Bangladesh

Since the dataset is representative of rural Bangladesh, the findings can be extrapolated to all rural households in Bangladesh, and perhaps to other similar contexts. The BIHS is the only nationally representative panel survey of rural Bangladesh that captures detailed information on negative shocks, including health shocks, that are faced by households in a certain period. It covers 6500 households in 325 primary sampling units. However, the rurally representative sample households are 4423, 4619, and 4886 respectively in 2011-12, 2015, and 2018-19.

In the survey, the information on negative shocks is collected from a male respondent in the household regardless of whether it is a male-headed or female-headed household- except when the data is collected from a female if there is no male in the household. The respondents were given a list of negative shocks and asked if they were affected by them in the last five years in the first wave, between the first and second wave of the survey in the second wave, and between the second and third wave in the third wave. The households are asked about the ‘bad surprises’

or things that hurt them financially, and the exact question was: *Has any shock occurred in this household in the last five years* (first wave) or since the baseline in 2011 (second wave) or since the mid-line in 2015 (third wave)? The households were given a list of health shocks, such as the death of the main earner, death of any other household member, injury or illness, and chronic illness, and then asked if they were financially affected negatively by each of these shocks separately. One point to note is that any death or injury or illness is only considered as health shock when it has financial impact. Also, the perception of what constitutes a health shock can vary from household to household depending on the socioeconomic status of the household. For instance, the same injury or illness or death may be a shock to some households, but not to others. This implies that that these issues may lead to bias in the estimates, especially since there is no way to measure these different perceptions from the data in the survey. So, it is important that readers keep these issues in mind when interpreting the estimates.

Once a household reported that they had faced a health shock- they were then asked how they had coped with the shock. The exact question was: *What did you do to cope with its (negative shocks) effect*? Accordingly, the households were given a list of coping strategies that included but were not limited to: taking a loan either from a bank, NGO, or relatives; changing jobs; sending non-earning members (including children) to the job market; selling different types of assets; eating less food, and eating poor quality food. The respondents also had the option to choose 'no coping strategy used'. In answering the above question, households were given a list of 25 coping strategies (same for every household) and asked to choose up to three coping strategies from the list in the case of a particular shock. For simplicity of the analysis, I use the coping strategy that households choose first- assuming it is the most important one- which could also be 'no coping'. Also, since it is only compulsory to mention one coping strategy (i.e., the second and third ones are optional), using the first two coping strategies leads to a significant number of households being dropped and the sample size becoming much lower. If a household mentions 'no coping' as its first coping strategy, it does not provide any coping strategies for the second and third choice. Moreover, since the information on both health shocks and coping strategies is collected as a few years recall (5 years for the first wave, 4 years for the second wave, and 3 years for the third wave), there may be some measurement errors depending on respondents' memory.

I start the analysis by looking at all the households and identifying those which face health shocks. The households with health shocks are then divided into two groups; households that

face only health shocks and households that face both health shocks and some other negative shocks as well. I then focus on the sub-sample of households who reported health shocks (including households that either reported only health shocks or reported both health shocks and any other shocks) and explore the coping strategies used by these households. Table 3.1 shows the distribution of households that reported different negative shocks in each wave. According to Table 3.1, health shock is the most prevalent shock- reported by 30%, 23%, and 45% of households respectively in 2011-12, 2015, and 2018-19- among the rural households in all the three waves.

3.3.2 Estimation strategy

In this study, I investigate, first, which households are associated with health shocks in rural Bangladesh and, second, what coping strategies households use in the face of health shocks. Two types of regressions have been employed for these purposes. First, I explore whether the prevalence of health shock has changed over time, and who is likely to face more of it. Second, I explore the correlates of different types of coping strategies of the households affected by health shocks. Accordingly, pooled ordinary least squares (OLS), logistic regression, and fixed effects regression are employed. The estimation models are as follows:

$$\Pr(H_{id} = 1 | X_{id}, d) = \alpha_0 + \sum_{j=2}^{3} \gamma_j d_j + \alpha_1 X_{id} + \varepsilon_{id} \quad \text{.....(1)}$$

$$\Pr(Cop_{id} = 1 | Z_{id}, d) = \beta_0 + \beta_1 Z_{id} + \sum_{j=2}^{3} \gamma_j d_j + e_{id} \quad \text{.....(2)}$$

Here, H_{id} is the health shock dummy variable of household i at year/wave d (it takes '1' if a household is affected by health shocks and '0' if a household is not affected by any health shocks), X_{id} is the vector of other covariates, $\sum_{j=2}^{3} d_j$ are the wave/year dummies, Cop_{id} is the coping strategy dummy (it takes '1' if household adopted a particular coping strategy and '0' if a household did not adopt any coping strategies), Z_{id} is the vector of household and regional characteristics, and ε_{id}, and e_{id} are the error terms of household i in wave d.

3.4 Descriptive analysis

This section focuses on the descriptive analysis regarding health shocks, the severity of health shocks, and coping strategies across rural Bangladesh. In addition, since Bangladesh is still a patriarchal society and patriarchy is more prevalent in rural areas, I explore whether households having female heads might have some association with health shocks and coping strategies.

I compare the difference between male-headed and female-headed households in terms of how many of them are affected by health shocks. Table 3.2 shows the percentage of male and female-headed households affected by any health shocks and disaggregated by the type of health shock. It shows that there is no significant difference in health shocks across male and female-headed households in 2011-12 and 2018-19, but that a higher number of female-headed households were affected by health shocks in 2015. Interestingly, more female-headed households are affected by death-related shocks, and fewer of them are affected by income loss or medical expense-related shocks. Since female-headed households are more likely to be affected by death-related shocks, there might be an association between females becoming household heads and the death of male household heads. The results indicate that households with a health shock from the death of the main earner are 29 percentage points more likely to be female-headed, and households with a health shock from the death of other earners are 5 percentage points more likely to be female-headed as compared to households with no health shocks (see Table B1 in the appendix).

The households are asked about the extent to which health shocks have affected their economic and food conditions, and I discuss the severity of the shocks for the first two waves and the third wave separately as the question about the severity of shocks has changed in the third wave. In the first two waves, households are asked about the current condition after health shocks- i.e., just one question about the change in their current condition. On the other hand, in the third wave, households are asked separately about current economic and food conditions after health shocks. The severity of health shocks among households is shown in Table 3.3 and Table 3.4. Tables 3.3 shows the severity of health shocks in 2011-12 and 2015, and Table 3.4 shows the severity of health shocks in terms of economic and food conditions in 2018-19. A higher number of female-headed households as compared to male-headed households report that they are worse than before after health shocks both in 2011-12 and 2015 (Tables 3.3). However, the

last row of Table 3.3 shows that there is no significant difference in the average monetary loss due to health shocks across male and female-headed households in the first two waves.

Since waves 1 and 2 use the same definition of severity, I have compared the transition matrix between these two waves in Table B2. Table B2 shows that 19% and 6% of the households reported being the 'same as before' and 'better than before' after health shocks in wave 2, and that these are households which initially reported being 'worse than before' in wave 1 after a health shock. On the other hand, 70% and 27% of the households reported being 'worse than before' and 'same as before' after health shocks in wave 2, and that these are households which initially reported being 'better than before' in wave 1 after a health shock. This indicates that the households, irrespective of the severity they report in the first wave, report worse conditions in the second wave- implying that health shocks hurt more later than before. Similar to waves 1 and 2, a higher proportion of female-headed households as compared to male-headed households fall into extremely severe economic and food conditions after health shocks in 2018-19 (Table 3.4). This might suggest that the female-headed households are using some food coping as a strategy, and that the impact of health shocks is worse for female-headed households compared to male-headed households across all the three waves.

I next look at how the coping strategies have changed over time and across households. Table 3.5 shows the broad categories[24] of the main coping strategies that households adopt in the face of health shocks. Between the first wave in 2011-12 and the third wave in 2018-19, the number of households that do not adopt coping strategies has increased. Accordingly, the percentage of households that adopted different types of coping strategies has decreased between the waves. In particular, the percentage of households adopting a 'no coping' strategy has increased from 25% to 35%, the percentage of households who coped by selling their assets has decreased from 16% to 8%, the percentage of households who asked for a loan or financial help has decreased from 29% to 27%, and the percentage of households who faced food insecurity has slightly increased from 3.3% to 3.7% over the period 2011-12 and 2018-19. Among these, an increase in food insecurity is aligned with the finding, shown in Table 3.4, that the food condition was worse in 2018-19 as a result of a health shock.

[24] The full list of coping strategies and how they have been grouped into different categories is given in Table B3 (Appendix B).

What about the differences in adopting coping strategies across male-headed and female-headed households? Table 3.6 shows the comparison between the percentage of male and female-headed households that adopted different types of coping mechanisms in the three waves. A higher proportion of female-headed households compared to male-headed households did not adopt any coping mechanism in 2011-12 and 2015, and the proportion of households that adopted no coping strategy is almost similar across different households in 2018-19. A lower percentage of female-headed households adopt asset coping, and loan coping as compared to male-headed households, and a higher percentage of female-headed households adopt food insecurity coping. Lower asset coping and loan coping for female-headed households might indicate that they have no assets to sell and no source from which to borrow money. Accordingly, higher food insecurity coping for female-headed households could indicate that they adjust their food consumption due to a health shock since they do not have much cash, savings, financial help or assets to sell.

The Government of Bangladesh (GoB) devotes a significant annual budget for social safety net programmes in the form of cash allowance, public works, education, and health incentives for the poor and vulnerable (The World Bank, 2019). This in turn allows poor and vulnerable households to cope with poverty and expand human capital. Thus, the use of, or the reliance on, social safety net programmes could potentially be used by households as a coping mechanism, since these programs could provide some support during health shocks. Table 3.7 compares the adoption of coping strategies across social safety net participatory and non-participatory households in all the waves. In most cases, a higher number of participatory households adopt coping strategies as compared to non-participatory households in the face of health shocks. This might be implying that vulnerable households are already in the social safety net programmes and, as such, have more means to cope with the shocks that they face.

In essence, the descriptive statistics show that a higher number of households are affected by health shocks and a lower number of households adopt coping mechanisms in 2018-19 as compared to 2011-12 and 2015. Additionally, female-headed households are more likely to be affected by death related shocks and less likely to be affected by income or medical expense related shocks as compared to male-headed households. Moreover, the severity of health shocks on economic and food conditions is worse in the case of female-headed households. All these findings warrant a deeper investigation- hence, further analysis is conducted and presented in the following sections.

3.5 Results and discussion

3.5.1 Results from the regression analysis

In this section, I explore the association, if any, between health shocks and coping strategies using regression methods controlling for other relevant factors. Following Nguyen et al. (2020), I use different household and regional characteristics that might be correlated with health shocks and coping strategies as control variables, such as: household size, demographic dependency ratio, consumption expenditure per capita, education, gender of the household heads, domestic and international migration dummies, year dummies, and division dummies. The household size is calculated as the sum of individuals residing in a household; the demographic dependency ratio is the ratio of dependent household members (0-15 years of age and above 65) to working-age household members (15-65 years of age); consumption expenditure per capita is calculated by aggregating households' total food and non-food consumption divided by household size; the gender dummy variable takes '1' if a household head is female and '0' otherwise; domestic and international (this variable is used as a proxy for remittances in the households) dummies each take '1' if there is at least one member who migrated within the country and outside the country respectively; and there are six divisional dummies as Bangladesh has seven divisions. The migration dummies are used because remittance is one of the most prominent income sources in rural Bangladesh (Sutradhar, 2020). Table 3.8 shows the average differences between the control variables across male and female-headed households. It reveals that female-headed households are negatively associated with household size, working-age members, household savings, and household assets. On the other hand, female-headed households are positively associated with demographic dependency, per capita expenditure, and domestic and international migrants.

Table 3.9 shows both the OLS and Logit regression results of health shocks using a range of explanatory variables. The dependent variable only includes households who reported health shocks in the reference period (yes=1) and households who never reported a shock (no=0)- not even shocks other than health shocks. According to the results, there is no significant difference in facing health shocks between male and female-headed households once we control for other covariates. Also, households are less likely to be associated with health shocks in 2015 and more likely to be associated with health shocks in 2018-19 as compared to 2011-12. In general,

in terms of the LPM results, households are 15 percentage points less likely to be associated with health shocks in 2015, and 5 percentage points more likely to be affected by health shocks in 2018-19 as compared to 2011-12. Further, households with higher assets, with higher educated (secondary and higher secondary as compared to no formal education) household heads, and with at least one international migrant in the household are less likely to be associated with health shocks.[25] In particular, households with secondary completed and higher secondary completed household heads are 3-6 percentage points less likely to be associated with health shocks as compared to households with 'no formal' educated heads. It is concerning that vulnerable households such as households with low-educated heads and low assets, and households in recent years, are more likely to be associated with health shocks. How do they cope with the shocks? How do they bear the cost of the financial burden? Has it become easier or harder to tackle the shocks? I aim to answer some of these questions below.

I explore how households cope with the shocks- that is, the correlates of the coping strategies that households adopt to face health shocks. In terms of coping strategies, I separately focus on asset and loan coping because these are the two biggest coping strategies that households generally adopt. Table 3.10 displays the LPM regression coefficients in the case of different coping strategies. It indicates that female-headed households as compared to male-headed households, households with primary completed or graduate household heads, and households with higher expenditures are less likely to adopt asset coping, loan coping, and any coping strategy at all, irrespective of the sample. This implies that most of the households which are already vulnerable- such as low-income households and households with low-educated heads- are more likely to cope by selling assets or by taking loans to bear the cost of health shocks as they might have little to no savings. In addition, households are less likely to adopt asset coping, loan coping, and any coping strategy at all, in 2018-19 compared to 2011-12- irrespective of the sample. Particularly, female-headed households are respectively 5-8 percentage points, 14-16 percentage points, and 6.7-7.7 percentage points less likely to adopt asset coping, loan coping, and any coping at all, as compared to male-headed households- this is applicable across different groups and for different kinds of coping strategies. If household expenditure per capita increases by one percentage point- asset coping, loan coping and any coping respectively decreases by 0.041 percentage points, 0.07-0.08 percentage points, and 0.048-0.05 percentage

[25] Note that the results do not suggest that having higher assets or education, or having an international migrant in the household, prevents deaths and illnesses in the household. The findings suggest that death and illness do not cause financial hardship for the household.

points- this is also applicable across different groups and for different kinds of coping strategies. This indicates that rich households need less coping than poor households as they can bear the expenditure by using the cash in their hands or savings.

Furthermore, the results reveal mixed evidence, whereby vulnerable households such as female-headed households and non-vulnerable households such as households with higher income are less likely to adopt coping strategies. The finding that comparatively higher-income households take fewer coping strategies makes sense since they are more likely to have a higher amount of cash and savings. Nonetheless, it would be worth exploring why female-headed households are adopting fewer coping strategies. Also, group 1 households[26] with domestic migrants and those with a higher number of working-age members are more likely to adopt loan coping- this potentially indicates that they can access loans, especially as they might be considered as households which could repay loans. Households that are part of some social safety net programmes are also more likely to adopt a coping strategy, implying that social safety net programs have some positive association with health shock coping.

There are no regional patterns in the case of adopting coping strategies across rich and poor regions. For example, households from comparatively rich[27] regions such as Dhaka and Sylhet, as compared to Barisal, are less likely to adopt asset coping, loan coping, or any coping strategy at all. Similarly, households from comparatively poor regions such as Rajshahi, as compared to Barisal, are also less likely to adopt asset coping, loan coping, or any coping strategy at all. Therefore, regional resource variations do not have any particular association with adopting coping strategies.

3.5.2 Discussion

Some of the most noteworthy findings of this paper and their implications warrant highlighting, and I discuss these as follows. First, households appear to be associated with more health shocks and adopt fewer coping strategies in 2018-19 as compared to 2011-12. This may indicate that either households suffer more from illnesses and other health shocks over time, or that the intensity of health shocks, e.g., acute/chronic illness, has increased over time. Moreover,

[26] Group 1 households: Households that are affected by both health and non-health shocks; Group 2 households: Households that are only affected by health shocks.
[27] Using regional poverty estimates from the latest Household Income and Expenditure Survey (HIES) 2016.

it is possible that some households are richer in the latest wave compared to the first wave and consequently rely less on coping strategies and more on their savings. Also, people who reported no coping in the survey likely rely on savings, especially since households in Bangladesh often use savings to cope with adult noncommunicable-disease-death (Mirelman, et al., 2019). Indeed, even the urban poor in Bangladesh use at least some savings to cope with health shocks (Khan, Bedi, & Sparrow, 2015).

Second, vulnerable households such as households with lower assets and households with low educated household heads are more likely to be associated with health shocks. This is understandable as these households are from disadvantaged socio-economic backgrounds and have fewer resources. Third, interestingly, female-headed households as compared to male-headed households are not more likely to be affected by health shocks after adjusting for covariates, but they are less likely to adopt a coping strategy. This may indicate that females are more far-sighted and save more for unforeseen negative events. This is just an inference as the dataset does not allow us to verify this- the savings information and the information on health shocks have a separate time reference in the BIHS survey (the health shocks refer back to 3 to 5 years but savings refer to the current time or at most only one year).

There is a way, however, to verify the assertion that female-headed households save more, and this is explored in Table 3.11. The percentage of households that save money in two different recall periods and the average amount of savings are shown in Table 3.11. A higher number of male-headed households, as compared to female-headed households, have savings now and also had savings in the last year in the case of all the three waves. In contrast, there are no significant differences in the average amount (in BDT[28]) of current savings across female-headed and male-headed households. This implies that female-headed households are not more prone to saving, and that the amount of savings across the two types of households is also similar. Thus, the finding that female-headed households are less likely to adopt 'no coping' after health shocks may not be because of the more savings that they have but rather due to other reasons. Moreover, female-headed households are less likely to have access to financial institutions, government and NGO support, and even financial support from friends and family.

[28] Bangladeshi taka (Bangladeshi currency).

It is evident that women as compared to men face multiple constraints in accessing credit (Almeyda, 1996; Lycette & White, 1989). This hurts households' welfare (Fletschner, 2008) as it is well known that females having relatively more control over household resources has significant positive effects on children's education, health, and nutrition (Pitt, Khandker, Chowdhury, & & Millimet, 2003; Pitt & Khandker, 1998). Consequently, I explore whether there is any significant difference in loan accessibility and in-kind consumption support- which are not part of the coping strategy question- between male-headed and female-headed households (Table 3.12). Regarding information on the loan accessibility, respondents are asked about the number of loans that every household member currently has. The in-kind consumption support information is derived from the consumption module where household consumption data is collected for the last 7 days. I find that there is no significant difference between female-headed and male-headed households in terms of receiving in-kind consumption support.

On the contrary, a lower number of female-headed households have loan access and the average number of people accessing loans in female-headed households is also lower than that of male-headed households. The reason behind this could be that they have a lower number of working-age members, and this has a positive association with loan coping as shown in Table 3.8. This may indicate that females have significantly less access to credit than males.

Moreover, it cannot be concluded that female-headed households adopting fewer coping strategies is necessarily a bad thing. On the contrary, it could be a good thing that female-headed households as compared to male-headed households require fewer coping strategies in the face of health shocks. For instance, it could be the case that female-headed households do not need to resort to adopting coping strategies because they solve their financial problems faster on their own. However, it is still not clear how such female-headed households solve the financial problems resulting from health shocks, and it is not possible to explore in this study as there is a lack of data.

3.5.3 Robustness checks

This section considers some robustness checks to examine the robustness of the LPM regression results, from the previous section, in the case of health shocks and coping strategies.

For instance, Table B4 shows the regression results of the same specification as Table 3.10 using logit regression. The logit regression results indicate qualitatively similar results to the LPM regression results, whereby rich households, female-headed households, and households in general, in 2015 and 2018-19 as compared to 2011-12, are less likely to adopt coping strategies. Additionally, controlling for household time-invariant unobservable heterogeneous characteristics, I run household FE regressions in the case of both health shocks and coping strategies respectively in Table B5 and Table B6. FE estimates indicate that female-headed households are more likely to be associated with health shocks, and are only less likely to adopt asset coping, in each case compared to male-headed households. Also, having a higher number of working-age members in a household is related to adopting loan coping. This indicates that female-headed households may have lower access to loans since the households supposedly have a lower number of adult males and working-age members.

3.6 Conclusion and policy implications

The aim that this study sets out to reach is to explore which households are more vulnerable to health shocks, and also the coping strategies adopted by households after health shocks, in the context of rural Bangladesh. This is very important, both in the context of Bangladesh and in the context of other developing countries, as it can help policymakers to understand the severity of health shocks and to design social safety net policies so that vulnerable households can get benefits in the face of health shocks and other negative shocks.

The contribution of this study is threefold. Firstly, it identifies the most vulnerable households i.e., households that are most likely to face a health shock. This informs public policy, especially in terms of targeting policy and determining who should be the primary focus of health-related policies. Secondly, it provides evidence on how households bear the burden of health shocks, and in doing so, it sheds light on where the focus of the public policy should be most concentrated. Finally, these two contributions combined contribute to the debate on universal health insurance in low-income countries by arguing for the design and delivery of such insurance schemes, and also pave the path towards streamlining useful and effective health policy, monitoring, and social safety nets.

Employing three rounds of the BIHS panel dataset, the descriptive statistics suggest that a higher number of households are associated with health shocks and a lower number of households adopt coping strategies in 2018-19 as compared to 2011-12. Since the GDP per capita has increased over time between 2011 and 2018 (The World Bank, 2022), households' pursuit of fewer coping strategies might be explained by the potential increase in savings due to increases in per capita income across Bangladesh- assuming that the benefits of growth are equally distributed. However, this cannot be captured by including savings in the regression models due to different reference periods for coping/shocks and savings.

Essentially, it is worrying that even when income increases, people often face more health shocks and struggle to maintain medical expenditures in the most recent wave. Understanding why this is the case is beyond the scope of this study but there is scope for future research to explore this. I also find that a higher number of female-headed households as compared to male-headed households are associated with health shocks. Additionally, the severity of shocks is also worse in the case of female-headed households. On the contrary, a comparatively lower number of households adopt coping strategies to overcome a health shock.

Accordingly, the regression results suggest that households with low socio-economic backgrounds, such as households with low assets and households with low-educated household heads, are more likely to be associated with health shocks, and that female-headed households are less likely to adopt coping strategies. This may indicate that the vulnerable households are the ones that are worst affected by health shocks as they potentially have fewer sources of support. This has far-reaching adverse implications for reducing inequality and poverty in least-developed countries such as Bangladesh.

If vulnerable households continue to be disproportionally associated with health shocks, it would be more difficult to maintain poverty reduction and the inequality would be even higher than in the current condition. Additionally, due to credit market imperfection, vulnerable households such as female-headed households are less likely to adopt coping strategies that might bind them to saving more money, and eventually, such households become prone to using their savings instead of taking out a loan or selling assets during a health shock. To conclude, I advocate that the government and policymakers should focus more on vulnerable households by facilitating and easing financial support for such households, especially according to their needs resulting from any negative health shocks or disasters.

3.7 TABLES

Table 3.1: Percentage of households affected by negative shocks.

Shock type	2011-12	2015	2018-19
No shock	2978 (45.8%)	4190 (62.4%)	2951 (49.1%)
Natural shocks	4227 (6.5%)	215 (3.2%)	481 (8.0%)
Health shocks	1957 (30.1%)	1531 (22.8%)	2675 (44.5%)
Economic shocks	1873 (28.8%)	725 (10.8%)	739 (12.3%)
Social shocks	371 (5.7%)	423 (6.3%	162 (2.7%)
Miscellaneous	267 (4.1%)	242 (3.6%)	132 (2.2%)
Sample households	6503	6715	6011

Note: This table shows the percentage of households affected by different types of negative shocks. Full list of coping strategies and how they have been grouped into different categories is given in Table B3 (Appendix B).

Table 3.2: Incidence of different types of health shocks across male and female-headed households.

	2011-12			2015			2018-19		
	Male	Female	Difference	Male	Female	Difference	Male	Female	Difference
Death of main earner	1.8	21.1	19***	3.6	23.1	19.5***	1.6	12.6	11***
Death of any member	3.4	5.6	2.2*	5.5	6.1	0.61	7.1	10.2	3.2**
Loss of income due to illness	15.1	9.1	-6.1***	19.9	11.0	-8.9**	8.2	6.5	-1.8
Medical expenses	79.7	64.3	-15***	71.1	59.8	-11.3	64.3	53.4	-10.9***
Severe illness	.	.	.	.	.		18.9	17.4	-1.6
Any health shocks	39.9	38.9	-1.1	27.1	32.0	4.9***	51.5	50.2	-1.36
N	1585	375		1173	346		2084	588	

Note: This table shows the comparison between the percentage of male and female-headed households affected by different types of health shocks in three waves of the BIHS survey. Also, *** p<0.01, ** p<0.05, * p<0.1.

Table 3.3: Severity of health shocks in the first and second wave.

			Current condition after health shocks			
			Worse than before	Same as before	Better than before	The Average monetary loss (in BDT) due to health shocks
2011-12	Male head (n=1585)	Mean	65.6%	23.7%	10.7%	39872
		SD	0.48	0.43	0.31	88930
	Female head (n=375)	Mean	74.4%	20.3%	5.3%	36093
		SD	0.44	0.40	0.22	89392
		Mean difference	8.85*	-3.45	-5.4***	-3779
2015	Male head (n=1173)	Mean	71.7%	22.3%	6.1%	46238
		SD	0.45	0.42	0.24	98681
	Female head (n=346)	Mean	76.0%	19.7%	4.3%	37424
		SD	0.43	0.40	0.20	93175

	Mean difference	4.31***	-2.6	-1.71	-8814

Note: This table shows the comparison between the percentage of male and female-headed households' current conditions after health shocks, and the average loss in Bangladeshi taka/currency (BDT) after health shocks in the first two waves of the BIHS survey.

Table 3.4: Intensity of health shocks in the third wave.

Economic condition	Male head (n=2084)	Female head (n=588)	Difference
Not Severe	4.27	2.89	-1.38
	0.15	0.12	
Somewhat severe	20.97	19.22	-1.75
	0.31	0.30	
Severe	40.74	37.59	-3.15
	0.41	0.39	
Extremely Severe	34.02	40.31	6.29**
	0.38	0.40	
Food condition			
Not Severe	15.64	11.05	-4.59***
	0.27	0.23	
Somewhat severe	29.37	31.46	2.09
	0.36	0.36	
Severe	31.24	28.91	-2.33
	0.37	0.35	
Extremely Severe	23.75	28.57	4.82*
	0.33	0.35	

Note: This table shows the comparison between the percentage of male and female-headed households' current economic and food conditions after health shocks in the third wave of the BIHS survey. Every second row shows the standard errors. Also, *** p<0.01, ** p<0.05, * p<0.1.

Table 3.5: Percentage of households adopting different coping strategies.

Coping category	2011-12	2015	2018-19
No coping	24.9	28.7	35.1
Asset coping	15.8	11.5	7.52
Loan coping	28.7	29	26.9
Food insecurity coping	3.32	5.17	3.67
Miscellaneous coping	27.2	25.6	26.8
No. of observations	1960	1529	2672

Note: This table shows the percentage of households that adopted different types of coping strategies after health shocks in three waves of the BIHS survey.

Table 3.6: Coping mechanism across male and female-headed households

	2011-12		2015		2018-19	
Coping type	Male	Female	Male	Female	Male	Female
None	23.5	30.7	28.1	30.4	35.2	35.0
Asset coping	17.1	10.4	12.7	7.8	7.9	6.1
Loan coping	31.0	18.9	31.0	21.7	29.3	18.2
Food insecurity coping	2.7	5.9	4.4	7.5	3.4	4.8
Miscellaneous coping	25.6	34.1	23.7	32.7	24.2	35.9
No. of cases	1585	375	1173	346	2084	588

Note: This table shows the comparison between the percentage of male and female-headed households that adopt different types of coping strategies in three waves of the BIHS survey.

Table 3.7: Percentage of the households adopting coping strategies according to their participation in social safety net programmes status.

	2011-12		2015		2018-19	
	Participation in social safety net programmes					
Coping strategies	No	Yes	No	Yes	No	Yes
None	28	21.93	32.31	24.04	39.14	31.1
Asset coping	15.78	15.85	11.28	11.8	8.04	7
Loan coping	26.54	30.81	26.67	32.01	22.99	30.8
Food insecurity coping	2.4	4.19	4.94	5.46	2.98	4.37
Miscellaneous coping	27.27	27.22	24.79	26.7	26.86	26.73
Total (percentage)	100	100	100	100	100	100

Note: This table shows the comparison between the percentage of social safety net participatory and non-participatory households that adopt different types of coping strategies in three waves of the BIHS survey.

Table 3.8: Comparison of the characteristics between male and female-headed households.

Variables	Male-headed households (n=4842)	Female-headed households (n=1309)	Difference	P-value
Household size	4.47	3.22	-1.25	0.000
Demographic dependency ratio	74.63	118.69	44.06	0.000
Number of working-age members	2.71	1.67	-1.04	0.000
Domestic immigrant dummy	0.07	0.14	0.06	0.000
International immigrant dummy	0.02	0.06	0.04	0.000
Asset index	0.07	-0.45	-0.52	0.000
Per capita expenditure (log)	7.96	8.11	0.15	0.000
Participation in the social safety net programs	0.45	0.44	0.00	0.951
The ratio of in-kind consumption help	0.01	0.01	0.00	0.531

Per capita savings in taka (log)	4.79	3.92	-0.87	0.000
HH head's years of education	3.55	3.48	-0.07	0.408

Note: This table shows the comparison of the characteristics between male and female-headed households in rural Bangladesh. The last column shows the P-values of the difference between the households.

Table 3.9**:** Health shocks regression results, dependent variable: facing health shocks (yes=1); base category for dependent variable: no shocks.

VARIABLES	OLS	Logit (odds ratio)
Household composition		
Household size	0.011*	1.048*
	(0.006)	(0.030)
	0.098	0.099
Dependency ratio	0.000	1.000
	(0.000)	(0.001)
	0.334	0.331
No. of working-age members	0.014	1.066
	(0.010)	(0.046)
	0.140	0.136
Domestic migrant (yes=1)	0.005	1.023
	(0.015)	(0.065)
	0.724	0.718
International migrants (yes=1)	-0.066***	0.746***
	(0.024)	(0.082)
	0.007	0.008
Household resources		
Asset index (PCA)	-0.033***	0.862***
	(0.005)	(0.020)
	0.000	0.000
Household expenditure per capita (log)	0.119***	1.698***
	(0.011)	(0.080)
	0.000	0.000
Social safety net programme (yes=1)	0.068***	1.351***
	(0.008)	(0.049)
	0.000	0.000
Household head's characteristics		
Female head (male=0)	0.012	1.055
	(0.011)	(0.052)
	0.265	0.278
HH head's education (base: no formal education)		
Less than primary	0.005	1.024
	(0.012)	(0.055)
	0.650	0.651
Primary completed	-0.009	0.961
	(0.009)	(0.040)
	0.345	0.336
Secondary completed	-0.035*	0.853*
	(0.019)	(0.075)
	0.071	0.069
Higher secondary completed	-0.062***	0.753***
	(0.023)	(0.077)
	0.006	0.006
Graduate	-0.024	0.899

VARIABLES	OLS	Logit (odds ratio)
	(0.045)	(0.179)
	0.599	0.590
Survey year (base: 2011-12)		
2015	-0.148***	0.508***
	(0.010)	(0.023)
	0.000	0.000
2018-19	0.050***	1.210***
	(0.011)	(0.060)
	0.000	0.000
Division (base: Barisal)		
Chittagong	-0.137***	0.545***
	(0.016)	(0.039)
	0.000	0.000
Dhaka	-0.094***	0.663***
	(0.015)	(0.043)
	0.000	0.000
Khulna	-0.029*	0.884*
	(0.017)	(0.065)
	0.079	0.094
Rajshahi	-0.031*	0.874*
	(0.018)	(0.070)
	0.085	0.091
Rangpur	-0.074***	0.724***
	(0.019)	(0.060)
	0.000	0.000
Sylhet	-0.003	0.981
	(0.017)	(0.072)
	0.879	0.794
No. of observations	15,265	15,265
R-squared	0.061	0.0532

Note: This table shows the results from Linear Probability Model (LPM) and Logit regression (odds ratio) respectively in columns 1 and 2 where whether a household is affected by health shocks (=1) or not (=0) is the dependent variable. Also, *** p<0.01, ** p<0.05, * p<0.1.

Table 3.10: LPM regression results; dependent variable: different coping strategies; base category: no coping strategy; Group 1: households that are affected by both health and non-health shocks; Group 2: households that are only affected by health shocks.

VARIABLES	Asset coping (yes=1, no coping=0)		Loan coping (yes=1, no coping=0)		Any coping (including the previous two) [yes=1, no coping=0]	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Household composition						
Household size	-0.015	-0.073	-0.015	-0.001	-0.010	-0.006
	(0.014)	(0.093)	(0.013)	(0.015)	(0.009)	(0.011)
	0.282	0.434	0.260	0.969	0.311	0.586
Dependency ratio	0.000	0.000	0.001**	0.000	0.000	0.000
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
	0.611	0.775	0.021	0.291	0.119	0.332
No. of working-age member	0.020	0.092	0.035*	0.019	0.016	0.010
	(0.021)	(0.137)	(0.020)	(0.023)	(0.014)	(0.016)
	0.350	0.504	0.074	0.391	0.248	0.528
Domestic migrant	0.056*	0.270	0.051*	0.027	0.030	0.022

VARIABLES	Asset coping (yes=1, no coping=0)		Loan coping (yes=1, no coping=0)		Any coping (including the previous two) [yes=1, no coping=0]	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
(yes=1)						
	(0.030)	(0.194)	(0.028)	(0.032)	(0.020)	(0.023)
	0.062	0.163	0.061	0.390	0.144	0.351
International migrants (yes=1)	-0.052	-0.239	-0.052	-0.058	-0.047	-0.031
	(0.054)	(0.424)	(0.051)	(0.059)	(0.038)	(0.042)
	0.330	0.572	0.310	0.323	0.210	0.462
Household resources						
Asset index (PCA)	0.015	0.022	-0.048***	-0.048***	-0.039***	-0.042***
	(0.011)	(0.072)	(0.011)	(0.013)	(0.008)	(0.009)
	0.176	0.764	0.000	0.000	0.000	0.000
Household expenditure per capita (log)	-0.041*	-0.190	-0.074***	-0.081***	-0.048***	-0.050***
	(0.023)	(0.145)	(0.022)	(0.025)	(0.015)	(0.018)
	0.075	0.190	0.001	0.001	0.002	0.005
Social safety net programme (yes=1)	0.035*	0.114	0.051***	0.043**	0.039***	0.034**
	(0.019)	(0.117)	(0.017)	(0.020)	(0.012)	(0.014)
	0.061	0.330	0.003	0.031	0.001	0.017
Household head's characteristics						
Female head (male=0)	-0.083***	-0.552***	-0.164***	-0.143***	-0.067***	-0.077***
	(0.025)	(0.162)	(0.024)	(0.026)	(0.016)	(0.018)
	0.001	0.001	0.000	0.000	0.000	0.000
HH head's education (base: no formal education)						
Less than primary	-0.016	-0.014	0.018	0.019	0.006	0.013
	(0.028)	(0.168)	(0.025)	(0.029)	(0.018)	(0.021)
	0.563	0.936	0.457	0.503	0.750	0.517
Primary completed	-0.038*	-0.330**	-0.042**	-0.043*	-0.030**	-0.037**
	(0.021)	(0.132)	(0.019)	(0.022)	(0.014)	(0.016)
	0.069	0.012	0.030	0.054	0.034	0.021
Secondary completed	-0.022	-0.358	-0.118***	-0.147***	-0.068**	-0.116***
	(0.041)	(0.257)	(0.042)	(0.046)	(0.030)	(0.035)
	0.582	0.164	0.005	0.002	0.024	0.001
Higher secondary completed	-0.095**	-0.369	-0.154***	-0.154***	-0.105***	-0.104**
	(0.047)	(0.299)	(0.049)	(0.057)	(0.036)	(0.041)
	0.042	0.217	0.002	0.006	0.003	0.011
Graduate	-0.243***		-0.329***	-0.316***	-0.296***	-0.338***
	(0.079)		(0.084)	(0.085)	(0.066)	(0.070)
	0.002		0.000	0.000	0.000	0.000
Survey year (base: 2011-12)						
2015	-0.088***	-0.337**	-0.008	-0.019	-0.021	-0.032*
	(0.024)	(0.144)	(0.023)	(0.027)	(0.016)	(0.019)
	0.000	0.019	0.742	0.467	0.186	0.085
2018-19	-0.176***	-0.849***	-0.046**	-0.050*	-0.066***	-0.075***
	(0.024)	(0.154)	(0.023)	(0.027)	(0.017)	(0.019)
	0.000	0.000	0.045	0.065	0.000	0.000
Division (base: Barisal)						
Chittagong	-0.035	-0.204	-0.021	0.015	0.021	0.052*
	(0.040)	(0.253)	(0.033)	(0.038)	(0.024)	(0.028)
	0.378	0.419	0.532	0.689	0.380	0.061
Dhaka	-0.053	-0.205	-0.186***	-0.177***	-0.096***	-0.082***

VARIABLES	Asset coping (yes=1, no coping=0)		Loan coping (yes=1, no coping=0)		Any coping (including the previous two) [yes=1, no coping=0]	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
	(0.034)	(0.207)	(0.029)	(0.033)	(0.021)	(0.025)
	0.126	0.323	0.000	0.000	0.000	0.001
Khulna	0.033	0.270	-0.147***	-0.136***	-0.068***	-0.051*
	(0.038)	(0.223)	(0.033)	(0.038)	(0.024)	(0.028)
	0.389	0.225	0.000	0.000	0.005	0.071
Rajshahi	-0.078*	-0.279	-0.232***	-0.200***	-0.175***	-0.139***
	(0.040)	(0.243)	(0.035)	(0.040)	(0.026)	(0.030)
	0.051	0.251	0.000	0.000	0.000	0.000
Rangpur	-0.028	-0.124	-0.106***	-0.152***	-0.028	-0.050
	(0.046)	(0.275)	(0.040)	(0.046)	(0.028)	(0.033)
	0.540	0.653	0.007	0.001	0.318	0.129
Sylhet	-0.072*	-0.492**	-0.162***	-0.198***	-0.068***	-0.076***
	(0.038)	(0.243)	(0.032)	(0.038)	(0.023)	(0.027)
	0.058	0.043	0.000	0.000	0.004	0.006
Constant	0.841***	1.876	1.354***	1.399***	1.236***	1.268***
	(0.195)	(1.229)	(0.184)	(0.211)	(0.131)	(0.150)
	0.000	0.127	0.000	0.000	0.000	0.000
No of observations	2,488	1,850	3,533	2,652	6,019	4,525
R-squared	0.066	0.068	0.090	0.094	0.054	0.058

Note: This table shows the results from Linear Probability Model (LPM) regression where the household's coping strategy is the dependent variable. Standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1.

Table 3.11: Percentage of male and female-headed households that have savings, and average amount of current savings in Bangladeshi taka (BDT).

		Savings in last one year	Savings now	Amount of current savings
	Male-headed households	66.18	61.1	14921
	Female-headed households	53.73	44.8	12338
	Difference	12.45	16.3	2584
2011-12	P-value	0.000	0.000	0.144
	Male-headed households	76.89	65.56	22149
	Female-headed households	66	51.79	23017
	Difference	10.89	13.77	-867.4
2015	P-value	0.000	0.000	0.709
	Male-headed households	80.85	66.63	36465
	Female-headed households	70.3	53.38	31858
	Difference	10.55	13.25	4607
2018-19	P-value	0.000	0.000	0.349

Note: This table shows the comparison of the percentage of male and female-headed households that have savings now and had savings in the last year, and the average amount of current savings (in BDT). The number of observations (N) in 2011-12, 2015 and 2018-19 is respectively 6503, 6715 and 6011.

Table 3.12: Comparison of the financial (loan) and in-kind consumption help between male-headed and female-headed households.

		No. of people having a loan	Had loan in anytime	Currently have a loan	In-kind help
2011	Male	1.1847	82.0%	69.2%	0.3%
	Female	0.695	69.5%	45.3%	0.4%
	Difference	-0.49	-12.5%	-23.9%	0.1%
	P-value	0.000	0.000	0.000	0.698
2015	Male	1.2439	94.4%	72.6%	0.5%
	Female	0.8579	86.9%	52.0%	0.5%
	Difference	-0.386	-7.6%	-20.5%	0.0%
	P-value	0.000	0.000	0.000	0.906
2018	Male	1.2776	98.6%	74.4%	0.8%
	Female	0.8384	96.5%	55.6%	1.1%
	Difference	-0.439	-2.1%	-18.8%	0.2%
	P-value	0.000	0.000	0.000	0.353

Note: This table shows the comparison of financial help and in-kind help between male and female-headed households. The number of observations (N) in 2011-12, 2015 and 2018-19 is respectively 6503, 6715 and 6011.

3.8 Appendix B: Chapter three

Table B1: Fixed effects regression results, the dependent variable is female-headed household.

VARIABLES	Female head (yes=1)
Type of shocks (no shock=0)	
1. Death of main earner	0.286***
	(0.027)
	0.000
2. Death of other earner	0.051*
	(0.031)
	0.099
3. Income loss due to illness or injury	-0.028
	(0.018)
	0.123
4. Medical expense due to illness or injury	-0.001
	(0.009)
	0.988
Wave (2011-12=0)	
1. 2015	0.013**
	(0.005)
	0.020
2. 2018-19	0.033***
	(0.008)
	0.000
Constant	0.188***
	(0.005)
	0.000
Number of households	6,705
R-squared	0.034

Note: This table shows the fixed effects regression results for the female head dummy variable. Standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1.

Table B2: Transitions of the intensity of health shocks between the first and second waves

	Wave 2 (2015)		
Wave-1 (2011-12)	Worse than before	Same as before	Better than before
Worse than before	74.71	19.41	5.88
Same as before	75.53	18.09	6.38
Better than before	70.45	27.27	2.27

Note: This table shows the transition of the intensity of health shocks across the first and second waves. The column intensities are for the first round and the row intensities are for the second round.

Table B3: List of coping strategies by the categories considered (N=1960+1529+2672= 6161).

Coping strategies	**Percent**
None	**30.27**
Selling lands	2.32
Mortgaging or leasing out land	2.43
Selling productive asset	3.39
Mortgaging productive asset	0.45
Selling consumption asset	1.57
Mortgaging consumption asset	0.73
Asset coping	**10.89**
Institutional/NGO loan	12.17
Non-Institutional loan	15.32
Emergency receipt of remittance from migrant family members	1.06
Financial help from others	19.93
Loan coping	**48.48**
Eating less food to reduce expenses	2.65
Eating lower-quality food to reduce expenses	1.28
Food insecurity coping	**3.93**
Taking children out of school	0.13
Transferring children to less expensive schools	0.02
Adult household members taking additional jobs	0.23
Sending household members away permanently	0.03
Sending children to be fostered by relatives	0.1
Sending children into domestic service	0.08
Sending children to work somewhere other than domestic services	0.23
Sending wife and children to parent's house	0.03
Are being forced to change occupation	0.24
Sending non-working household members to work	0.47
Others	4.85
Miscellaneous coping	**6.41**

Note: This table shows the percentage of households adopting different coping strategies after a health shock.

Table B4: Logit regression (odds ratio) results; dependent variable: different coping strategies; base category: no coping strategy; Group 1: households that are affected by both health and non-health shocks; Group 2: households that are only affected by health shocks.

	Asset coping (yes=1, no coping=0)		Loan coping (yes=1, no coping=0)		Any coping (including the previous two) [yes=1, no coping=0]	
VARIABLES	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Household composition						
Household size	0.914	0.930	0.936	0.997	0.951	0.968
	(0.072)	(0.086)	(0.055)	(0.067)	(0.045)	(0.053)
	0.256	0.434	0.255	0.967	0.289	0.552
Dependency ratio	1.001	1.000	1.002**	1.001	1.001	1.001
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
	0.559	0.775	0.021	0.296	0.115	0.320
No. of working-age member	1.120	1.096	1.171*	1.092	1.087	1.056
	(0.132)	(0.151)	(0.102)	(0.109)	(0.077)	(0.086)
	0.334	0.504	0.068	0.379	0.238	0.503
Domestic migrant (yes=1)	1.421**	1.310	1.256*	1.132	1.150	1.104
	(0.245)	(0.254)	(0.152)	(0.159)	(0.114)	(0.126)
	0.041	0.163	0.060	0.377	0.160	0.385
International migrants (yes=1)	0.601	0.787	0.798	0.772	0.817	0.874
	(0.234)	(0.334)	(0.183)	(0.208)	(0.142)	(0.173)
	0.191	0.572	0.326	0.336	0.246	0.497
Household resources						
Asset index (PCA)	1.094	1.022	0.809***	0.808***	0.827***	0.816***
	(0.067)	(0.074)	(0.039)	(0.045)	(0.032)	(0.036)
	0.145	0.764	0.000	0.000	0.000	0.000
Household expenditure per capita (log)	0.800*	0.827	0.724***	0.697***	0.785***	0.781***
	(0.101)	(0.120)	(0.070)	(0.078)	(0.060)	(0.068)
	0.076	0.190	0.001	0.001	0.002	0.005
Social safety net programme (yes=1)	1.200*	1.121	1.250***	1.207**	1.218***	1.186**
	(0.120)	(0.131)	(0.094)	(0.105)	(0.075)	(0.085)
	0.070	0.330	0.003	0.030	0.001	0.017
Household head's characteristics						
Female head (male=0)	0.610***	0.576***	0.485***	0.532***	0.721***	0.685***
	(0.088)	(0.094)	(0.051)	(0.063)	(0.058)	(0.062)
	0.001	0.001	0.000	0.000	0.000	0.000
HH head's education (base: no formal education)						
Less than primary	0.918	0.987	1.082	1.086	1.022	1.067
	(0.136)	(0.166)	(0.116)	(0.136)	(0.093)	(0.112)
	0.566	0.936	0.465	0.511	0.813	0.537
Primary completed	0.812*	0.719**	0.839**	0.834*	0.860**	0.828**
	(0.091)	(0.095)	(0.071)	(0.081)	(0.060)	(0.066)
	0.064	0.012	0.036	0.063	0.029	0.018
Secondary completed	0.884	0.699	0.598***	0.526***	0.723**	0.589***
	(0.193)	(0.180)	(0.111)	(0.111)	(0.104)	(0.096)
	0.573	0.164	0.006	0.002	0.023	0.001
Higher secondary completed	0.581**	0.691	0.491***	0.488***	0.626***	0.631**
	(0.158)	(0.207)	(0.113)	(0.132)	(0.103)	(0.120)

	Asset coping (yes=1, no coping=0)		Loan coping (yes=1, no coping=0)		Any coping (including the previous two) [yes=1, no coping=0]	
VARIABLES	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
	0.046	0.217	0.002	0.008	0.005	0.015
Graduate	0.082**		0.149***	0.158***	0.277***	0.228***
	(0.084)		(0.082)	(0.088)	(0.086)	(0.078)
	0.015		0.001	0.001	0.000	0.000
Survey year (base: 2011-12)						
2015	0.666***	0.714**	0.971	0.924	0.889	0.842*
	(0.082)	(0.103)	(0.098)	(0.109)	(0.074)	(0.081)
	0.001	0.019	0.773	0.501	0.157	0.075
2018-19	0.397***	0.428***	0.823*	0.811*	0.718***	0.686***
	(0.052)	(0.066)	(0.083)	(0.097)	(0.059)	(0.067)
	0.000	0.000	0.054	0.081	0.000	0.000
Division (base: Barisal)						
Chittagong	0.840	0.815	0.904	1.064	1.091	1.296*
	(0.178)	(0.206)	(0.134)	(0.180)	(0.141)	(0.193)
	0.409	0.419	0.497	0.714	0.502	0.081
Dhaka	0.759	0.815	0.440***	0.461***	0.604***	0.653***
	(0.135)	(0.169)	(0.057)	(0.069)	(0.068)	(0.085)
	0.123	0.323	0.000	0.000	0.000	0.001
Khulna	1.142	1.310	0.521***	0.547***	0.686***	0.758*
	(0.220)	(0.292)	(0.077)	(0.093)	(0.087)	(0.111)
	0.489	0.225	0.000	0.000	0.003	0.059
Rajshahi	0.662*	0.757	0.362***	0.415***	0.422***	0.499***
	(0.140)	(0.184)	(0.057)	(0.074)	(0.056)	(0.076)
	0.051	0.251	0.000	0.000	0.000	0.000
Rangpur	0.861	0.884	0.619***	0.509***	0.851	0.761
	(0.207)	(0.243)	(0.108)	(0.104)	(0.127)	(0.130)
	0.533	0.653	0.006	0.001	0.280	0.110
Sylhet	0.676*	0.611**	0.489***	0.418***	0.690***	0.670***
	(0.139)	(0.148)	(0.070)	(0.070)	(0.085)	(0.095)
	0.057	0.043	0.000	0.000	0.002	0.005
No of observations	2,488	1,850	3,533	2,652	6,019	4,525

Note: This table shows the odds ratio from Logistic regression where the household's coping strategy is the dependent variable. Standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1.

Table B5: Fixed effects regression results, dependent variable: facing health shocks (yes=1); base category for dependent variable: no shocks

VARIABLES	Coefficients
Household composition	
Household size	0.029**
	(0.011)
	0.011
Dependency ratio	0.000*
	(0.000)
	0.057
No. of working-age member	0.000
	(0.017)
	0.990
Domestic migrant (yes=1)	-0.019
	(0.021)
	0.374
International migrants (yes=1)	-0.073**
	(0.034)
	0.034
Household resources	
Asset index (PCA)	-0.001
	(0.011)
	0.905
Household expenditure per capita (log)	0.203***
	(0.019)
	0.000
Social safety net programme (yes=1)	0.017
	(0.014)
	0.223
Household head's characteristics	
Female head (male=0)	0.051**
	(0.024)
	0.036
HH head's education (base: no formal education)	
Less than primary	0.012
	(0.032)
	0.701
Primary completed	0.006
	(0.031)
	0.839
Secondary completed	0.096
	(0.061)
	0.113
Higher secondary completed	0.176**
	(0.077)
	0.022
Graduate	0.049
	(0.128)
	0.703
Survey year (base: 2011-12)	
2015	-0.146***
	(0.013)
	0.000
2018-19	0.012

VARIABLES	Coefficients
	(0.017)
	0.477
No of observations	6,943
R-squared	0.073

Note: This table shows the results from FE regression. Whether a household is affected by health shocks (=1) or not (=0) is the dependent variable. Also, *** p<0.01, ** p<0.05, * p<0.1.

Table B6: Fixed effects regression results; dependent variable: different coping strategies; base category: no coping strategy; Group 1: households that are affected by both health and non-health shocks; Group 2: households that are only affected by health shocks.

VARIABLES	Asset coping (yes=1, no coping=0)		Loan coping (yes=1, no coping=0)		Any coping (including the previous two) [yes=1, no coping=0]	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Household composition						
Household size	0.026	-0.023	-0.027	-0.010	-0.004	-0.007
	(0.058)	(0.073)	(0.039)	(0.046)	(0.024)	(0.031)
	0.654	0.754	0.493	0.834	0.878	0.834
Dependency ratio	-0.000	0.001	0.001**	0.001	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
	0.696	0.606	0.050	0.274	0.293	0.533
No. of working-age member	0.065	0.116	0.119**	0.158**	0.042	0.065
	(0.085)	(0.115)	(0.060)	(0.070)	(0.035)	(0.045)
	0.443	0.312	0.050	0.025	0.231	0.150
Domestic migrant (yes=1)	-0.065	-0.059	0.093	0.066	0.032	-0.001
	(0.106)	(0.128)	(0.076)	(0.091)	(0.046)	(0.058)
	0.541	0.645	0.223	0.467	0.486	0.988
International migrants (yes=1)	-0.115	-0.080	0.144	0.077	-0.040	-0.008
	(0.172)	(0.246)	(0.146)	(0.183)	(0.082)	(0.114)
	0.504	0.747	0.324	0.675	0.623	0.944
Household resources						
Asset index (PCA)	-0.059	-0.103	0.018	-0.037	-0.008	-0.033
	(0.050)	(0.066)	(0.041)	(0.051)	(0.025)	(0.032)
	0.243	0.119	0.664	0.463	0.749	0.300
Household expenditure per capita (log)	0.102	0.154	0.046	-0.008	0.037	0.051
	(0.088)	(0.116)	(0.066)	(0.084)	(0.040)	(0.052)
	0.249	0.187	0.487	0.923	0.351	0.321
Social safety net programme (yes=1)	0.086	0.055	0.008	-0.052	0.003	-0.013
	(0.065)	(0.081)	(0.047)	(0.055)	(0.028)	(0.035)
	0.186	0.492	0.858	0.347	0.922	0.721
Household head's characteristics						
Female head (male=0)	-0.092	-0.090	-0.132	-0.235**	-0.005	-0.045
	(0.112)	(0.158)	(0.086)	(0.103)	(0.048)	(0.063)
	0.411	0.571	0.126	0.023	0.911	0.481
HH head's education (base: no formal education)						
Less than primary	-0.132	-0.030	0.046	0.048	-0.019	0.004
	(0.155)	(0.199)	(0.109)	(0.126)	(0.068)	(0.085)
	0.394	0.879	0.676	0.706	0.776	0.964

VARIABLES	Asset coping (yes=1, no coping=0)		Loan coping (yes=1, no coping=0)		Any coping (including the previous two) [yes=1, no coping=0]	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Primary completed	0.077	-0.063	-0.048	-0.209	0.006	0.014
	(0.143)	(0.185)	(0.112)	(0.132)	(0.065)	(0.082)
	0.590	0.734	0.670	0.114	0.931	0.866
Secondary completed	0.056	-0.291	-0.030	0.330	0.053	-0.048
	(0.198)	(0.289)	(0.198)	(0.323)	(0.117)	(0.164)
	0.777	0.317	0.879	0.308	0.652	0.771
Higher secondary completed	0.134	0.216	-0.264	-1.128**	0.095	0.029
	(0.244)	(0.377)	(0.329)	(0.539)	(0.155)	(0.205)
	0.582	0.568	0.423	0.037	0.540	0.886
Graduate	-0.131	-0.064	-0.272	-0.834*	-0.215	-0.441
	(0.325)	(0.467)	(0.380)	(0.473)	(0.250)	(0.302)
	0.687	0.892	0.474	0.079	0.391	0.145
Survey year (base: 2011-12)						
2015	-0.214***	-0.211***	-0.111**	-0.127**	-0.107***	-0.144***
	(0.058)	(0.079)	(0.048)	(0.059)	(0.027)	(0.034)
	0.000	0.008	0.022	0.032	0.000	0.000
2018-19	-0.291***	-0.323***	-0.184***	-0.234***	-0.142***	-0.199***
	(0.068)	(0.094)	(0.056)	(0.070)	(0.032)	(0.042)
	0.000	0.001	0.001	0.001	0.000	0.000
No. of observations	2,227	1,711	3,017	2,339	4,653	3,685
R-squared	0.159	0.141	0.046	0.152	0.026	0.052

Note: This table shows the results from FE regressions where the household's coping strategy is the dependent variable. Standard errors are mentioned in the parentheses and every third row shows the p-values. In the case of these models, the following specifications apply: *** p<0.01, ** p<0.05, * p<0.1.

CHAPTER 4: COMMUNITY CLINICS AND WOMEN'S HEALTHCARE-SEEKING BEHAVIOUR: EVIDENCE FROM BANGLADESH

4.1 Introduction

Bangladesh, one of the most densely populated countries in the world, has continuously struggled with providing quality health care for its population, and so, health care remains a primary concern and the target of numerous initiatives. It is one of the countries that signed the "Alma-Ata Declaration" (WHO, 1978) in 1978 in the hope that this would lead to ensuring "Health for All (HFA)" through Primary Health Care (PHC) by 2000. Essentially, the provision of PHC is the fundamental principle of universal health coverage (UHC) stating that it is everyone's right to access quality health services without facing financial difficulties (WHO, 2023). Although Bangladesh has made notable progress over time in health indicators, especially by reducing maternal and child mortality and increasing immunization coverage (WHO, 2022)- some challenges remain as the country still does not have UHC. Additionally, there continues to be a high out-of-pocket healthcare expenditure, inequitable healthcare access across income groups, and a lack of quality healthcare (WHO, 2022). Admittedly, Bangladesh has been lagging in reaching the set standards for achieving HFA. This is mainly due to the lack of accessibility of PHC in the case of rural communities, which constitutes three-fourths of the total population of the country (Riaz, et al., 2020).

The noteworthy initiative undertaken by the Bangladesh government to mitigate these healthcare problems was to establish Community Clinics (CCs) in 1998 to provide basic healthcare services mainly in rural areas, targeted towards women and children. Establishing CCs to deliver PHC in rural areas was a big step in Bangladesh's health sector, especially for poor and underprivileged people. It is assumed that these community clinics may be helpful in achieving Sustainable Development Goal (SDG) 2- 'Good Health and Well-being'- in Bangladesh (World Vision, 2021). The question arises, has this been the case? It is in the attempt to answer this question and understand whether or not community clinics in Bangladesh have been playing their expected role in improving healthcare that I, in this chapter, explore the association of community clinics with women's healthcare-seeking behaviour for themselves and for their children (below the age of 5) using nationally representative data.

Arguably, it makes sense to investigate whether CCs play a significant role in the case of the healthcare-seeking behaviour of women and their children because, essentially, CCs were established mostly in remote areas and mainly target women and children. Additionally, good healthcare-seeking behaviour is necessary as it is important for managing, preventing and earlier diagnosis of diseases, and it helps to decrease death, disability and expenditure from diseases (Haileamlak, 2018).

4.2 Country background

For an overview of the healthcare market in Bangladesh, we need to, first, understand the existing administrative structure in Bangladesh. Administratively, Bangladesh is divided into 8 divisions, 64 districts, 546 sub-districts, 4545 unions in rural areas (a union consists of multiple wards), and 3215 wards in urban areas which are under municipalities (DGHS, 2022). The Government of Bangladesh (GoB) is constitutionally [29] responsible for providing healthcare to its population (Rahman R. , 2020). Broadly, there are three types of healthcare providers in Bangladesh- public, private, and NGOs, each respectively financed by the government of Bangladesh, private individuals and NGOs[30]. Every public and private hospital has both outpatient and inpatient facilities, and most of the NGO clinics do not have any inpatient facilities. Currently, Bangladesh has 5054 private clinics and hospitals with 90,587 inpatient beds, and 673 public hospitals with 52,807 inpatient beds for 165 million people (DGHS, 2019). Additionally, the number of hospital beds, physicians, and the number of nurses and midwives per 1000 people (in 2016) is respectively 0.8, 0.5 and 0.3- these numbers are comparatively low even compared to the average numbers in the case of other developing countries (WB, 2024). These numbers are respectively 4, 1.9, and 2.5 (in 2016) for China, and 1.7 (in 2012), 0.6 (in 2021), 1.5 (in 2016) for Bhutan.

Before the implementation of CCs in 1998, general public healthcare services in Bangladesh were available at the national-level in the form of hospitals, divisional/district-level medical college hospitals, district hospitals, sub-district hospitals, and union outpatient facilities. Additionally, public healthcare was also provided by ward-level domiciliary workers and village-level domiciliary workers. As of 2019, the country had 10 Postgraduate Institutes and

[29] According to the constitution of the Peoples' Republic of Bangladesh, the main responsibility of providing adequate healthcare to the population lies with the government.
[30] Only private providers seek profits.

hospitals, 26 Medical College Hospitals, 60 District/General Hospitals, 429 Sub-district Health Complexes, and 5245 Union health and family welfare centres and Union health centres/sub-centres. Union Health and Family Welfare centres and Union health centres/sub-centres do not have any inpatient facilities. Starting from the bigger to smaller public healthcare providers, considering inpatient and outpatient services, post-graduate hospitals have higher or similar services as medical college hospitals- while postgraduate hospitals are situated at the division level, and medical college hospitals are situated both in divisions and districts- followed by district hospitals, sub-district hospitals/health complexes, Union health and family welfare centres and Union health centres/sub-centres, and Community Clinics.

Critically, the presence of such a variety of healthcare facilities may be misleading because it may be misconstrued that there are many healthcare facilities widespread across Bangladesh. However, the number of hospitals, physicians, and nurses per capita is low, especially in rural areas (Islam M. T., 2019). For example, there are 182 doctors per 100,000 population in the urban areas of Bangladesh as opposed to 11 doctors per 100,000 population in the rural areas (Ahmed, Evans, Standing, & Mahmud, 2013). Also, especially in the case of rural areas, there is a lack of static[31] health facilities within the village and ward[32] levels. Consequently, the situation is the worst in rural areas, whereby people from remote rural households have to travel a long way to union health facilities for public healthcare services. The CCs- which do not have any inpatient facilities- were established with the aim of filling this gap by providing healthcare facilities in remote areas across Bangladesh.

Basically, private healthcare providers in Bangladesh can be divided into two categories: formal (e.g. private medical college hospitals, private clinics, NGO clinics, trained doctors' chambers) and informal (e.g. dispensaries, village doctors). The private medical college hospitals and private clinics are mostly situated in urban areas of districts or divisions. In general, people seek treatment mostly from compounders/dispensaries[33] (33-34%), followed by nonqualified doctors (25%) and qualified doctors (14.4%) in rural areas, and qualified doctors (18.5%) and non-qualified doctors (14.8%) in urban areas (BBS, 2019).

[31] It means a health facility with infrastructure.
[32] Ward is the smallest administrative unit in Bangladesh.
[33] Ideally, these are equivalent to pharmacists in the UK. However, in reality, most of these individuals are salesmen with only some experience and, often, no educational qualifications for becoming a certified pharmacist.

4.3 Community clinics: An overview

4.3.1 Community Clinics in Bangladesh

In 1996, the GoB began to plan the establishment of CCs, and finally, CCs were initially established in 1998, whereby 10723 CCs were built and 8000 started functioning between 1998 and 2001 before they were stopped in 2001 (DGHS, 2018). Notedly, CCs operated for only a short time due to political reasons, whereby CCs were established as a government project for a particular duration under the regime of a particular political party and then made non-functional when a different political party than the one that had championed the initiation of CCs came into power in 2001. To put simply, the new incumbent government did not continue or reinstate the CC project which had begun under the previous political regime. As a result, people did not have adequate time to realise or reap the potential benefits of the services provided by CCs. During 2001 and 2008, a large number of CCs were illegally occupied and turned into places for anti-social activities such as drug use (DGHS, 2018).

CCs began a new journey in 2009, under a new project, when the regime changed, and the previous political party came into power again. Each CC was built such that it could serve at least 6,000 people and be available within a 30-minute walking distance to more than 80% of that population (Al Zubayer, Shanto, Kumkum, Alam, & Ahammed, 2023). CCs provide primary healthcare services at the clinic free of cost, and all the residents in the catchment area are eligible to access the healthcare. Additionally, one of the two community healthcare workers visits households in the catchment area regularly as well. Currently, there are 13,812 fully functioning CCs as of June 2020, which are mostly located in rural areas in a ward (United Nations, 2023).

4.3.2 The healthcare services in a cluster[34]

In this paper, I exploit the cluster variations in CCs to explore the association of CCs with women's healthcare-seeking behaviour; there are two types of clusters- rural and urban. There

[34] Clusters are small geographical regions, and survey sampling units, in Bangladesh designed by the Bangladesh Bureau of Statistics (BBS)- and also often referred to as Enumeration Areas (EAs). Of note, wards and clusters are separate geographical units- the former one is for administrative purposes and the latter one is for survey purposes. There is no information on whether these two coincide or not.

are no medical college hospitals, district hospitals, or sub-district hospitals in the rural clusters. The only public healthcare providers in rural clusters are the Union Health and Family Welfare Centres (UHFWC) and Community Clinics. There might be other NGOs and, in rare cases, private clinics. The NGO clinics, CCs and UHFWC mainly provide similar primary healthcare services such as family planning, antenatal and postnatal care, treating of minor illnesses, and screening and referring for chronic illnesses such as diabetes. On the other hand, in urban clusters, there might be other public hospitals.

Notedly, establishing new CCs would have some implications, overall, for the healthcare providers' market, especially since there would plausibly be other healthcare providers- such as private and NGOs- in the case of some areas. Since all three types of providers operate in the same market in different capacities and with different aims (i.e., some function mainly for profit while others are more non-profit in nature), any health policy advocated and implemented by the government would have separate effects on the different providers as well as varying implications. Consequently, increasing the supply of healthcare providers due to the entrance of new CCs in the market would lead to less concentration of healthcare providers and higher competition in the market. Also, depending on the market structure and competition, the providers would behave differently across their types, i.e., across whether they are, by nature, for-profit (FP), not-for-profit (NFP), or public providers.

Consider, for example, the conjecture that when there is more competition- FP providers decrease medical costs in order to attract more demand and sustain in the market, while NFPs increase their services (Yi et al. (2019). FPs decrease their costs of provision by, for instance, reducing the number of medical staffs and wages, which they then pass off as decreased costs in terms of lower prices for users. On the other hand, NFPs might also, in several cases, behave as FPs- especially when they hold a significantly higher weight on the market output (Lakdawalla & Philipson, 2006). In contrast, NFP providers may also provide higher quality services to get rid of competition and maintain reputation (Kranton, 2003). Lakdawalla & Philipson (2006) argue that in a perfectly competitive equilibrium market- where both FPs and NFPs are present- FPs maximize profits while NFPs maximize utilities. In such a case, NFPs sometimes operate for profit at a lower marginal cost than FPs, and they crowd out the FPs. However, when the number of NFPs are limited, the market environment is dependent on the FPs as they are the marginal firms.

Therefore, considering the Bangladesh context, if CCs are introduced in an area- private providers such as informal practitioners/village doctors, dispensaries, private clinics, and trained doctors' private practices would face higher competition. This would, thereby, lead to these entities attempting to attract more patients by reducing medical costs and/or by increasing the quality of the services that they provide. In contrast, NGO clinics might either increase their services, or do nothing as they might not care, or they might even act as FP providers by decreasing medical costs. In the latter case, the NGOs might think that they would lose funding from donors if they do not have enough demands, and eventually they might be inclined to close their services. If they perceive that they might lose funding due to lower demand, they might try to offset the decreased demand by reducing medical costs, for example, by reducing the number of employed staff.

Moreover, from a demand-side or consumer perspective, individuals living in the area would have an additional free public healthcare provider due to the establishment of CCs, as well as a potential increase in timely and cost-effective private healthcare providers (Ricketts & Holmes, 2007). This could, in turn, increase people's satisfaction towards healthcare providers in the area, and private providers could also be the source of such increased satisfaction (Dietrichson, Ellegard, & Kjellsson, 2016). The public may contemplate substituting other providers with CCs as they would provide more or less similar primary healthcare such as antenatal and prenatal care, treatments for sickness and diarrhoea, and treatments for other minor illnesses and injuries. However, the only thing that might differentiate CCs from other providers is that, in very rare cases, NGO and private providers might have hospital beds. Interestingly, although increasing competition is beneficial for consumers- it does not necessarily lead to pro-social welfare growth in all cases, because, in equilibrium, providers face less demand than anticipated in the case of increased competition and thus, the benefits of higher quality healthcare due to increased competition is offset by the cost of entering the market, i.e., the entry cost (Gaynor, Ho, & Town, 2015).

In this paper, I aim to test the hypothesis that CCs in Bangladesh are associated with the healthcare-seeking behaviours of women and children in clusters. Significantly, there are two main theories of organizational behaviour relevant to this. The first theory postulates that people who work with NFP or public providers are more altruistic and have a greater interest in people's well-being, and, in turn, have more incentives to focus on improving peoples' well-being if there is a health policy (Wilson, 1989). Arguably, any positive association of CCs with

healthcare-seeking behaviour can be explained by the first theory, which suggests that the extra provision of healthcare workers and the CCs themselves would improve healthcare-seeking outcomes.

The second theory suggests that due to the profit distribution nature of the FP providers, they would be more likely to be incentivized to provide higher healthcare services as a result of any public health policies (Duggan, 2000). Consequently, any new health policies would pose competition for private healthcare providers, thereby leading them to try to improve their services. Therefore, it could also be the case that any positive results of the CCs would stem from the improved services provided by the private healthcare providers in an area. Furthermore, the mix of the distribution of FP, NFP and public providers in an area would perpetuate incentives for the providers as well as for the people.

In summary, the effect of healthcare providers' concentration/competition on the quality of services could be both positive and negative. For instance, there is evidence that low mortality is observed in less concentrated areas than in more concentrated areas in the USA (Kessler & McClellan, 2000), and, similarly, low mortality is also observed due to increasing competition after NHS reforms in the UK (Gaynor, Moreno-Serra, & Propper, 2013; Cooper, Gibbons, Jones, & McGuire, 2010). Gaynor et al. (2013) and Cooper et al. (2010) use the changes in mortality rates to explore the quality of healthcare after changing the providers' market concentration (due to policy changes or otherwise), and they find a positive impact of market competition on mortality rates in two different contexts. This pattern may have stemmed from the quality of management being associated with the overall hospital service quality (Propper, Bloom, Seiler, & Van Reenen, 2010).

On the contrary, a higher number of providers may sometimes decrease the quality of services and increase mortality rates (Propper, Burgess, & Gossage, 2003; Volpp, et al., 2003) as lower concentration potentially reduces the price-cost margin which, in turn, disincentivizes providers from delivering high-quality services (Katz, 2013). Propper et al. (2003) and Volpp et al. (2003) argue that, due to higher competition in the market, providers face less demand than expected and try to attract more people by reducing the cost. For instance, they may replace higher quality products by lower quality products and high-cost staff by low-cost staff, which would eventually reduce the quality of the services that they provide. However, lower concentration, in some cases, may not decrease quality as the providers' reputation can be

hampered in the future due to lower quality healthcare- thereby leading them to prioritise maintaining high quality despite operating at a low price-cost margin (Kranton, 2003). Thus, the increased competition due to the introduction of CCs in Bangladesh may be positively associated with the overall healthcare service quality, and this chapter, essentially, aims to investigate whether this is the case.

4.3.3 Services provided by CCs.

Every CC has one full-time community healthcare provider (CHCP) who works six days a week and two healthcare workers who alternatively conduct part-time work in a CC and part-time visits to households in the catchment area (WHO, 2021). They have a minimum of 12 years of formal education (higher secondary education completed) before joining, and they receive 12 weeks of training after joining- half of which is theoretical and the other half practical. The number of healthcare providers in each CC in Bangladesh is assumed to be very low compared to other developing and developed countries, and perhaps even compared to other healthcare providers in Bangladesh. For example, every community health centre (CHC) in Indonesia has at least one physician, one dentist, one midwife, one nurse, one pharmacist, one public health worker, one nutritionist, and one environmental health worker (Miharti, Wittek, Los, & Heyse, 2022).

In addition, unlike CCs, sub-district/district hospitals and other private clinics have physicians with higher medical degrees, and even the nurses in these clinics and hospitals have additional nursing diplomas along with higher secondary education. Moreover, if we compare community healthcare providers with village doctors, some village doctors may have higher qualifications and experiences than CHCPs (Muurlink, et al., 2023). Further, the CCs are expected to provide healthcare services such as (i) maternal and neonatal services including family planning and reproductive health, immunization, acute respiratory infection, and diarrhoeal diseases; (ii) combined childhood illness management including nutrition learning and micronutrient supplements; (iii) screening and guidance for treating non-communicable chronic illness, such as diabetes, cancer, heart disease, hypertension, and disabilities; (iv) treating minor illness and simple injuries; (v) education for health and family planning, and identifying difficult and urgent cases with referrals, and (vi) providing some basic medicines free of cost.

4.3.4 Objectives of the study

Since community clinics have been operating for some time now, it is important to evaluate their impact on health indicators. One such health indicator could be healthcare-seeking behaviour, especially in the case of women as one of the main targets of the CCs, from the onset, has been to achieve better healthcare for women. Healthcare-seeking behaviour of women depends on several aspects, such as the distance to a healthcare facility, awareness, quality of care, women's position in society or households, etc. (Yaya, et al., 2017). It is expected that CCs, on one hand, may increase the availability of healthcare facilities, and on the other hand, may decrease the distance between patients' homes and healthcare facilities, and eventually affect- positively- women's healthcare seeking behaviour and health outcomes. However, it might not always be the case that only CCs are associated with healthcare-seeking behaviour- rather sometimes it might be the case that CCs have a positive association with healthcare-seeking behaviours when they co-exist with other clinics (e.g. private/NGO clinics) in the region. Importantly, women's healthcare-seeking behaviour- especially in the case of antenatal, and postnatal care visits- is particularly vital to reducing maternal mortality and achieving the Sustainable Development Goals (SDG) (WHO, 2021)- thereby rendering the aim of CCs all the more important.

Therefore, there is much potential for community clinics to improve the state of health care, primarily by incentivizing women to seek more, and better, health care. Additionally, these clinics are run with low funding from the government, which means that they do not require large amounts of costs to function. For instance, the training is provided to healthcare workers only for 12 weeks and even the land upon which the infrastructure of the CCs is built are donated by the inhabitants of the area. Thus, if the CCs are indeed successful in increasing healthcare-seeking behaviour within such a small cost, then there is potential for CCs to be scaled up to other similar contexts.

Furthermore, in low- and middle-income countries, women's healthcare-seeking behaviour is very important for the development of maternal and child health outcomes (Aremu, Lawoko, T, & Dalal, 2011; Akinyemi, Bamgboye, & Ayeni, 2013). Although it might be ideal to explore the impacts of CCs on other health outcomes (e.g. birth weight) as well, just as Kose et al. (2022) do in the USA context- this is not possible in this paper due to data limitations. Therefore, this paper aims to explore whether community clinics in clusters are related to women's

healthcare-seeking behaviour for themselves and their children using three rounds of the Bangladesh Demographic and Health Survey (BDHS) 2011, 2014, and 2017-18.

The rest of the paper is designed as follows. In the following section, I discuss the relevant literature on the impact of primary healthcare centres in different countries and contexts. I then present the empirical strategy and data before presenting the results of the descriptive analysis and the regression analysis. In the final section, I conclude by discussing the contributions and future scope of this study.

4.4 Literature Review.

Community health centres (CHC) and CCs are primary healthcare centres and mostly target poor and underprivileged people, or areas, (or both) in developed and developing countries. Primary healthcare providers such as CCs and CHCs in developed and other developing countries are different than those in Bangladesh. On one hand, the CCs or CHCs in other countries are much more equipped than the CCs in Bangladesh- in most cases, there are no properly trained doctors or nurses in CCs in Bangladesh. On the other hand, CCs in Bangladesh have some similarities with CCs from other contexts in terms of impact, specifically in terms of increasing public healthcare services provisions. Considering this, it is worth reviewing health outcomes, and health-seeking behaviour, of CCs in other contexts- especially to be able to understand whether, and how, the availability of PHCs can affect health-related outcomes.

Arguably, CCs or CHCs can positively affect health outcomes and health behaviours. For instance, Bailey and Goodman-Bacon (2015), in a developed country context, examine the association between the rollout of CHCs in the USA and the mortality rates of people older than 50 years of age. They use both electronic and hand-entered CHC rollout data from 1965 to 1974, respectively collected from the National Archives Community Action Program (NACAP) and the annual Public Health Service Reports. Employing fixed effect (FE) estimates and the number and timing of CHC rollouts in the regions, they find that CHCs are associated with a 2 percent reduction in the age-adjusted mortality rate among people over 50 years of age. Another study exploring the impact of CHCs on infants' health based in the USA, by Kose et al. (2022), finds that, since exposing mothers to CHCs improves prenatal care visits and reduces smoking- access to CHCs increases child birthweight between 25 and 42 grams and

reduces the probability of low birthweight by 9%-16%. The authors collect the birthweight data from Vital Statistics 1968-1988 combined with CHCs rollout data and county-level characteristics and exploit the Difference-in-Difference (DiD) model and a flexible event study framework to account for dynamic treatment effects.

Of course, community health centres or community clinics are also available in some developing countries as well, and so several studies on the topic exist in the context of developing countries. For instance, Yu et al. (2016) compare breastfeeding practices and infant health outcomes when receiving care from hospitals and CHCs. For this purpose, a cohort study data was collected for children and women from a hospital and five CHCs in Chengu (Sichuan province, China) between April 2010 and January 2012. After some mothers dropped out of the study, the final sample comprised 760 mothers (originally the sample size was 845)- 378 were from the hospital category and 382 were from the CHCs category- and including their children. The authors find that the breastfeeding rates at one and three months post-partum are higher for the CHC category (92% and 78%) as compared to the hospital category (84% and 68%). Also, the incidence of lower respiratory tract infections is significantly lower for the CHC category (6%) than for the hospitals category (15%).

Similarly, Sakeah et al. (2023) examine the impact of the Community-based Health Services and Planning (CHPS) initiative plus (CHPS+) in Ghana's Upper East Region. In this study, 7693 women in the baseline and 4694 women of reproductive age in the end-line were surveyed respectively in 2014/15 and 2020. The study finds that CHPS+ has a significant effect on maternal antenatal and postnatal care visits, delivering in the health centres, and taking oral rehydration salts (ORS) as the diarrhoea treatment after the intervention as compared to pre-intervention. However, the study ignores the fact that there might have been other programmes affecting the outcome variables. Therefore, the impact shown in the paper might be overstated. In a different context, Gatakaa et al. (2019) conducted an impact evaluation study based on 10 community health units (CHU) operated by Ubuntu-Afya Kiosks in rural Kenya. CHU infrastructures were completed in December 2016, the baseline survey was conducted in June 2016, and the end-line survey was done in May 2018. This is not an experimental study- there are no control areas. Two surveys were conducted on the treatment areas where CHUs were established. The study concludes that CHUs have increased antenatal care visits from 81% to 99%, skilled birth attendants from 85% to 90%, and examining new-borns within 2 days of delivery from 74% to 92%.

The studies mentioned above are from other developed and developing countries' contexts. I now explore the evidence that exists on Bangladeshi primary health centres, namely Community Clinics. The first relevant study was conducted by Al-Zubayer et al. (2023) which investigates the determinants of CCs visitation of ever-married women of reproductive age using the Bangladesh Demographic and Health Survey (BDHS) 2017 dataset. The authors find that visiting CCs is comparatively low in the case of women in general compared to women who are aware of the availability of CCs in the region. Additionally, a higher number of women from rural areas, compared to women from urban areas, and poor women are more likely to attend CCs for treatments- which makes sense as CCs target poorer, remote, and underprivileged women.

Similarly, another study on awareness and visitation of CCs is conducted by Yaya et al. (2017). They use the previous round of the same survey- BDHS 2014- and find a positive relationship between CC awareness/visitation and geographical location, education, wealth, and reading newspapers. They use a set of outcome variables regarding CCs visitation, which are immunization, family planning, vitamin A, antenatal care, and children's health care and growth. From a different angle, Sarker et al. (2018) find that CCs increase the healthcare utilization of adolescent girls. The authors explore the maternal healthcare utilization of adolescent girls employing the BDHS 2014 dataset. The outcome variables that they consider are pregnancy, contraceptive use, antenatal care visits, facility-based delivery, and the presence of skilled birth attendants during the last delivery. However, the focus of this study was not CCs but rather all the determinants of adolescent girls' (15-19 years of age) health behaviour. In addition, they use individual-level information on whether respondents knew and visited a CC in the last three months, while my main variable of interest is the cluster-level availability of CCs- information collected from a group of key people from the clusters.

Notedly, the studies mentioned above on CCs in Bangladesh use the awareness and utilization questions that are asked of the respondents. There is a high probability that these variables are endogenous as both the awareness about CCs and the rate of visiting CCs can be related to several factors that these studies do not control for- such as, distance from the CCs as people may be more likely to know and visit CCs if the distances are low, personal communication within the community and with the clinics since these might help to increase knowledge and awareness, the number of males in households as they are more likely to venture and stay more

outside in the Bangladesh context and may be more likely to hear about CCs, and husband's/male's education since education might help to increase awareness. These sources of bias are not addressed in these studies.

On the other hand, this paper uses the cluster-level availability of CCs as the main variable of interest. Considering this backdrop, the main contribution of this study is to explore the association of CCs using a relatively less endogenous variable- the number of CCs in clusters. The number of CCs, and other healthcare providers, in clusters is collected through key informant interviews of a group of four to six people- from the clusters- who know about the socioeconomic characteristics and healthcare facilities within the clusters. Conventionally, these people are believed to have substantial knowledge about the socio-demographic characteristics of a region. Therefore, the cluster information data can be assumed to be of high quality. This group of people include community leaders, teachers, government officials, social workers, religious leaders, traditional healers, as well as healthcare providers. It is generally believed that these people have positive reputations, are well-known about their respective contexts and are more likely to know the characteristics of clusters.

4.5 Data and methodology

4.5.1 Dataset

Three rounds of the Bangladesh Demographic and Health Survey (BDHS) 2011, 2014, and 2017-18 are used in this chapter. These are repeated cross-section data, and representative at the following levels:

- Nationally representative of Bangladesh
- Representative of the seven divisions of Bangladesh

The target sample is the ever-married women of childbearing age (15-49 years) which is between 17,000 and 21,000 in each wave. The BDHS also has a supplementary community survey that contains community/cluster characteristics, which is between 600 and 700 clusters in each wave with every surveyed woman belonging to a sample cluster.

4.5.2 Empirical specifications

$$H_{ircdt} = \alpha_0 + \alpha_1 CC_{ct} + \alpha_2 H_{dt-1} + \alpha_3 TFR_{dt-1} + \alpha_4 X_{irct} + \alpha_5 Z_{rct} + \alpha_6 Y_{ct} + \alpha_7 Year_t + \varepsilon_{irct}$$

Here, H_{ircdt} is the health behaviour of woman i from household r from cluster c from district/division d in year t, CC_{ct} is having at least one CC (yes=1, no=0) in cluster c in year t, H_{dt-1} is the lagged district/division health behaviour indicators, TFR_{dt-1} is the lagged district/division total fertility rate, X_{irct} is the vector of individual characteristics, Z_{rct} is a vector of households characteristics, Y_{ct} is a vector of cluster characteristics over time (e.g., distance to district and sub-district headquarters, main economic activity, distances to educational institutions, number of different healthcare facilities, number of health and family planning workers, and number of doctors etc.) in year t, $Year_t$ are the wave/year dummies, and ε_{irct} is the error term. Standard errors are clustered by cluster. The variable of interest- i.e., the number of CCs in a cluster- might be endogenous as it might be related to healthcare characteristics and health indicators within the clusters. To deal with some of this potential endogeneity, I use cluster characteristics and district/division lagged health indicators.

4.5.3 The variables of interest

The outcome variables that I focus on in this paper are: ever used a family planning method (yes/no), antenatal care visits (yes/no), Caesarean delivery (yes/no), seeking treatment for children's diarrhoea (yes/no), seeking treatment for children's fever/cough (yes/no), and immunization coverage (yes/no)- Polio 1, 2, and 3 vaccinations. The explanations of these outcome variables are given in Table 4.1. The main explanatory variable is the number of CCs in a cluster which is generated from the supplementary cluster surveys.

The outcome variables are chosen based on their importance in terms of the health and morbidity of women and children. For instance, both the use of contraceptives and adequate antenatal care visits of women significantly reduce maternal death (Cleland, Conde-Agudelo, Peterson, Ross, & Tsui, 2012; Nam, Oh, & Park, 2022; McCauley, Lowe, Furtado, Mangiaterra, & van den Broek, 2022); while caesarean delivery is associated with a higher risk of health

problems for mothers and their children (Rahman, Khan, Rahman, Alam, & Khan, 2022). Additionally, diarrhoea is one of the main causes of children's (under 5 years of age) death (GBD 2016 Diarrhoeal Disease Collaborators, 2018), while polio is considered another deadly disease (CDC, 2022). Despite a declining trend in the prevalence of polio disease in Bangladesh, this chapter focuses on polio vaccinations for two reasons. First, this is the only vaccination for which data was collected in all three rounds of the BDHS survey. Second, there have been threats of the resurgence of polio where it was previously eradicated, so it is important to keep vaccinations updated and continue to generate evidence related to polio vaccinations coverage (Kim, Piamonte, Allen, & Thakur, 2023). Critically, since the healthcare-seeking behaviour of children are only available in terms of diarrhoea and fever/cough, these two indicators are considered outcome variables along with others.

4.6 Descriptive statistics

This section focuses on the descriptive statistics regarding community clinics in Bangladesh and women's healthcare-seeking behaviour for themselves and their children including immunization. I start by discussing the yearly changes in the healthcare-seeking behaviour of women, followed by their relationship with the community clinics in the areas.

Table 4.2 and Table 4.3 respectively show the percentage of women using family planning methods (ever), doing antenatal care visits, and having a caesarean delivery. The use (ever) of family planning methods has increased from 82% to 89% between 2011 and 2017-18. In addition, the use of antenatal care and caesarean delivery has increased from 67% to 92%, and 16% to 33%. This implies that women's healthcare-seeking behaviours in terms of these services have increased over the years.

Similarly, the healthcare-seeking behaviour of women for their children's diarrhoea and fever/cough has risen between the years 2011 and 2017-18 as well. Table 4.4 shows that diarrhoea treatment was sought for 76% of children in 2011, while the percentage was 86% in 2017-18, and fever/cough treatment was sought for 74% of children in 2011, while it was 84% in 2017-18. In contrast, the polio immunization between 2011 and 2017-18 has decreased. Table 4.5 shows that Polio 1, Polio 2 and Polio 3 immunization have respectively decreased from 93% to 91%, 89% to 85%, and 84% to 80% between 2011 and 2017-18. The reason behind this could be that Bangladesh was announced as polio-free in 2014 (WHO, 2019). As a

result, people may have felt secure and may have been less fearful of polio- thus leading to their low interest in getting their children vaccinated against polio.

Table 4.6 shows the distribution of CCs across the three waves of the survey. Out of 600 clusters in 2011 and 2014 and 672 clusters in 2017-18, at least one CC is available in 76%, 74%, and 77% clusters respectively in 2011, 2014, and 2017-18. Across the survey years, the number of clusters with CCs are more or less similar, but the percentage of clusters that have more than one CC has increased.

Table 4.7 and Table 4.8 show the comparisons of women's healthcare-seeking behaviour for themselves and their children, and polio vaccination coverages between the clusters with and without CCs[35]. Table 4.7 indicates that, relative to women from clusters with no CCs, in the clusters with at least one CC- 2% fewer women report ever using family planning methods, 9% fewer women go for antenatal care visits, and 15% fewer women have caesarean delivery as compared to women without any CCs in their clusters. Accordingly, Table 4.8 shows that around 1% fewer children from the clusters with at least one CC are polio 1 and polio 2 vaccinated as compared to children from the clusters without CCs. However, there is no significant difference between children from the clusters with or without CCs in terms of seeking treatments for diarrhoea, fever/cough, and getting polio 3 vaccinations.

Therefore, the descriptive statistics show that the availability of CCs in the clusters is negatively associated with women having fewer caesarean deliveries in the clusters, which might imply that increasing the number of CCs has some positive association with providing normal deliveries. In contrast, CCs do not have any positive association with women's other healthcare-seeking behaviour either for themselves or for their children. This may be because CCs are, generally, established in areas where healthcare-seeking behaviours are weak to begin with, and where the number of healthcare providers is low. To account for these types of factors, I control for several relevant characteristics in the regression models, and these results are provided in the next section.

[35] I have looked into the number of CCs and healthcare-seeking behaviours as well. However, it does not show any pattern.

4.7 Regression results

Beyond the descriptive statistics, this section highlights the regression results from the investigation of the association of CCs with reproductive-aged women's healthcare-seeking behaviour for themselves and their children in Bangladesh. In this analysis estimating the association of CCs with healthcare-seeking behaviour, I control for several socio-economic and cluster characteristics including the availability of healthcare facilities. The reason behind using these covariates stems from the assumption that these covariates might significantly influence or even determine the outcome variables. The average differences in the control variables across the clusters with no CC and at least one CC are shown in Table 4.9. Table 4.9 shows that clusters with CCs are positively associated with younger women, low-educated women, women with a higher number of sons and daughters[36], older household heads, households with lower wealth, a lower number of private and NGO clinics, a lower number of allopathic doctors, and a higher distance to the nearest hospitals. This implies that CCs are situated in such clusters where there is a lower number of healthcare providers, as well as in remote areas. It is not surprising that CCs are established where the accessibility[37] to healthcare providers is comparatively low.

To begin with the regression results, Table 4.10 shows the Linear Probability Model (LPM) results of women's (ever) adoption of family planning methods. The results (column 4) reveal that women from clusters with at least one CC are 15 percentage points more likely to adopt a family planning method as compared to women from clusters without any CCs. CCs only show a significant positive association with the outcome of interest when I control for the availability of other types of healthcare providers- there are no significant results in the case of other specifications. Additionally, private clinics also have a positive association with adopting family planning methods. This is in accordance with the literature, which suggests that increasing competition or decreasing concentration leads to positive health outcomes (Cooper, Gibbons, Jones, & McGuire, 2010; Gaynor, Moreno-Serra, & Propper, 2013; Kessler & McClellan, 2000). Cooper et al. (2010), Gaynor et al. (2013), and Kessler & McClellan (2000) argue that higher competition leads to higher quality in terms of reducing the rate of mortality in lower concentrated areas. Accordingly, Table 4.10 also shows that CCs have a positive

[36] The number of sons and daughters are separately controlled for, since patriarchy is still prevalent in Bangladesh, and so, the number of sons and daughters may have different implications in this regard.
[37] The access/accessibility to CCs and other healthcare providers means the availability of them not the use of them.

association (0.146+0.188-0.140= 0.194) with women's adopting family planning methods when private clinics are present in the cluster along with CCs. This implies that women from clusters with both CCs and private clinics are more likely to be associated with adopting family planning methods. However, their aggregate interaction coefficient (0.194) is lower than the accumulation of their separate coefficients (0.146+0.188=0.334) as there are some negative coefficients. This can be explained by the negative impact of higher competition on quality, as mentioned by Volpp et al. (2003) and Propper et al. (2003). The authors in both these studies suggest that, due to higher competition, quality is sometimes compromised as the providers may reduce both the number of medical staff and their wages in order to sustain in the market.

Also, older women, higher educated women, women with more children, and non-Muslim women compared to Muslim women are more likely to adopt family planning methods. In contrast, women from female-headed households as compared to male-headed households, women from households with older household heads, women from low-asset households, and women from rural areas as compared to urban areas are less likely to adopt family planning methods. Additionally, an increase is observed in this trend between 2011 and 2017-18.

Moving from family planning methods to caesarean delivery, Table 4.11 shows the LPM regression results in the case of women's caesarean delivery during their last pregnancy. The results in Table 4.11 show that there is no relationship of CCs with women's caesarean delivery. However, women with more children are less likely to have caesarean delivery. On the contrary, older women, higher educated women, Muslim women compared to non-Muslim women, women from high asset households and women from clusters with high private clinics are more likely to have caesarean delivery. The latter two aspects- women from high asset households and women from clusters with higher private clinics- may be linked as rich people might seek more treatment from private clinics and private clinics may also be highly motivated towards caesarean deliveries as they operate mainly for profits and since caesarean deliveries are more expensive for the patient (Sk, 2020). Furthermore, the overall rate of caesarean delivery increased in 2014 and 2017-18, each time compared to 2011.

Table 4.12 shows the LPM regression results of women's antenatal care visits related to their most recent live births in three years. The results show that the women from clusters with at least one CC are 3.5 to 13 percentage points more likely to seek antenatal care compared to women from clusters without any CCs. This range is from different columns with different sets

of controls. Since the availability of other healthcare providers matters a lot in terms of healthcare-seeking behaviour, I choose the specification that includes other healthcare providers and this reveals the maximum result of 13%- which is almost four times higher than the default specification (3.5% in column 1). Additionally, similar to the results in terms of family planning methods, when CCs are present alongside private clinics in a cluster- there is a higher prevalence of women's antenatal care visits (Table 4.12). This means that women from clusters with both CCs and private clinics are more likely to be associated with visiting healthcare providers for their antenatal care. However, the aggregate coefficient of CCs and private clinics (0.134+0.144-0.103=0.175) is lower than the accumulation of their separate coefficients (0.134+0.144=0.278) as there are some negative coefficients.

Also, older women, higher educated women, women from wealthier households, and women from female-headed households as compared to male-headed households are more likely to seek antenatal care. In contrast, women with more children, and women from rural areas as compared to women from urban areas are less likely to seek antenatal care. Over time, women have become more likely to seek antenatal care in 2014 and 2017-18, in each case compared to 2011.

Significantly, CCs may also be associated with vaccination coverage. To explore this possibility, I focus on polio vaccination coverage. There are three polio vaccines- Polio 1, Polio 2, and Polio 3- all of which are provided to children of different ages by the government free of cost. The vaccination coverage of Polio 1, Polio 2, and Polio 3 are respectively shown in Table 4.13, Table 4.14, and Table 4.15. The results reveal that CCs and other healthcare providers do not have any significant association with Polio 1 and Polio 2 vaccination coverage. However, they have a positive association with Polio 3 vaccination coverage. Results show that children from clusters with at least one CC are 4 (column 2) to 18 (column 4) percentage points more likely to be vaccinated with Polio 3 than children from clusters without any CCs. This positive association is subject to the control variables because significant results are observed only when I control for lagged district health indicators and the availability of other healthcare providers. Additionally, similar to the results in terms of family planning methods and antenatal care visits, Table 4.15 also shows that private clinics- either alone in the cluster or with CCs- have a positive association with polio 3 vaccination coverage. This implies that children from clusters with both CCs and private clinics are more likely to be associated with getting polio 3 vaccinations. This might be because private clinics can also be helpful in

providing children's vaccination in the locality even if there are public providers such as CCs. Moreover, the aggregate coefficients of CCs and private clinics- when these are available together in clusters- (0.175+ 0.157-0.163=0.169) are lower than their separate aggregate coefficients (0.175+ 0.157=0.332).

Furthermore, over time, all three vaccination coverages have declined between 2011 and 2017-18, which may be a result of the announcement of a polio-free Bangladesh in 2014 (WHO, 2019). Thus, the announcement might have made people feel safer and more secured against polio and may have made them less interested in getting their children vaccinated.

Proceeding to focus on women's healthcare-seeking behaviour for their children, Table 4.16 shows the LPM regression results in the case of children's diarrhoea. Table 4.16 shows that there is no relationship between CCs and women's seeking treatment for children's diarrhoea. However, CCs do have a positive association with the outcome variable if there is a private clinic in the cluster (column 4, where I control for other healthcare providers). Women from clusters with at least one CC and one private clinic are 12.1 (26.5-14.4) percentage points more likely to seek treatment for their children's diarrhoea. So, women from clusters with CCs and private clinics are more likely to be associated with seeking treatment for their children's diarrhoea. In contrast, private clinics have a negative association with women seeking healthcare for children's diarrhoea. The higher competition reduces this negative association as the interaction coefficient of private clinics with CCs shows a positive result.

Moreover, divorcee women as compared to married women are 80 to 84 percentage points less likely to seek treatment for their children's diarrhoea- which may be an indication that socioeconomic vulnerability and stigma towards divorcee women plays a role in their healthcare-seeking behaviour (World Bank, 2016b). Lastly, no significant difference is observed in the case of seeking treatment for diarrhoea across time.

Finally, Table 4.17 shows the LPM regression results of women's healthcare-seeking behaviour in the case of their children's fever/cough. According to the results from Table 4.17, there is a positive association between CCs and women's seeking treatment for children's fever/cough. Women from clusters with at least one CC are 4 percentage points (columns 1 and 3, where I control for default control variables and lagged division healthcare indicators respectively) more likely to seek treatment for their children's fever/cough. On the contrary,

CCs are negatively associated (0.123-0.129=-0.006) with healthcare-seeking for children's fever/cough (column 4) when private clinics and CCs are present in the clusters. This implies that CCs and private clinics co-existing in the same cluster is negatively associated with women seeking treatment for their children's fever/cough. This may be explained by the negative impact of a higher number of providers on the quality of healthcare services (Propper, Burgess, & Gossage, 2003; Volpp, et al., 2003). Also, over time, seeking treatment for children's cough/fever has increased between 2011 and 2017-18.

In sum, out of eight indicators of women's healthcare-seeking behaviour- including vaccinations- for themselves and for their children, the availability of CCs alone in clusters has a positive significant association with three of the indicators, and a positive significant association with one other indicator of healthcare-seeking behaviour when there are also private clinics in the clusters. Therefore, CCs either alone or jointly with private clinics appear to be, in several cases, positively associated with some of the healthcare-seeking behaviour in the clusters where they operate.

4.8 Discussion and Robustness checks

The analyses in this chapter yield several noteworthy findings, even after controlling for individual, household and cluster-level characteristics. For instance, CCs are observed to have a positive association with the adoption of family planning methods in the clusters in which they exist and function, and there may be two main explanations behind this. First, CCs provide family planning services, such as creating awareness for contraceptive use, which can increase the overall use of contraceptives among women. Second, CCs may provide contraceptives free of cost- thereby increasing the use of contraceptives by women. However, when I do not control for other characteristics (in Table 4.7 and Table 4.8), there is a negative association between CCs and healthcare-seeking behaviour. The reason behind this might be that CCs are established in such areas where people are already lagging behind in terms of health indicators, which is evident from Table 4.9. And when I control for this disadvantage, the association of CCs turns positive. This simply means that women in clusters with CCs are still lagging behind women in clusters without CCs, but the presence of CCs reduces this gap.

Another noteworthy finding of this paper is that CCs have a positive association with women's antenatal care seeking, as well as their seeking treatment for their children's diarrhoea and

fever/cough. This could be explained in two ways. First, establishing CCs in a locality increases the availability of public healthcare providers within a smaller radius, which in turn increases the visitation of women for antenatal care and seeking treatment for their children's illnesses- especially in rural areas where women have mobility restrictions due to the lack of adequate transport systems. Second, women may be more likely to go to other healthcare providers as other providers would now provide higher quality services at a low cost as a result of the market competition created by CCs in the area.

The positive associations yielded from the results can also be explained in terms of supply and demand side perspectives of the healthcare market in Bangladesh. From a supply-side perspective, an increased supply of healthcare providers may increase the quality of healthcare services across clusters (Cooper, Gibbons, Jones, & McGuire, 2010; Gaynor, Moreno-Serra, & Propper, 2013; Kessler & McClellan, 2000), and may decrease the distance to the healthcare providers- which, in turn, would lead to more cost-effective healthcare services for the population (Ricketts & Holmes, 2007). These considerations imply that there is a high chance that any new healthcare providers would reduce the distances for some households in a region and would also increase the quality of healthcare services- which would eventually improve the health outcomes. There is also a demand-side perspective of the healthcare market, whereby increased awareness and decreased distances may increase both individuals' visits to healthcare service providers and the overall satisfaction of consumers (Dietrichson, Ellegard, & Kjellsson, 2016). Basically, people would be more encouraged to visit more healthcare providers due to the decreased distances from the providers.

However, there are some negative results in terms of the association between the availability of healthcare providers and healthcare-seeking behaviour. For example, the association between the availability of CCs and children's healthcare-seeking behaviour in the case of fever/cough when I control for other healthcare providers. This may be because increased competition, or decreased concentration, sometimes leads to lower quality of healthcare as discussed by Volpp et al. (2003) and Propper et al. (2003).

In addition, women's healthcare-seeking behaviour has increased over the years between 2011 and 2017-18, but women from rural areas are less likely to seek treatments as compared to women from urban areas. This may be an indication that there are still rural-urban inequalities in terms of access and the availability of healthcare services even after the establishment of

CCs in remote areas. This warrants considering whether a further increment of healthcare providers in rural areas is necessary.

In this paper, using different LPM regression specifications to explore the association of CCs with women's healthcare-seeking behaviour, I find positive results in the case of some specifications. To further explore the effect of CCs and check the robustness of the results, I run logit regressions separately for all the outcome variables (Tables C1 to C8 in appendix C). The logit regression results for the coefficients of the variables of concern are broadly consistent with the LPM results.

4.9 Conclusion and policy implications

This paper aims to explore whether a newly introduced PHC- community clinics- in Bangladesh are associated with the healthcare-seeking behaviour of reproductive-aged women- for themselves and for their children (below 5 years of age)- and children's vaccination coverage. For this purpose, I use three rounds of the nationally representative repeated cross-section datasets of BDHS 2011, 2014, and 2017-18. I exploit the cluster-level availability of CCs to determine and explain their potential association with healthcare-seeking behaviour.

The descriptive statistics show that women's healthcare-seeking behaviour and health behaviour such as contraceptive use, antenatal care visits, caesarean delivery, and seeking treatment for their children's fever/cough and diarrhoea have increased in 2014 and 2017-18 compared to 2011. However, polio vaccination coverages- Polio 1, Polio 2, and Polio 3- have decreased over time. In addition, the availability of CCs in clusters does not have any positive relationship with healthcare-seeking behaviour.

On the other hand, the regression results- where I control for women, households, cluster characteristics, and lagged health indicators- indicate some positive associations of CCs with women's healthcare-seeking behaviour. For example, women from clusters with at least one CC are more likely to use contraceptive methods, seek antenatal care, and seek treatment for children's recent diarrhoea and fever/cough as compared to women from clusters without any CCs.

These findings suggest that a low-cost initiative such as CCs for PHC can be effective in improving women's healthcare-seeking behaviour in contexts such as Bangladesh, which promises the potential for this mechanism of healthcare to be scaled up to other similar contexts in low and middle-income countries. Moreover, future research can utilize data on the year of establishment of CCs and cluster identification across different waves to estimate stronger estimates for the relationship of CCs with health outcomes.

4.10 Tables

Table 4.1: Description of outcome variables

Variable	**Description**	**Explanation**
Ever use of family planning method	1=yes, no=0	Whether the women ever used a family planning method or not
Antenatal care	1=yes, no=0	Did antenatal care visit for the most recent live birth in the last three years
Caesarean delivery	1=yes, no=0	Had caesarean delivery for the most recent live birth in the last three years
Polio 1	1=yes, no=0	Received polio 1 vaccination for children 12-23 months of age
Polio 2	1=yes, no=0	Received polio 2 vaccination for children 12-23 months of age
Polio 3	1=yes, no=0	Received polio 3 vaccination for children 12-23 months of age
Treatment for diarrhoea	1=yes, no=0	Sought treatment for children's (below 5 years of age) diarrhoea in the last two weeks
Treatment for fever/cough	1=yes, no=0	Sought treatment for children's (below 5 years of age) fever/cough in the last two weeks

Note: This table shows the description of outcome variables used in this chapter.

Table 4.2: Percentage of women who ever used any family planning method.

Year	N	Ever used a family planning method %
2011	17,842	81.79
2014	17,863	81.43
2017-18	20,127	88.89

Note: This table shows the percentages of ever-married women of reproductive age who ever used any family planning method.

Table 4.3: Percentage of women who used antenatal care and had a caesarean delivery.

Year	N	Antenatal care %	Caesarean delivery %
2011	7,323	66.62	15.97
2014	4,494	78.54	24.22
2017-18	5,012	91.86	33.37

Note: This table shows the percentages of ever-married women of reproductive age who used antenatal care, and had caesarean delivery for the last pregnancy or birth within the last three years.

Table 4.4: Percentage of women who sought treatment for their children's (below 5 years of age) diarrhoea and fever/cough.

	Diarrhoea			Fever/cough		
Year	N	Having diarrhoea (% of N)	Treatment (% of having diarrhoea)	N	Having cough/fever (% of N)	Treatment (% of having cough/fever)
2011	7,107	4.87	75.94	7,113	38.56	74.05
2014	6,661	5.1	78.82	6,660	37.81	81.17
2017-18	7,395	5.29	85.9	7,395	34.06	84.03

Note: This table shows the percentages of ever-married women of reproductive age who sought treatment for their children's diarrhoea and fever/cough in the last two weeks. This is from a two-step question. The respondents are first asked if the child is ill, and then if they seek treatment or not.

Table 4.5: Percentage of children of ever-married women who received polio vaccines.

Year	Polio 1		Polio 2		Polio 3	
	N	%	N	%	N	%
2011	7,122	93.25	7,117	88.75	7,117	83.76
2014	6,675	93.26	6,670	89.7	6,670	84.41
2017-18	4,897	90.57	4,896	84.5	4,896	78.9

Note: This table shows the percentages of children of ever-married women who received polio 1, polio 2 and polio 3 vaccines.

Table 4.6: Percentage distribution of the number of CCs in clusters.

No. of CCs	2011	2014	2017-18
0	24.33	25.5	23.36
1	52.5	43.67	36.61
2	18	18.17	27.23
3	3.83	8.33	8.93
4	1.33	4.33	3.87
No. of clusters	600	600	672

Note: This table shows the distribution of clusters by the number of CCs in clusters in all three years of the BDHS 2011, 2014 and 2017-18.

Table 4.7: Percentage of women who ever used family planning method, antenatal care, and had a caesarean delivery by the availability of CCs in the cluster.

CCs in the cluster	Ever use of family planning method (n=55,832)	Antenatal care (n=16,829)	Caesarean delivery (n=16,829)
No CC	85.9%	84.4%	34.9%
At least one CC	83.7%	75.3%	20.0%

Difference	-2.2%	-9.1%	-14.9%
P-value	0.000	0.000	0.000

Note: This table shows the percentages of ever-married women of reproductive age who ever used any family planning method, visited for antenatal care and had a caesarean delivery by the availability of CCs in the cluster.

Table 4.8: Percentage of women who sought treatment for their children's diarrhoea and fever/cough, and percentages of children who had polio 1, polio 2 and polio 3 vaccines by the availability of CCs in the cluster.

CCs in the cluster	Diarrhoea treatment (n=18,679)	Fever/cough treatment (n=21,168)	Polio 1 (n=18,684)	Polio 2 (n=18683)	Polio 3 (n=18683)
No CC	82.3%	79.1%	93.2%	88.7%	83.2%
At least one CC	79.9%	79.5%	92.3%	87.7%	82.6%
Difference	-2.4%	0.4%	-0.9%	-1.0%	-0.6%
P-value	0.397	0.684	0.052	0.078	0.382

Note: This table shows the percentages of ever-married women of reproductive age who sought treatment for their children's diarrhoea and fever/cough in the last two weeks, and the percentage of children who had polio 1, polio 2 and polio 3 vaccines by the availability of CCs in the cluster.

Table 4.9: The differences in control variables between the clusters with no CC and at least one CC.

	No CC	At least one CC	Difference	P-value
Women characteristics (n=55,832)				
Age	31.43	31.06	-0.37	0.000
No. of sons	1.06	1.17	0.11	0.000
No. of daughters	1.01	1.12	0.11	0.000
Non-Muslim dummy	0.10	0.10	0.00	0.706
Average years of education	3.21	3.04	-0.17	0.000
Household characteristics (n=55,832)				
Female household head	0.12	0.12	0.00	0.365
Household head's age	43.82	45.05	1.23	0.000
Wealth index	4.05	2.81	-1.25	0.000
Rural dummy	0.16	0.80	0.64	0.000
Cluster characteristics (1,872)				
% of private clinics	71.82	52.12	-19.69	0.000
% of NGO clinics	28.18	17.31	-10.88	0.000
No. of allopathic doctors	1.58	0.88	-0.70	0.000
Distance to nearest hospital	13.61	30.08	16.48	0.000

Note: This table shows the average difference of women, household and clusters characteristics between the clusters with and without CC. The last column shows the p-values of difference.

Table 4.10: LPM regression results; dependent variable: women ever adopted a family planning method.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	0.006	0.018	0.005	0.146***
	(0.010)	(0.012)	(0.009)	(0.042)
	0.506	0.149	0.565	0.001
At least one private clinic in the cluster				0.188***
				(0.034)
				0.000
At least one NGO clinic in the cluster				0.009
				(0.015)
				0.545
At least one CC*one private clinic in the cluster				-0.140***
				(0.043)
				0.001
At least one CC*one NGO clinic in the cluster				-0.011
				(0.016)
				0.474
Women's characteristics				
Age group (base: 15-19)				
1. 20-24	0.072***	0.072***	0.072***	0.072***
	(0.008)	(0.010)	(0.008)	(0.008)
	0.000	0.000	0.000	0.000
2. 25-29	0.075***	0.074***	0.075***	0.075***
	(0.009)	(0.012)	(0.009)	(0.009)
	0.000	0.000	0.000	0.000
3. 30-34	0.053***	0.048***	0.053***	0.053***
	(0.009)	(0.012)	(0.009)	(0.009)
	0.000	0.000	0.000	0.000
4. 35-39	0.020*	0.006	0.020*	0.020*
	(0.011)	(0.014)	(0.011)	(0.011)
	0.061	0.646	0.068	0.067
5. 40-44	-0.035***	-0.060***	-0.035***	-0.035***
	(0.012)	(0.015)	(0.012)	(0.012)
	0.004	0.000	0.003	0.003
6. 45-49	-0.117***	-0.168***	-0.117***	-0.117***
	(0.012)	(0.015)	(0.012)	(0.012)
	0.000	0.000	0.000	0.000
Level of education (base: no education)				
1. Primary	0.055***	0.050***	0.055***	0.055***
	(0.005)	(0.007)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000
2. Secondary	0.072***	0.073***	0.072***	0.071***
	(0.006)	(0.007)	(0.006)	(0.006)
	0.000	0.000	0.000	0.000
3. Higher Secondary	0.083***	0.102***	0.084***	0.083***
	(0.008)	(0.011)	(0.008)	(0.008)
	0.000	0.000	0.000	0.000
No. of sons	0.074***	0.075***	0.075***	0.075***
	(0.003)	(0.004)	(0.003)	(0.003)
	0.000	0.000	0.000	0.000
No. of daughters	0.061***	0.063***	0.062***	0.062***
	(0.002)	(0.003)	(0.002)	(0.002)
	0.000	0.000	0.000	0.000
Marital status (base: married)				
1. Widowed	-0.272***	-0.336***	-0.272***	-0.272***
	(0.015)	(0.019)	(0.015)	(0.015)
	0.000	0.000	0.000	0.000
2. Divorced	-0.311***	-0.372***	-0.310***	-0.311***

VARIABLES	(1)	(2)	(3)	(4)
	(0.021)	(0.027)	(0.021)	(0.021)
	0.000	0.000	0.000	0.000
3. Separated	-0.250***	-0.307***	-0.251***	-0.250***
	(0.022)	(0.027)	(0.022)	(0.022)
	0.000	0.000	0.000	0.000
Other religion (base: Islam)	0.047***	0.045***	0.046***	0.047***
	(0.006)	(0.009)	(0.006)	(0.006)
	0.000	0.000	0.000	0.000
Household characteristics				
Female household head	-0.074***	-0.081***	-0.073***	-0.074***
	(0.007)	(0.010)	(0.007)	(0.007)
	0.000	0.000	0.000	0.000
Age of household head	-0.002***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000	0.000
Wealth index	0.010***	0.009***	0.010***	0.010***
	(0.002)	(0.003)	(0.002)	(0.002)
	0.000	0.003	0.000	0.000
Rural (urban=0)	-0.024***	-0.007	-0.005	-0.025***
	(0.007)	(0.010)	(0.009)	(0.007)
	0.000	0.520	0.560	0.000
Division (base: Barisal)				
1. Chattogram	-0.113***	-0.059***	-0.053***	-0.112***
	(0.008)	(0.013)	(0.011)	(0.008)
	0.000	0.000	0.000	0.000
2. Dhaka	-0.028***	-0.010	-0.008	-0.028***
	(0.008)	(0.010)	(0.010)	(0.008)
	0.000	0.352	0.430	0.000
3. Khulna	0.025***	0.015	0.020**	0.025***
	(0.007)	(0.009)	(0.010)	(0.007)
	0.000	0.105	0.046	0.000
4. Mymensingh	-0.001		0.014	-0.001
	(0.011)		(0.012)	(0.011)
	0.912		0.267	0.894
5. Rajshahi	0.026***	0.007	0.024**	0.025***
	(0.007)	(0.010)	(0.010)	(0.007)
	0.000	0.484	0.020	0.000
6. Rangpur	0.008	0.009	0.012	0.008
	(0.007)	(0.010)	(0.009)	(0.007)
	0.262	0.348	0.209	0.265
7. Sylhet	-0.219***	-0.128***	-0.086***	-0.218***
	(0.012)	(0.024)	(0.023)	(0.012)
	0.000	0.000	0.000	0.000
Cluster characteristics				
No. of doctors	-0.001	-0.002	0.000	-0.001
	(0.003)	(0.004)	(0.003)	(0.003)
	0.841	0.692	0.945	0.756
Distance to the nearest hospital (km)	-0.000*	-0.000**	-0.000	-0.000*
	(0.000)	(0.000)	(0.000)	(0.000)
	0.077	0.014	0.108	0.054
Percentage of private clinics	0.000	0.000	0.000	
	(0.000)	(0.000)	(0.000)	
	0.171	0.157	0.242	
Percentage of NGO clinics	0.000	0.000	0.000	
	(0.000)	(0.000)	(0.000)	
	0.107	0.411	0.228	
Survey year (base: 2011)				
1. 2014	0.000	-0.011*	-0.007	0.000
	(0.006)	(0.006)	(0.007)	(0.006)

VARIABLES	(1)	(2)	(3)	(4)
	0.981	0.090	0.291	0.980
2. 2017-18	0.070***		0.064***	0.069***
	(0.006)		(0.007)	(0.006)
	0.000		0.000	0.000
Lagged (previous survey) indicators				
Percentage of women who used a family planning method before (district)		-0.000***		
		(0.000)		
		0.000		
Total fertility rate (district)		0.340***		
		(0.059)		
		0.000		
Percentage of women who used a family planning method before (division)			0.000	
			(0.000)	
			0.730	
Total fertility rate (division)			0.515***	
			(0.082)	
			0.000	
Constant	0.779***	0.575***	0.286**	0.615***
	(0.028)	(0.070)	(0.115)	(0.039)
	0.000	0.000	0.013	0.000
No. of observations	55,689	35,030	55,689	55,711
R-squared	0.164	0.181	0.166	0.165

Note: This table shows the LPM regression results of whether a woman ever adopted a family planning method or not. Four different specifications are in four separate columns under the same dependent variable. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table 4.11: LPM regression results; dependent variable: women had a caesarean delivery.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	0.010	0.010	0.011	-0.059
	(0.015)	(0.018)	(0.015)	(0.093)
	0.516	0.561	0.457	0.521
At least one private clinic in the cluster				-0.034
				(0.083)
				0.680
At least one NGO clinic in the cluster				-0.036
				(0.023)
				0.114
At least one CC*one private clinic in the cluster				0.026
				(0.091)
				0.772
At least one CC*one NGO clinic in the cluster				0.030
				(0.025)
				0.217
Women's characteristics				
Age group (base: 15-19)				
1. 20-24	0.035***	0.032**	0.036***	0.035***
	(0.011)	(0.013)	(0.011)	(0.011)
	0.002	0.015	0.001	0.002
2. 25-29	0.073***	0.071***	0.074***	0.073***
	(0.012)	(0.014)	(0.012)	(0.012)
	0.000	0.000	0.000	0.000
3. 30-34	0.132***	0.123***	0.133***	0.132***
	(0.020)	(0.026)	(0.020)	(0.020)
	0.000	0.000	0.000	0.000
4. 35-39	0.174***	0.162***	0.176***	0.174***
	(0.020)	(0.024)	(0.020)	(0.020)
	0.000	0.000	0.000	0.000
5. 40-44	0.184***	0.167***	0.185***	0.181***
	(0.028)	(0.031)	(0.028)	(0.028)

VARIABLES	(1)	(2)	(3)	(4)
	0.000	0.000	0.000	0.000
6. 45-49	0.141***	0.108**	0.142***	0.142***
	(0.050)	(0.044)	(0.048)	(0.049)
	0.004	0.015	0.003	0.004
Level of education (base: no education)				
1. Primary	-0.006	0.006	-0.004	-0.005
	(0.009)	(0.009)	(0.009)	(0.009)
	0.513	0.539	0.622	0.584
2. Secondary	0.067***	0.069***	0.068***	0.068***
	(0.011)	(0.013)	(0.012)	(0.011)
	0.000	0.000	0.000	0.000
3. Higher Secondary	0.253***	0.274***	0.254***	0.254***
	(0.018)	(0.023)	(0.018)	(0.018)
	0.000	0.000	0.000	0.000
No. of sons	-0.045***	-0.040***	-0.045***	-0.045***
	(0.005)	(0.005)	(0.004)	(0.005)
	0.000	0.000	0.000	0.000
No. of daughters	-0.054***	-0.046***	-0.054***	-0.054***
	(0.004)	(0.004)	(0.004)	(0.004)
	0.000	0.000	0.000	0.000
Marital status (base: married)				
1. Widowed	-0.062	0.005	-0.064	-0.063
	(0.045)	(0.052)	(0.045)	(0.045)
	0.172	0.918	0.160	0.163
2. Divorced	-0.004	-0.010	-0.005	-0.005
	(0.070)	(0.070)	(0.071)	(0.069)
	0.959	0.890	0.938	0.940
3. Separated	-0.054*	-0.098***	-0.052	-0.055*
	(0.033)	(0.033)	(0.033)	(0.033)
	0.097	0.003	0.109	0.096
Other religion (base: Islam)	0.027*	0.019	0.026*	0.026*
	(0.014)	(0.016)	(0.014)	(0.014)
	0.061	0.239	0.069	0.069
Household characteristics				
Female household head	0.011	-0.004	0.011	0.010
	(0.013)	(0.015)	(0.013)	(0.013)
	0.390	0.770	0.379	0.417
Age of household head	0.000	-0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
	0.752	0.813	0.702	0.697
Wealth index	0.058***	0.048***	0.058***	0.059***
	(0.004)	(0.004)	(0.004)	(0.004)
	0.000	0.000	0.000	0.000
Rural (urban=0)	-0.016	0.012	0.036*	-0.021*
	(0.012)	(0.018)	(0.019)	(0.012)
	0.170	0.497	0.055	0.075
Division (base: Barisal)				
1. Chattogram	-0.023*	-0.014	-0.024*	-0.022*
	(0.012)	(0.014)	(0.014)	(0.012)
	0.054	0.317	0.078	0.065
2. Dhaka	0.052***	0.030**	0.029**	0.055***
	(0.012)	(0.013)	(0.014)	(0.012)
	0.000	0.022	0.038	0.000
3. Khulna	0.093***	0.065***	0.058***	0.096***
	(0.014)	(0.016)	(0.021)	(0.014)
	0.000	0.000	0.006	0.000
4. Mymensingh	0.006		-0.023	0.010
	(0.023)		(0.025)	(0.023)
	0.783		0.365	0.663
5. Rajshahi	0.042***	0.013	0.024	0.043***
	(0.013)	(0.014)	(0.019)	(0.013)
	0.001	0.373	0.214	0.001
6. Rangpur	0.014	0.002	0.006	0.012
	(0.013)	(0.014)	(0.018)	(0.013)
	0.294	0.881	0.752	0.362
7. Sylhet	0.011	0.013	0.019	0.008

VARIABLES	(1)	(2)	(3)	(4)
	(0.012)	(0.014)	(0.022)	(0.012)
	0.345	0.362	0.373	0.512
Cluster characteristics				
No. of doctors	0.010**	0.008	0.010**	0.010**
	(0.004)	(0.005)	(0.004)	(0.004)
	0.019	0.114	0.021	0.024
Distance to the nearest hospital (km)	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
	0.186	0.185	0.183	0.116
Percentage of private clinics	0.001***	0.001***	0.001***	
	(0.000)	(0.000)	(0.000)	
	0.004	0.010	0.004	
Percentage of NGO clinics	0.000	0.000	0.000	
	(0.000)	(0.000)	(0.000)	
	0.474	0.391	0.402	
Survey year (base: 2011)				
1. 2014	0.069***	0.050***	0.048***	0.074***
	(0.010)	(0.010)	(0.011)	(0.010)
	0.000	0.000	0.000	0.000
2. 2017-18	0.135***		0.082***	0.136***
	(0.011)		(0.018)	(0.011)
	0.000		0.000	0.000
Lagged (previous survey) indicators				
Percentage of women who had a caesarean delivery (district)		-0.000		
		(0.000)		
		0.547		
Total fertility rate (district)		0.297***		
		(0.068)		
		0.000		
Percentage of women who had a caesarean delivery (division)			-0.000	
			(0.000)	
			0.735	
Total fertility rate (division)			0.321***	
			(0.101)	
			0.001	
Constant	-0.103**	-0.107	-0.175	0.037
	(0.048)	(0.072)	(0.117)	(0.091)
	0.031	0.136	0.135	0.681
No. of observations	16,788	11,620	16,788	16,793
R-squared	0.204	0.192	0.205	0.203

Note: This table shows the LPM regression results of whether a woman had a caesarean delivery or not. Four different specifications are in four separate columns under the same dependent variable. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table 4.12: LPM regression results; dependent variable: women's antenatal care visit.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	0.035*	0.029	0.035*	0.134**
	(0.020)	(0.024)	(0.020)	(0.060)
	0.083	0.233	0.083	0.026
At least one private clinic in the cluster				0.144***
				(0.029)
				0.000
At least one NGO clinic in the cluster				0.021
				(0.030)
				0.479
At least one CC*one private clinic in the cluster				-0.103*
				(0.058)
				0.077

VARIABLES	(1)	(2)	(3)	(4)
At least one CC*one NGO clinic in the cluster				-0.005
				(0.031)
				0.875
Women's characteristics				
Age group (base: 15-19)				
1. 20-24	-0.006	-0.005	-0.006	-0.006
	(0.010)	(0.013)	(0.010)	(0.010)
	0.541	0.721	0.543	0.561
2. 25-29	0.028**	0.022	0.028**	0.028**
	(0.011)	(0.015)	(0.011)	(0.011)
	0.013	0.159	0.013	0.012
3. 30-34	0.058***	0.052***	0.058***	0.059***
	(0.015)	(0.020)	(0.015)	(0.015)
	0.000	0.010	0.000	0.000
4. 35-39	0.090***	0.081***	0.090***	0.090***
	(0.021)	(0.027)	(0.021)	(0.021)
	0.000	0.003	0.000	0.000
5. 40-44	0.069**	0.063	0.069**	0.071**
	(0.035)	(0.042)	(0.035)	(0.035)
	0.049	0.134	0.047	0.045
6. 45-49	0.005	-0.006	0.006	0.004
	(0.073)	(0.081)	(0.073)	(0.073)
	0.946	0.940	0.933	0.959
Level of education (base: no education)				
1. Primary	0.120***	0.101***	0.120***	0.119***
	(0.015)	(0.017)	(0.015)	(0.015)
	0.000	0.000	0.000	0.000
2. Secondary	0.203***	0.197***	0.203***	0.202***
	(0.015)	(0.018)	(0.015)	(0.015)
	0.000	0.000	0.000	0.000
3. Higher Secondary	0.208***	0.235***	0.208***	0.208***
	(0.016)	(0.020)	(0.016)	(0.016)
	0.000	0.000	0.000	0.000
No. of sons	-0.052***	-0.048***	-0.052***	-0.052***
	(0.006)	(0.007)	(0.006)	(0.006)
	0.000	0.000	0.000	0.000
No. of daughters	-0.039***	-0.037***	-0.039***	-0.039***
	(0.005)	(0.006)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000
Marital status (base: married)				
1. Widowed	-0.016	-0.011	-0.016	-0.015
	(0.057)	(0.072)	(0.056)	(0.057)
	0.780	0.882	0.773	0.788
2. Divorced	-0.091	-0.090	-0.091	-0.092
	(0.073)	(0.089)	(0.073)	(0.073)
	0.210	0.309	0.212	0.207
3. Separated	-0.072	-0.106	-0.072	-0.071
	(0.060)	(0.081)	(0.061)	(0.060)
	0.234	0.190	0.234	0.239
Other religion (base: Islam)	0.011	0.018	0.011	0.011
	(0.018)	(0.021)	(0.018)	(0.018)
	0.541	0.393	0.554	0.546
Household characteristics				
Female household head	0.042***	0.059***	0.042***	0.043***
	(0.011)	(0.015)	(0.011)	(0.011)
	0.000	0.000	0.000	0.000
Age of household head	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
	0.346	0.586	0.351	0.350
Wealth index	0.057***	0.067***	0.057***	0.057***
	(0.004)	(0.005)	(0.003)	(0.004)
	0.000	0.000	0.000	0.000
Rural (urban=0)	-0.042***	-0.003	-0.028	-0.042***
	(0.013)	(0.020)	(0.025)	(0.013)
	0.001	0.887	0.270	0.001
Division (base: Barisal)				

VARIABLES	(1)	(2)	(3)	(4)
1. Chattogram	-0.021	-0.034	-0.027	-0.021
	(0.018)	(0.026)	(0.020)	(0.018)
	0.245	0.179	0.165	0.239
2. Dhaka	0.011	0.011	0.013	0.010
	(0.020)	(0.025)	(0.021)	(0.019)
	0.586	0.657	0.543	0.600
3. Khulna	0.055***	0.021	0.048*	0.054***
	(0.017)	(0.025)	(0.027)	(0.017)
	0.001	0.396	0.074	0.002
4. Mymensingh	0.052**		0.047*	0.051**
	(0.024)		(0.027)	(0.024)
	0.028		0.082	0.033
5. Rajshahi	0.054***	0.041	0.054**	0.054***
	(0.019)	(0.026)	(0.025)	(0.019)
	0.005	0.117	0.027	0.005
6. Rangpur	0.108***	0.073***	0.103***	0.109***
	(0.019)	(0.027)	(0.024)	(0.019)
	0.000	0.008	0.000	0.000
7. Sylhet	-0.049**	-0.061*	-0.053*	-0.048**
	(0.022)	(0.032)	(0.031)	(0.023)
	0.027	0.056	0.092	0.033
Cluster characteristics				
No. of doctors	-0.001	-0.007	-0.001	-0.001
	(0.005)	(0.006)	(0.005)	(0.005)
	0.851	0.290	0.794	0.787
Distance to the nearest hospital (km)	-0.001**	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
	0.013	0.017	0.012	0.010
Percentage of private clinics	0.001	-0.001	0.000	
	(0.000)	(0.001)	(0.000)	
	0.740	0.900	0.729	
Percentage of NGO clinics	0.001	0.001	0.001	
	(0.000)	(0.001)	(0.000)	
	0.186	0.422	0.174	
Survey year (base: 2011)				
1. 2014	0.122***	0.109***	0.119***	0.121***
	(0.015)	(0.014)	(0.018)	(0.015)
	0.000	0.000	0.000	0.000
2. 2017-18	0.224***		0.208***	0.223***
	(0.011)		(0.025)	(0.011)
	0.000		0.000	0.000
Lagged (previous survey) indicators				
Percentage of women who have antenatal care visits (district)		0.001		
		(0.000)		
		0.837		
Total fertility rate (district)		0.269***		
		(0.071)		
		0.000		
Percentage of women who have antenatal care visits (division)			0.001	
			(0.000)	
			0.553	
Total fertility rate (division)			0.122	
			(0.127)	
			0.336	
Constant	0.393***	0.141	0.221	0.261***
	(0.054)	(0.130)	(0.172)	(0.051)
	0.000	0.278	0.201	0.000
No. of observations	16,804	11,631	16,804	16,809
R-squared	0.227	0.208	0.227	0.227

Note: This table shows the LPM regression results of women's antenatal care visits. Four different specifications are in four separate columns under the same dependent variable. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table 4.13: LPM regression results; dependent variable: children had polio 1 vaccine.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	-0.003	0.001	-0.003	0.190
	(0.010)	(0.011)	(0.010)	(0.126)
	0.727	0.924	0.739	0.133
At least one private clinic in the cluster				0.204
				(0.124)
				0.101
At least one NGO clinic in the cluster				-0.006
				(0.016)
				0.693
At least one CC*one private clinic in the cluster				-0.199
				(0.126)
				0.114
At least one CC*one NGO clinic in the cluster				0.011
				(0.016)
				0.487
Women's characteristics				
Age group (base: 15-19)				
1. 20-24	0.043***	0.049***	0.043***	0.044***
	(0.008)	(0.009)	(0.008)	(0.008)
	0.000	0.000	0.000	0.000
2. 25-29	0.071***	0.081***	0.071***	0.072***
	(0.008)	(0.010)	(0.008)	(0.008)
	0.000	0.000	0.000	0.000
3. 30-34	0.083***	0.086***	0.083***	0.084***
	(0.012)	(0.014)	(0.012)	(0.012)
	0.000	0.000	0.000	0.000
4. 35-39	0.119***	0.122***	0.119***	0.119***
	(0.013)	(0.014)	(0.013)	(0.013)
	0.000	0.000	0.000	0.000
5. 40-44	0.130***	0.148***	0.130***	0.131***
	(0.020)	(0.019)	(0.020)	(0.020)
	0.000	0.000	0.000	0.000
6. 45-49	0.121***	0.114***	0.121***	0.122***
	(0.037)	(0.040)	(0.037)	(0.037)
	0.001	0.005	0.001	0.001
Level of education (base: no education)				
1. Primary	0.029***	0.032***	0.029***	0.029***
	(0.009)	(0.010)	(0.009)	(0.009)
	0.001	0.001	0.001	0.002
2. Secondary	0.051***	0.052***	0.051***	0.050***
	(0.008)	(0.009)	(0.008)	(0.008)
	0.000	0.000	0.000	0.000
3. Higher Secondary	0.038***	0.031***	0.038***	0.038***
	(0.010)	(0.010)	(0.010)	(0.010)
	0.000	0.003	0.000	0.000
No. of sons	-0.020***	-0.020***	-0.020***	-0.020***
	(0.004)	(0.004)	(0.004)	(0.004)
	0.000	0.000	0.000	0.000
No. of daughters	-0.018***	-0.015***	-0.018***	-0.019***
	(0.004)	(0.004)	(0.004)	(0.004)
	0.000	0.000	0.000	0.000
Marital status (base: married)				
1. Widowed	0.027	0.010	0.027	0.028
	(0.026)	(0.033)	(0.026)	(0.026)
	0.306	0.770	0.305	0.290
2. Divorced	0.049**	0.038	0.049**	0.049**
	(0.024)	(0.032)	(0.024)	(0.024)
	0.046	0.241	0.046	0.043
3. Separated	-0.006	-0.001	-0.005	-0.005
	(0.026)	(0.029)	(0.026)	(0.026)
	0.833	0.966	0.840	0.854
Other religion (base: Islam)	0.009	0.011	0.009	0.009
	(0.009)	(0.009)	(0.009)	(0.009)

VARIABLES	(1)	(2)	(3)	(4)
	0.307	0.184	0.309	0.318
Household characteristics				
Female household head	0.006	0.008	0.007	0.007
	(0.007)	(0.008)	(0.007)	(0.007)
	0.369	0.337	0.364	0.355
Age of household head	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000	0.000
Wealth index	0.006***	0.006***	0.006**	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)
	0.009	0.008	0.010	0.012
Rural (urban=0)	0.000	-0.006	0.006	0.001
	(0.007)	(0.008)	(0.009)	(0.007)
	0.955	0.441	0.516	0.837
Division (base: Barisal)				
1. Chattogram	-0.006	-0.013	-0.002	-0.006
	(0.009)	(0.010)	(0.010)	(0.009)
	0.544	0.188	0.874	0.511
2. Dhaka	0.008	0.002	0.006	0.007
	(0.009)	(0.009)	(0.009)	(0.009)
	0.398	0.773	0.487	0.447
3. Khulna	-0.001	-0.000	-0.006	-0.001
	(0.009)	(0.010)	(0.012)	(0.009)
	0.948	0.969	0.634	0.901
4. Mymensingh	-0.002		-0.004	-0.003
	(0.016)		(0.017)	(0.016)
	0.887		0.793	0.848
5. Rajshahi	0.013	0.010	0.008	0.014
	(0.009)	(0.010)	(0.011)	(0.009)
	0.142	0.350	0.440	0.118
6. Rangpur	0.020**	0.021**	0.016	0.020**
	(0.009)	(0.009)	(0.010)	(0.009)
	0.024	0.022	0.122	0.021
7. Sylhet	-0.046***	-0.056***	-0.036**	-0.044***
	(0.011)	(0.012)	(0.017)	(0.011)
	0.000	0.000	0.034	0.000
Cluster characteristics				
No. of doctors	-0.000	-0.000	-0.000	0.000
	(0.003)	(0.003)	(0.003)	(0.003)
	0.937	0.927	0.951	0.993
Distance to the nearest hospital (km)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
	0.379	0.354	0.373	0.373
Percentage of private clinics	-0.000	-0.000	-0.000	
	(0.000)	(0.000)	(0.000)	
	0.317	0.587	0.321	
Percentage of NGO clinics	-0.000	-0.000	-0.000	
	(0.000)	(0.000)	(0.000)	
	0.662	0.299	0.663	
Survey year (base: 2011)				
1. 2014	0.004	0.003	0.003	0.003
	(0.005)	(0.005)	(0.006)	(0.005)
	0.494	0.634	0.644	0.609
2. 2017-18	-0.024***		-0.027***	-0.025***
	(0.008)		(0.008)	(0.008)
	0.001		0.001	0.001
Lagged (previous survey) indicators				
Percentage of polio 1 vaccine coverage (district)		0.001		
		(0.000)		
		0.315		
Total fertility rate (district)		-0.004		
		(0.051)		
		0.940		
Percentage of polio 1 vaccine coverage (division)			-0.001	
			(0.000)	
			0.563	

VARIABLES	(1)	(2)	(3)	(4)
Total fertility rate (division)			0.057	
			(0.198)	
			0.773	
Constant	0.902***	0.881***	0.874***	0.688***
	(0.028)	(0.070)	(0.216)	(0.127)
	0.000	0.000	0.000	0.000
No. of observations	18,663	13,597	18,663	18,673
R-squared	0.025	0.028	0.025	0.026

Note: This table shows the LPM regression results of whether a child had polio 1 vaccine or not. Four different specifications are in four separate columns under the same dependent variable. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table 4.14: LPM regression results; dependent variable: children had polio 2 vaccine.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	0.013	0.021	0.012	0.154
	(0.013)	(0.014)	(0.012)	(0.113)
	0.309	0.116	0.320	0.171
At least one private clinic in the cluster				0.138
				(0.110)
				0.209
At least one NGO clinic in the cluster				-0.012
				(0.021)
				0.577
At least one CC*one private clinic in the cluster				-0.154
				(0.112)
				0.171
At least one CC*one NGO clinic in the cluster				0.022
				(0.022)
				0.331
Women's characteristics				
Age group (base: 15-19)				
1. 20-24	0.080***	0.091***	0.080***	0.080***
	(0.010)	(0.012)	(0.010)	(0.010)
	0.000	0.000	0.000	0.000
2. 25-29	0.112***	0.125***	0.112***	0.112***
	(0.011)	(0.013)	(0.011)	(0.011)
	0.000	0.000	0.000	0.000
3. 30-34	0.149***	0.163***	0.149***	0.150***
	(0.013)	(0.015)	(0.013)	(0.013)
	0.000	0.000	0.000	0.000
4. 35-39	0.186***	0.195***	0.186***	0.186***
	(0.017)	(0.019)	(0.017)	(0.017)
	0.000	0.000	0.000	0.000
5. 40-44	0.199***	0.214***	0.199***	0.200***
	(0.025)	(0.027)	(0.025)	(0.025)
	0.000	0.000	0.000	0.000
6. 45-49	0.128*	0.137*	0.128*	0.129*
	(0.074)	(0.079)	(0.074)	(0.074)
	0.081	0.084	0.081	0.081
Level of education (base: no education)				
1. Primary	0.044***	0.045***	0.044***	0.043***
	(0.012)	(0.014)	(0.012)	(0.012)
	0.000	0.001	0.000	0.000
2. Secondary	0.073***	0.072***	0.073***	0.073***
	(0.011)	(0.011)	(0.011)	(0.011)
	0.000	0.000	0.000	0.000
3. Higher Secondary	0.061***	0.044***	0.061***	0.061***
	(0.012)	(0.013)	(0.012)	(0.012)
	0.000	0.001	0.000	0.000
No. of sons	-0.026***	-0.024***	-0.026***	-0.026***

VARIABLES	(1)	(2)	(3)	(4)
	(0.005)	(0.005)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000
No. of daughters	-0.025***	-0.023***	-0.025***	-0.026***
	(0.004)	(0.005)	(0.004)	(0.004)
	0.000	0.000	0.000	0.000
Marital status (base: married)				
1. Widowed	0.034	0.017	0.034	0.035
	(0.034)	(0.042)	(0.034)	(0.034)
	0.319	0.682	0.319	0.304
2. Divorced	0.099***	0.086***	0.099***	0.100***
	(0.025)	(0.033)	(0.025)	(0.025)
	0.000	0.010	0.000	0.000
3. Separated	-0.013	-0.006	-0.013	-0.012
	(0.032)	(0.035)	(0.032)	(0.031)
	0.686	0.865	0.684	0.706
Other religion (base: Islam)	0.017*	0.020**	0.017*	0.017*
	(0.010)	(0.010)	(0.010)	(0.010)
	0.096	0.043	0.096	0.097
Household characteristics				
Female household head	0.015*	0.017	0.015*	0.015*
	(0.009)	(0.010)	(0.009)	(0.009)
	0.091	0.104	0.093	0.089
Age of household head	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000	0.000
Wealth index	0.007***	0.010***	0.007***	0.007***
	(0.003)	(0.003)	(0.003)	(0.003)
	0.007	0.002	0.006	0.008
Rural (urban=0)	-0.009	-0.015	-0.014	-0.009
	(0.009)	(0.009)	(0.012)	(0.009)
	0.314	0.105	0.260	0.334
Division (base: Barisal)				
1. Chattogram	-0.022*	-0.029**	-0.024*	-0.023**
	(0.011)	(0.013)	(0.013)	(0.011)
	0.050	0.026	0.072	0.045
2. Dhaka	0.001	-0.000	0.003	-0.000
	(0.011)	(0.011)	(0.012)	(0.011)
	0.931	0.995	0.797	0.991
3. Khulna	-0.006	-0.006	-0.000	-0.007
	(0.011)	(0.013)	(0.015)	(0.011)
	0.603	0.641	0.979	0.558
4. Mymensingh	-0.011		-0.008	-0.012
	(0.020)		(0.021)	(0.020)
	0.599		0.722	0.569
5. Rajshahi	0.007	0.007	0.013	0.008
	(0.012)	(0.015)	(0.014)	(0.012)
	0.557	0.660	0.375	0.492
6. Rangpur	0.021*	0.019	0.025*	0.021*
	(0.011)	(0.012)	(0.013)	(0.011)
	0.057	0.126	0.058	0.051
7. Sylhet	-0.060***	-0.075***	-0.064***	-0.059***
	(0.014)	(0.017)	(0.022)	(0.013)
	0.000	0.000	0.004	0.000
Cluster characteristics				
No. of doctors	0.001	-0.001	0.001	0.001
	(0.003)	(0.004)	(0.003)	(0.003)
	0.870	0.847	0.841	0.771
Distance to the nearest hospital (km)	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
	0.443	0.176	0.443	0.443
Percentage of private clinics	-0.000	-0.000	-0.000	
	(0.000)	(0.000)	(0.000)	
	0.365	0.459	0.358	
Percentage of NGO clinics	-0.000	-0.000	-0.000	
	(0.000)	(0.000)	(0.000)	
	0.746	0.455	0.719	

VARIABLES	(1)	(2)	(3)	(4)
Survey year (base: 2011)				
1. 2014	0.009	0.009	0.011	0.008
	(0.007)	(0.008)	(0.008)	(0.007)
	0.211	0.245	0.190	0.247
2. 2017-18	-0.047***		-0.044***	-0.047***
	(0.009)		(0.010)	(0.009)
	0.000		0.000	0.000
Lagged (previous survey) indicators				
Percentage of polio 2 vaccine coverage (district)		0.000		
		(0.000)		
		0.167		
Total fertility rate (district)		0.018		
		(0.053)		
		0.738		
Percentage of polio 2 vaccine coverage (division)			0.000	
			(0.000)	
			0.586	
Total fertility rate (division)			0.038	
			(0.204)	
			0.852	
Constant	0.822***	0.756***	0.750***	0.676***
	(0.034)	(0.075)	(0.235)	(0.114)
	0.000	0.000	0.001	0.000
No. of observations	18,652	13,588	18,652	18,662
R-squared	0.036	0.040	0.036	0.037

Note: This table shows the LPM regression results of whether a child had polio 2 vaccine or not. Four different specifications are in four separate columns under the same dependent variable. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table 4.15: LPM regression results; dependent variable: children had polio 3 vaccine.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	0.023	0.044**	0.023	0.175*
	(0.015)	(0.017)	(0.015)	(0.099)
	0.139	0.011	0.128	0.079
At least one private clinic in the cluster				0.157*
				(0.095)
				0.097
At least one NGO clinic in the cluster				-0.003
				(0.026)
				0.905
At least one CC*one private clinic in the cluster				-0.163*
				(0.098)
				0.098
At least one CC*one NGO clinic in the cluster				0.017
				(0.027)
				0.534
Women's characteristics				
Age group (base: 15-19)				
1. 20-24	0.112***	0.130***	0.112***	0.112***
	(0.011)	(0.013)	(0.011)	(0.011)
	0.000	0.000	0.000	0.000
2. 25-29	0.162***	0.186***	0.162***	0.162***
	(0.013)	(0.016)	(0.013)	(0.013)
	0.000	0.000	0.000	0.000
3. 30-34	0.225***	0.243***	0.224***	0.225***
	(0.015)	(0.018)	(0.015)	(0.015)
	0.000	0.000	0.000	0.000
4. 35-39	0.276***	0.291***	0.275***	0.275***
	(0.019)	(0.022)	(0.019)	(0.019)
	0.000	0.000	0.000	0.000
5. 40-44	0.299***	0.335***	0.299***	0.299***
	(0.028)	(0.029)	(0.028)	(0.028)

VARIABLES	(1)	(2)	(3)	(4)
	0.000	0.000	0.000	0.000
6. 45-49	0.236***	0.251***	0.237***	0.236***
	(0.078)	(0.084)	(0.078)	(0.078)
	0.003	0.003	0.002	0.003
Level of education (base: no education)				
1. Primary	0.055***	0.057***	0.055***	0.054***
	(0.013)	(0.015)	(0.013)	(0.013)
	0.000	0.000	0.000	0.000
2. Secondary	0.089***	0.087***	0.089***	0.088***
	(0.012)	(0.013)	(0.012)	(0.012)
	0.000	0.000	0.000	0.000
3. Higher Secondary	0.065***	0.056***	0.066***	0.065***
	(0.015)	(0.016)	(0.015)	(0.015)
	0.000	0.001	0.000	0.000
No. of sons	-0.035***	-0.034***	-0.035***	-0.036***
	(0.005)	(0.006)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000
No. of daughters	-0.038***	-0.035***	-0.038***	-0.038***
	(0.005)	(0.006)	(0.005)	(0.005)
	0.000	0.000	0.000	0.000
Marital status (base: married)				
1. Widowed	0.053	0.034	0.052	0.054
	(0.038)	(0.046)	(0.038)	(0.038)
	0.163	0.454	0.165	0.154
2. Divorced	0.090**	0.089	0.090**	0.091**
	(0.046)	(0.056)	(0.046)	(0.046)
	0.049	0.113	0.049	0.048
3. Separated	-0.035	-0.046	-0.036	-0.034
	(0.037)	(0.045)	(0.037)	(0.037)
	0.350	0.304	0.339	0.358
Other religion (base: Islam)	0.027**	0.027**	0.027**	0.027**
	(0.012)	(0.013)	(0.012)	(0.012)
	0.024	0.034	0.026	0.023
Household characteristics				
Female household head	0.018*	0.025*	0.018*	0.019*
	(0.011)	(0.013)	(0.011)	(0.011)
	0.093	0.067	0.099	0.091
Age of household head	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
	0.000	0.000	0.000	0.000
Wealth index	0.013***	0.015***	0.013***	0.012***
	(0.003)	(0.004)	(0.003)	(0.003)
	0.000	0.000	0.000	0.000
Rural (urban=0)	0.002	-0.005	-0.005	0.003
	(0.011)	(0.012)	(0.014)	(0.011)
	0.838	0.668	0.721	0.776
Division (base: Barisal)				
1. Chattogram	-0.024*	-0.037**	-0.034**	-0.025*
	(0.014)	(0.016)	(0.016)	(0.014)
	0.089	0.023	0.041	0.080
2. Dhaka	0.002	-0.001	0.005	0.001
	(0.013)	(0.014)	(0.014)	(0.013)
	0.861	0.961	0.719	0.921
3. Khulna	-0.003	-0.006	0.001	-0.004
	(0.013)	(0.016)	(0.018)	(0.013)
	0.802	0.698	0.961	0.769
4. Mymensingh	-0.015		-0.015	-0.016
	(0.026)		(0.027)	(0.026)
	0.552		0.585	0.524
5. Rajshahi	0.010	0.007	0.012	0.012
	(0.015)	(0.018)	(0.018)	(0.015)
	0.479	0.688	0.487	0.414
6. Rangpur	0.041***	0.042***	0.045***	0.042***
	(0.013)	(0.015)	(0.015)	(0.013)
	0.001	0.005	0.003	0.001
7. Sylhet	-0.074***	-0.099***	-0.101***	-0.073***

VARIABLES	(1)	(2)	(3)	(4)
	(0.016)	(0.021)	(0.028)	(0.016)
	0.000	0.000	0.000	0.000
Cluster characteristics				
No. of doctors	-0.004	-0.007	-0.004	-0.004
	(0.004)	(0.005)	(0.004)	(0.004)
	0.330	0.197	0.322	0.354
Distance to the nearest hospital (km)	-0.000	-0.000*	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
	0.269	0.086	0.288	0.268
Percentage of private clinics	-0.000	0.000	-0.000	
	(0.000)	(0.000)	(0.000)	
	0.561	0.890	0.590	
Percentage of NGO clinics	0.000	0.000	0.000	
	(0.000)	(0.000)	(0.000)	
	0.892	0.727	0.864	
Survey year (base: 2011)				
1. 2014	0.005	-0.008	-0.057	0.005
	(0.009)	(0.016)	(0.049)	(0.009)
	0.547	0.630	0.244	0.602
2. 2017-18	-0.047***		-0.105**	-0.048***
	(0.011)		(0.047)	(0.011)
	0.000		0.026	0.000
Lagged (previous survey) indicators				
Percentage of polio 3 vaccine coverage (district)		0.000		
		(0.000)		
		0.241		
Total fertility rate (district)		-0.028		
		(0.031)		
		0.370		
Percentage of polio 3 vaccine coverage (division)			0.000	
			(0.000)	
			0.646	
Total fertility rate (division)			-0.141	
			(0.110)	
			0.202	
Constant	0.709***	0.657***	0.862***	0.544***
	(0.043)	(0.079)	(0.168)	(0.102)
	0.000	0.000	0.000	0.000
No. of observations	18,652	13,588	18,652	18,662
R-squared	0.048	0.055	0.048	0.048

Note: This table shows the LPM regression results of whether a child had polio 3 vaccine or not. Four different specifications are in four separate columns under the same dependent variable. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table 4.16: LPM regression results; dependent variables: women seeking treatment for children's diarrhoea.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	-0.037	-0.065	-0.036	-0.199
	(0.051)	(0.071)	(0.051)	(0.144)
	0.464	0.364	0.478	0.168
At least one private clinic in the cluster				-0.144*
				(0.085)
				0.090
At least one NGO clinic in the cluster				0.084
				(0.087)
				0.339
At least one CC*one private clinic in the cluster				0.265**
				(0.127)
				0.038

VARIABLES	(1)	(2)	(3)	(4)
At least one CC*one NGO clinic in the cluster				-0.129
				(0.091)
				0.154
Women's characteristics				
Age group (base: 15-19)				
1. 20-24	-0.039	-0.024	-0.039	-0.038
	(0.052)	(0.054)	(0.051)	(0.052)
	0.445	0.663	0.449	0.467
2. 25-29	-0.009	-0.066	-0.008	-0.006
	(0.052)	(0.063)	(0.052)	(0.052)
	0.864	0.293	0.878	0.904
3. 30-34	0.015	-0.051	0.016	0.010
	(0.082)	(0.089)	(0.083)	(0.082)
	0.857	0.571	0.847	0.902
4. 35-39	-0.047	-0.048	-0.046	-0.047
	(0.096)	(0.136)	(0.096)	(0.095)
	0.624	0.725	0.631	0.623
5. 40-44	0.180	0.261	0.182	0.163
	(0.128)	(0.160)	(0.127)	(0.127)
	0.159	0.104	0.153	0.197
6. 45-49	0.182	0.189	0.183	0.264**
	(0.114)	(0.164)	(0.114)	(0.125)
	0.110	0.249	0.108	0.035
Level of education (base: no education)				
1. Primary	-0.022	-0.005	-0.022	-0.021
	(0.057)	(0.078)	(0.057)	(0.057)
	0.699	0.952	0.696	0.710
2. Secondary	0.003	0.002	0.003	0.003
	(0.055)	(0.073)	(0.055)	(0.055)
	0.954	0.980	0.953	0.954
3. Higher Secondary	0.003	-0.008	0.004	0.005
	(0.061)	(0.094)	(0.061)	(0.061)
	0.956	0.933	0.952	0.937
No. of sons	-0.005	-0.007	-0.006	-0.005
	(0.018)	(0.022)	(0.018)	(0.018)
	0.776	0.739	0.765	0.791
No. of daughters	-0.032	-0.037	-0.033	-0.032
	(0.024)	(0.031)	(0.024)	(0.023)
	0.171	0.232	0.168	0.175
Marital status (base: married)				
1. Widowed	-0.213	-0.219	-0.211	-0.213
	(0.260)	(0.265)	(0.262)	(0.258)
	0.413	0.409	0.419	0.411
2. Divorced	-0.798***	-0.838***	-0.800***	-0.805***
	(0.065)	(0.070)	(0.066)	(0.064)
	0.000	0.000	0.000	0.000
3. Separated	-0.236	-0.521**	-0.235	-0.246
	(0.182)	(0.238)	(0.183)	(0.181)
	0.195	0.029	0.198	0.174
Other religion (base: Islam)	0.039	-0.025	0.039	0.034
	(0.050)	(0.073)	(0.050)	(0.051)
	0.435	0.736	0.443	0.497
Household characteristics				
Female household head	-0.013	-0.011	-0.013	-0.012
	(0.049)	(0.084)	(0.049)	(0.048)
	0.792	0.898	0.789	0.809
Age of household head	0.000	0.002*	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
	0.940	0.070	0.940	0.894
Wealth index	0.005	0.009	0.005	0.003
	(0.013)	(0.019)	(0.013)	(0.013)
	0.681	0.627	0.698	0.790
Rural (urban=0)	0.008	-0.033	0.020	0.009
	(0.051)	(0.065)	(0.066)	(0.051)
	0.880	0.616	0.763	0.853
Division (base: Barisal)				

VARIABLES	(1)	(2)	(3)	(4)
1. Chattogram	-0.018	-0.054	-0.015	-0.018
	(0.044)	(0.060)	(0.053)	(0.044)
	0.686	0.366	0.782	0.688
2. Dhaka	-0.058	-0.057	-0.064	-0.053
	(0.049)	(0.072)	(0.055)	(0.049)
	0.237	0.430	0.243	0.281
3. Khulna	-0.076	-0.094	-0.086	-0.070
	(0.061)	(0.100)	(0.074)	(0.060)
	0.209	0.347	0.245	0.243
4. Mymensingh	0.058		0.053	0.065
	(0.059)		(0.066)	(0.060)
	0.325		0.427	0.277
5. Rajshahi	-0.015	-0.090	-0.027	-0.012
	(0.050)	(0.084)	(0.071)	(0.051)
	0.765	0.283	0.701	0.809
6. Rangpur	-0.026	-0.013	-0.034	-0.022
	(0.053)	(0.082)	(0.064)	(0.053)
	0.630	0.879	0.595	0.677
7. Sylhet	-0.015	-0.045	-0.002	-0.017
	(0.053)	(0.076)	(0.084)	(0.054)
	0.784	0.559	0.983	0.751
Cluster characteristics				
No. of doctors	0.024*	0.023	0.024*	0.023
	(0.014)	(0.022)	(0.014)	(0.014)
	0.088	0.304	0.091	0.113
Distance to the nearest hospital (km)	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
	0.797	0.891	0.806	0.711
Percentage of private clinics	0.000	-0.000	0.000	
	(0.001)	(0.002)	(0.001)	
	0.766	0.885	0.770	
Percentage of NGO clinics	-0.001	-0.003	-0.001	
	(0.001)	(0.002)	(0.001)	
	0.473	0.146	0.480	
Survey year (base: 2011)				
1. 2014	-0.014	0.009	-0.019	-0.007
	(0.037)	(0.041)	(0.040)	(0.037)
	0.697	0.826	0.646	0.858
2. 2017-18	0.050		0.041	0.056
	(0.035)		(0.050)	(0.035)
	0.160		0.416	0.116
Lagged (previous survey) indicators				
Percentage of children that treatment sought for (district)		0.000		
		(0.000)		
		0.513		
Total fertility rate (district)		0.059		
		(0.106)		
		0.582		
Percentage of children that treatment sought for (division)			-0.000	
			(0.000)	
			0.832	
Total fertility rate (division)			0.043	
			(0.193)	
			0.823	
Constant	0.857***	0.786***	0.892**	0.919***
	(0.214)	(0.302)	(0.403)	(0.189)
	0.000	0.010	0.027	0.000
No. of observations	1,075	613	1,075	1,075
R-squared	0.044	0.069	0.044	0.047

Note: This table shows the LPM regression results of whether treatment is sought for children's diarrhoea (in the last two weeks) or not. Four different specifications are in four separate columns under the same dependent variable. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table 4.17: LPM regression results; dependent variables: women seeking treatment for children's fever/cough.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	0.041*	0.034	0.042*	-0.129**
	(0.022)	(0.027)	(0.022)	(0.065)
	0.062	0.206	0.054	0.049
At least one private clinic in the cluster				-0.043
				(0.027)
				0.107
At least one NGO clinic in the cluster				-0.040
				(0.029)
				0.176
At least one CC*one private clinic in the cluster				0.123*
				(0.067)
				0.067
At least one CC*one NGO clinic in the cluster				0.058*
				(0.031)
				0.066
Women's characteristics				
Age group (base: 15-19)				
1. 20-24	-0.020	-0.033*	-0.020	-0.020
	(0.015)	(0.019)	(0.015)	(0.015)
	0.190	0.083	0.190	0.195
2. 25-29	0.006	0.005	0.005	0.005
	(0.016)	(0.021)	(0.016)	(0.016)
	0.720	0.797	0.738	0.745
3. 30-34	-0.012	-0.020	-0.013	-0.012
	(0.024)	(0.032)	(0.024)	(0.024)
	0.619	0.528	0.591	0.624
4. 35-39	-0.039	-0.055	-0.039	-0.040
	(0.031)	(0.040)	(0.031)	(0.031)
	0.204	0.165	0.204	0.186
5. 40-44	-0.122**	-0.137**	-0.121**	-0.119**
	(0.054)	(0.066)	(0.054)	(0.054)
	0.025	0.038	0.026	0.028
6. 45-49	-0.066	-0.011	-0.068	-0.066
	(0.088)	(0.085)	(0.088)	(0.088)
	0.456	0.894	0.436	0.452
Level of education (base: no education)				
1. Primary	0.002	0.007	0.003	0.002
	(0.018)	(0.020)	(0.017)	(0.018)
	0.896	0.742	0.859	0.916
2. Secondary	0.017	0.016	0.018	0.017
	(0.019)	(0.022)	(0.019)	(0.019)
	0.376	0.479	0.335	0.376
3. Higher Secondary	0.011	-0.003	0.013	0.010
	(0.024)	(0.032)	(0.024)	(0.024)
	0.655	0.931	0.589	0.683
No. of sons	-0.007	-0.003	-0.007	-0.007
	(0.007)	(0.009)	(0.007)	(0.007)
	0.320	0.743	0.336	0.332
No. of daughters	-0.014*	-0.014	-0.014*	-0.014**
	(0.007)	(0.009)	(0.007)	(0.007)
	0.052	0.109	0.055	0.049
Marital status (base: married)				
1. Widowed	0.045	0.107	0.046	0.047
	(0.065)	(0.079)	(0.065)	(0.066)
	0.486	0.175	0.478	0.478
2. Divorced	-0.038	-0.125	-0.040	-0.038
	(0.083)	(0.130)	(0.084)	(0.084)
	0.647	0.337	0.636	0.648
3. Separated	-0.071	-0.026	-0.073	-0.073
	(0.080)	(0.087)	(0.079)	(0.079)
	0.369	0.768	0.352	0.352

VARIABLES	(1)	(2)	(3)	(4)
Other religion (base: Islam)	0.000	-0.018	0.000	0.000
	(0.024)	(0.030)	(0.023)	(0.023)
	0.992	0.544	0.990	0.990
Household characteristics				
Female household head	0.009	0.025	0.010	0.008
	(0.016)	(0.020)	(0.016)	(0.016)
	0.583	0.223	0.534	0.595
Age of household head	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
	0.621	0.710	0.601	0.622
Wealth index	0.004	0.003	0.004	0.005
	(0.005)	(0.006)	(0.005)	(0.005)
	0.379	0.586	0.418	0.347
Rural (urban=0)	-0.023	-0.014	-0.002	-0.026*
	(0.016)	(0.022)	(0.023)	(0.016)
	0.137	0.529	0.919	0.100
Division (base: Barisal)				
1. Chattogram	0.047**	0.039	0.100***	0.045**
	(0.021)	(0.026)	(0.028)	(0.021)
	0.028	0.133	0.000	0.033
2. Dhaka	-0.004	-0.009	0.002	-0.003
	(0.021)	(0.025)	(0.022)	(0.020)
	0.845	0.718	0.938	0.876
3. Khulna	0.041*	0.026	0.044	0.041*
	(0.021)	(0.026)	(0.028)	(0.021)
	0.054	0.333	0.118	0.051
4. Mymensingh	-0.016		-0.005	-0.017
	(0.031)		(0.034)	(0.031)
	0.605		0.882	0.587
5. Rajshahi	-0.009	-0.014	-0.016	-0.005
	(0.021)	(0.026)	(0.027)	(0.021)
	0.668	0.600	0.548	0.795
6. Rangpur	0.063***	0.043	0.082***	0.065***
	(0.022)	(0.028)	(0.028)	(0.022)
	0.005	0.122	0.003	0.003
7. Sylhet	0.075***	0.064**	0.145***	0.072***
	(0.020)	(0.026)	(0.035)	(0.020)
	0.000	0.014	0.000	0.000
Cluster characteristics				
No. of doctors	0.006	0.006	0.006	0.006
	(0.006)	(0.008)	(0.006)	(0.006)
	0.292	0.503	0.320	0.284
Distance to the nearest hospital (km)	-0.001**	-0.001***	-0.001*	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
	0.041	0.004	0.052	0.036
Percentage of private clinics	0.000	0.000	0.000	
	(0.000)	(0.001)	(0.000)	
	0.582	0.971	0.567	
Percentage of NGO clinics	0.000	-0.000	0.000	
	(0.000)	(0.001)	(0.000)	
	0.838	0.689	0.821	
Survey year (base: 2011)				
1. 2014	0.075***	0.074***	0.077***	0.076***
	(0.015)	(0.016)	(0.016)	(0.014)
	0.000	0.000	0.000	0.000
2. 2017-18	0.091***		0.119***	0.093***
	(0.015)		(0.024)	(0.015)
	0.000		0.000	0.000
Lagged (previous survey) indicators				
Percentage of children that treatment sought for (district)		0.000		
		(0.000)		
		0.690		
Total fertility rate (district)		0.045		
		(0.054)		
		0.398		
Percentage of children that treatment sought for (division)			-0.000*	

VARIABLES	(1)	(2)	(3)	(4)
			(0.000)	
			0.098	
Total fertility rate (division)			-0.421**	
			(0.164)	
			0.010	
Constant	0.709***	0.669***	1.187***	0.806***
	(0.065)	(0.104)	(0.187)	(0.053)
	0.000	0.000	0.000	0.000
No. of observations	8,897	6,094	8,897	8,902
R-squared	0.028	0.026	0.029	0.029

Note: This table shows the LPM regression results of whether treatment is sought for children's fever/cough (in the last two weeks) or not. Four different specifications are in four separate columns under the same dependent variable. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

4.11 Appendix C: Chapter four

Table C1: Logit regression results (odds ratio); dependent variable: women ever adopted a family planning method.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	1.024	1.104	1.011	2.062***
	(0.073)	(0.091)	(0.069)	(0.502)
	0.735	0.228	0.878	0.003
At least one CC*one private clinic in the cluster				0.450***
				(0.109)
				0.001
At least one CC*one NGO clinic in the cluster				0.972
				(0.112)
				0.806
Constant	4.041***	0.904	0.138**	1.860***
	(0.852)	(0.420)	(0.110)	(0.332)
	0.000	0.828	0.013	0.001
No. of observations	55,689	35,030	55,689	55,711
Pseudo R-squared	0.164	0.181	0.166	0.165

Note: This table shows the Logit regression results of whether a woman ever adopted a family planning method or not. Four different specifications are in four separate columns under the same dependent variable. Control variables are the same as Table 4.10 to Table 4.17. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table C2: Logit regression results (odds ratio); dependent variable: women had a caesarean delivery.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	1.136	1.216*	1.136	0.881
	(0.102)	(0.136)	(0.102)	(0.852)
	0.153	0.079	0.156	0.896
At least one CC*one private clinic in the cluster				0.960
				(0.929)
				0.967
At least one CC*one NGO clinic in the cluster				1.165
				(0.145)
				0.221
Constant	0.013***	0.008***	0.010***	0.037***
	(0.004)	(0.004)	(0.007)	(0.035)
	0.000	0.000	0.000	0.000
No. of observations	16,788	11,570	16,788	16,793
Pseudo R-squared	0.204	0.192	0.205	0.203

Note: This table shows the Logit regression results of whether a woma had a caesarean delivery or not. Six different specifications are in six separate columns under the same dependent variable. Control variables are the same as Table 4.10 to Table 4.17. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table C3: Logit regression results (odds ratio); dependent variable: women's antenatal care visit

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	1.189	1.129	1.182	1.830*
	(0.130)	(0.128)	(0.129)	(0.598)
	0.113	0.283	0.127	0.065
At least one CC*one private clinic in the cluster				0.554*
				(0.172)
				0.057
At least one CC*one NGO clinic in the cluster				1.029
				(0.179)
				0.869
Constant	0.388***	0.114***	0.953	0.312***
	(0.126)	(0.063)	(1.216)	(0.089)
	0.003	0.000	0.970	0.000
No. of observations	16,804	11,631	16,804	16,809
Pseudo R-squared	0.227	0.208	0.227	0.227

Note: This table shows the Logit regression results of women's antenatal care visits. Six different specifications are in six separate columns under the same dependent variable. Control variables are the same as Table 4.10 to Table 4.17. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table C4: Logit regression results (odds ratio); dependent variable: children had polio 1 vaccine.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	1.115	1.204	1.123	3.469***
	(0.155)	(0.185)	(0.156)	(1.646)
	0.432	0.228	0.405	0.009
At least one CC*one private clinic in the cluster				0.271***
				(0.123)
				0.004
At least one CC*one NGO clinic in the cluster				1.271
				(0.281)
				0.278
Constant	10.818***	10.926**	310.820**	2.843**
	(3.805)	(11.265)	(888.476)	(1.337)
	0.000	0.020	0.045	0.026
No. of observations	18,663	13,597	18,663	18,673
Pseudo R-squared	0.025	0.028	0.025	0.026

Note: This table shows the Logit regression results of whether a child had polio 1 vaccine or not. Six different specifications are in six separate columns under the same dependent variable. Control variables are the same as Table 4.10 to Table 4.17. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table C5: Logit regression results (odds ratio); dependent variable: children had polio 2 vaccine.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	1.145	1.236*	1.148	2.630**
	(0.127)	(0.159)	(0.127)	(1.209)
	0.222	0.100	0.210	0.035
At least one CC*one private clinic in the cluster				0.389**
				(0.172)
				0.033
At least one CC*one NGO clinic in the cluster				1.190
				(0.220)
				0.346
Constant	5.110***	4.635**	9.855	2.066*
	(1.516)	(3.235)	(19.460)	(0.888)
	0.000	0.028	0.247	0.091

VARIABLES	(1)	(2)	(3)	(4)
No. of observations	18,652	13,588	18,652	18,662
Pseudo R-squared	0.036	0.040	0.036	0.037

Note: This table shows the Logit regression results of whether a child had polio 2 vaccine or not. Six different specifications are in six separate columns under the same dependent variable. Control variables are the same as Table 4.10 to Table 4.17. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table C6: Logit regression results (odds ratio); dependent variable: children had polio 3 vaccine.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	1.185*	1.353***	1.194*	2.780**
	(0.109)	(0.144)	(0.110)	(1.132)
	0.064	0.005	0.053	0.012
At least one CC*one private clinic in the cluster				0.390**
				(0.154)
				0.017
At least one CC*one NGO clinic in the cluster				1.107
				(0.177)
				0.525
Constant	2.459***	2.397*	8.509*	1.025
	(0.663)	(1.131)	(9.313)	(0.379)
	0.001	0.064	0.050	0.946
No. of observations	18,652	13,588	18,652	18,662
Pseudo R-squared	0.048	0.055	0.048	0.048

Note: This table shows the Logit regression results of whether a child had polio 3 vaccine or not. Six different specifications are in six separate columns under the same dependent variable. Control variables are the same as Table 4.10 to Table 4.17. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table C7: Logit regression results (odds ratio); dependent variables: women seeking treatment for children's diarrhoea.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	0.764	0.514*	0.757	1.290
	(0.228)	(0.204)	(0.226)	(0.533)
	0.368	0.093	0.351	0.537
At least one CC*one NGO clinic in the cluster				0.575
				(0.263)
				0.226
Constant	2.470	1.235	1.001	0.788
	(2.459)	(2.005)	(2.135)	(0.685)
	0.364	0.897	1.000	0.784
No. of observations	1,070	610	1,070	1,067
Pseudo R-squared	0.044	0.069	0.044	0.047

Note: This table shows the Logit regression results of whether treatment is sought for children's diarrhoea (in the last two weeks) or not. Six different specifications are in six separate columns under the same dependent variable. Control variables are the same as Table 4.10 to Table 4.17. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

Table C8: Logit regression results (odds ratio); dependent variables: women seeking treatment for children's fever/cough.

VARIABLES	(1)	(2)	(3)	(4)
Variable of interest(s)				
Having at least one CC in the cluster (yes=1)	1.249**	1.153	1.257**	0.546*
	(0.130)	(0.136)	(0.131)	(0.190)
	0.033	0.228	0.029	0.082
At least one CC*one private clinic in the cluster				1.684
				(0.588)
				0.136
At least one CC*one NGO clinic in the cluster				1.383**
				(0.225)
				0.047
Constant	2.241**	1.786	12.508**	4.483***
	(0.780)	(0.905)	(13.105)	(1.313)
	0.020	0.253	0.016	0.000
No. of observations	8,897	6,094	8,897	8,902
Pseudo R-squared	0.028	0.026	0.029	0.029

Note: This table shows the Logit regression results of whether treatment is sought for children's fever/cough (in the last two weeks) or not. Six different specifications are in six separate columns under the same dependent variable. Control variables are the same as Table 4.10 to Table 4.17. Cluster standard errors (over survey clusters) in parentheses, every third row shows the p-values, and *** p<0.01, ** p<0.05, * p<0.1.

CHAPTER 5: CONCLUSION AND POLICY RECOMMENDATIONS

Bangladesh continues to experience, as a nation, several socio-economic problems, especially in terms of healthcare- for example, issues such as high stunting rate, high out-of-pocket healthcare expenditure, and a high occurrence of negative shocks. Motivated by the willingness to contribute to solving these problems, this thesis aims to analyse the factors associated with child nutritional status, household health shocks and coping behaviour, and the association of recently introduced public healthcare providers with healthcare-seeking behaviours and vaccination coverage. In focusing on these issues, this thesis consists of three empirical chapters.

In particular, since Bangladesh is one of highest fish-producing countries and since the child stunting rate in the country is still high, the first empirical chapter of this thesis deals with the association between households' involvement in fish production and children's HAZ and stunting. The second empirical chapter explores the factors associated with health shocks and how people cope with such shocks. Findings of this chapter provide useful information in terms of designing social safety net programs for more vulnerable households and make a case for implementing UHC in Bangladesh. Lastly, for the last one decade or so, CCs have been operating in Bangladesh targeting mainly women and children in remote areas. Thus, it is important to ask: Have CCs been an effective means of providing healthcare for women and their children as was envisioned in its purpose? It is vital to determine the answer to this question, and thus, to explore the relationship between the availability of CCs and healthcare-seeking outcomes. Also, if introducing CCs are positively associated with healthcare-seeking outcomes, this could help achieve UHC in Bangladesh. As such, the third and final empirical chapter of this thesis discusses the relationship between the availability of CCs and women's healthcare-seeking behaviour in terms of several measures including antenatal care visits and contraceptive use.

5.1 Summary of Findings and Policy Recommendations

5.1.1 Fish production and child stunting

Employing three rounds of the Bangladesh Integrated Household Survey- BIHS 2011-12, 2015, and 2018-19- and using LPM and Logit regressions, the first empirical chapter finds that there is a positive association between household fish production and children's (under the age of 5) HAZ, and a negative association between fish production and children's stunting. The positive association between fish production and child nutritional status holds across boys and girls. Essentially, there may be two sources of this positive association: (1) direct fish consumption from the production, and (2) higher consumption from the income generated by selling fish in the market. However, FE regression only finds positive results for girls, not for boys.

The negative and significant correlation (from FE regression) between fish production and girls' stunting implies that girls belonging to non-fish farming families are, on average, more stunted than girls belonging to fish farming families. So, some government policies may be designed to support poor fish farmers to keep their business running, and to improve the nutrition of girls of poor non-fish farmers could be an effective policy given the negative association between income and child stunting. Additionally, policymakers may consider a few other interventions with a further scrutiny. Importantly, many policies may be adopted but this should be done cautiously keeping in mind that the results from the study are not causal. For instance, fish farmers may be incentivised and encouraged to keep their ponds/fish farming plots and homestead gardening so that there is a possibility that it could improve children's nutritional outcomes.

Additionally, the government can aim to channel funds for conducting Randomized Control Trials (RCT) to test whether the suggested correlations hold or not in terms of causal relationships. If the RCT research finds that there is a causal relationship between fish production and children's stunting, the government then may consider allotting small fish farming plots with zero cost or a very low cost to poor households that have no farming plots (or very small farming plots) so that they are able to pursue fish farming. Anecdotally, large water bodies in Bangladesh are controlled by powerful (in terms of money, muscle and political power) people. So, this initiative may be worth pursuing when proven effective by causal evidence through RCTs. Additionally, extrapolating from the fish farming, the government

may also consider giving subsidies to non-farming households to encourage their engagement in some homestead gardening and/or livestock rearing.

Further, the association shown between fish production and child nutritional status could be through the income generation resulting from the household's involvement in fish production. So, giving direct income support or microfinance to the poor households may also help to reduce child malnutrition in Bangladesh. Overarchingly, reducing poverty at a faster rate may have a positive impact on child malnutrition. Thus, other social safety-net programs that are effective in reducing poverty can also be used as a tool for decreasing malnutrition.

5.1.2 Health shocks and coping strategies

The second empirical chapter also uses LPM, Logit and FE to explore health shocks and coping strategies. It also uses three rounds of the BIHS panel dataset- 2011-12, 2015, and 2018-19. This chapter finds that households with lesser wealth and lower educated household heads are more likely to be associated with health shocks. This implies that households from lower socioeconomic backgrounds are more vulnerable to health shocks and may even be vulnerable to other negative shocks such as floods and pandemics. Additionally, female-headed households, as compared to male-headed households, are more likely to be associated with health shocks and are less likely to be associated with adopting coping mechanisms in the face of health shocks.

The findings from the second empirical chapter suggest that households from poorer socioeconomic backgrounds such as poor households, and households with low-educated and female-headed household heads have a higher probability of being associated with health shocks. So, to protect these types of households, the government may introduce UHC or institutionalize private healthcare insurance or a mix of both, so that consumption-smoothing is possible during health-related shocks. In addition, I also find that female-headed households adopt lower coping strategies than male-headed households. This could be because of women's movement restrictions or their lower access to credits and other help. Thus, GoB should actively try to increase credit access for women and increase transportation facilities for women so that women's mobility restrictions can be reduced.

5.1.3 Community clinics and healthcare-seeking behaviour

The third empirical chapter discusses the association of community clinics with women's healthcare-seeking behaviour for their illnesses, their children's illnesses and polio vaccination coverage. In this third chapter, three repeated cross-section surveys of the BDHS 2011, 2014 and 2017-18 datasets are used. Employing women and household characteristics along with the cluster characteristics of the availability of community clinics and other healthcare providers, this chapter finds that there is a positive association of existing CCs in the locality with women's contraceptive use, antenatal care visits, seeking treatment for children's diarrhoea and seeking treatment for children's fever/cough. Therefore, providing public healthcare in remote areas with even a small budget can be effective in increasing healthcare-seeking behaviour. In addition, rural women as compared to urban women are less likely to seek treatments in general. This may be an indication that there is a rural-urban divide in terms of the access to, and the use of, healthcare.

The third empirical chapter suggests that there is a positive association of CCs with women's healthcare-seeking behaviour for themselves and for their children (below 5 years of age). This implies that even with a very low cost- it is possible to have some positive results by introducing primary healthcare providers where it is needed the most. Therefore, CCs could be scaled up to other low-income countries to target women and children in remote areas. Also, I find that rural women, compared to urban women, are less likely to seek treatment for their and their children's illnesses. This suggests that even after establishing CCs mostly in rural areas, it is not easy to break the rural-urban divide in healthcare access and utilization that prevails in Bangladesh. Thus, GoB must increase CCs in remote areas, especially where there is a low number of healthcare providers altogether.

5.2 Limitations and future scope of research

Critically, there are some limitations specific to each of the empirical chapters in this thesis. In general, the results from all the chapters are only associational- not causal. In terms of the first empirical chapter, the main variable of interest could be endogenous. This can be solved in future research by using time-variant IVs, which is beyond the scope of this thesis due to the lack of data to construct reliable IVs. In this case, some potential IVs could be the number of

agricultural and fish production officers, the amount of government funding per capita in the region, to mention a few.

The second empirical chapter also has some limitations, mainly in terms of how the survey defines health shocks. In the survey, households are only considered as affected by health shocks when any illness or injury or death impacts the households financially. This is problematic because it disallows separating the effect of health shocks when there is no financial burden. To solve this, future research can target defining health shocks purely by the incidence of shocks, i.e., regardless of whether the households are negatively affected financially or not, and then explore the coping strategies accordingly.

Similarly, the final empirical chapter also has some limitations as I am not able to use a panel dataset and rollout information of the CCs by year (because of the lack of it). If this information is obtained, future research could estimate a less biased impact of CCs on women's healthcare-seeking behaviour for themselves and for their children. Also, health outcomes such as children's birth weight or mortality rate could be used as outcome variables to explore the impact of CCs.

5.3 Potential impact of this research

The issues explored in the three empirical chapters of this thesis have implications for achieving gender equity, health, and overall wellbeing in the context of Bangladesh as well as for other similar contexts and low-income countries. Importantly, the findings and consequent policy recommendations of this thesis could be useful in aiming to achieve the SDGs in Bangladesh. Specifically, the findings from chapter 2 are related to the SDG goals of ending poverty in all forms everywhere (SDG goal 1), ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture (SDG goal 2). Then, the findings from chapter 3 and chapter 4 can be useful in ensuring healthy lives and in promoting well-being for all and at all ages (SDG goal 3) (UNDP, 2022). Therefore, the implications derived from the three empirical chapters in this thesis could help to achieve the SDG goals in Bangladesh and in other similar contexts. For instance, the second chapter discusses how farming activities such as fish farming in households could be helpful in ensuring child

nutrition, which in turn might contribute to reducing poverty and increasing human capital through income and consumption respectively.

The third chapter explores which type of households are more vulnerable to health shocks and the ways that these households manage their finances in terms of health shocks. Thus, the results could be essential in shaping social safety net programs in such a way that vulnerable households have some sort of assistance in the time of health shocks and also have better assurance of food security and wellbeing. The fourth and final empirical chapter analyses how low-cost primary healthcare centres are associated with good health and wellbeing through encouraging people to seek treatment for their bad health. In summary, these three issues discussed in the three empirical chapters indicate that countries similar to Bangladesh context may focus on these issues as well with a view of achieving SDGs especially SDG2 (Zero Hunger) and SDG3 (Good Health and Wellbeing).

References

Ahmed, B. N., & Waibel, H. (2019). The role of homestead fish ponds for household nutrition security in Bangladesh. *Food Security, 11*(4), 835-854. doi:10.1007/s12571-019-00947-6

Ahmed, S., Evans, T., Standing, H., & Mahmud, S. (2013). Harnessing pluralism for better health in Banglades. *The Lancet, 382*(9906), 1746-1755. Retrieved from https://doi.org/10.1016/S0140-6736(13)62147-9

Akinyemi, J. O., Bamgboye, E. A., & Ayeni, O. (2013). New trends in under-five mortality determinants and their effects on child survival in Nigeria: A review of childhood mortality data from 1990-2008. *African Population Studies, 27*(1), 25–42. Retrieved from https://doi.org/10.11564/27-1-5

Al Zubayer, M. A., Shanto, H. H., Kumkum, R., Alam, S. T., & Ahammed, B. (2023). Prevalence and socioeconomic determinants of awareness and visitation of community clinic among ever married women: evidence from Bangladesh Demographic and Health Survey 2017-18. *BMJ Open, 13*(2), e067823–e067823. Retrieved from https://doi.org/10.1136/bmjopen-2022-067823

Alam, K., & Mahal, A. (2014). Economic impacts of health shocks on households in low and middle income countries: a review of the literature. *Global Health , 10*(21). Retrieved from https://doi.org/10.1186/1744-8603-10-21

Alderman, H., Hoddinott, J., & Kinsey, B. (2006). Long term consequences of early childhood malnutrition. *Oxford Economic Papers, 58*(3), 450-474. doi:10.1093/oep/gpl008

Almeyda, G. (1996). *Money matters : reaching women microentrepreneurs with financial services.* DC :United Nations Development Fund for Women : Inter-American Development Bank. Retrieved from https://publications.iadb.org/en/money-matters-reaching-women-microentrepreneurs-financial-services

Angrist, J., & Krueger, A. (1991). Does Compulsory School Attendance Affect Schooling and Earnings? *The Quarterly Journal of Economics, 106*(4), 979-1014.

Aremu, O., Lawoko, S., T, M., & Dalal, K. (2011). Socio-economic determinants in selecting childhood diarrhoea treatment options in Sub-Saharan Africa: A multilevel model. *Italian Journal of Pediatrics, 37*(1), 13–13. Retrieved from https://doi.org/10.1186/1824-7288

Asadullah, M. N., Mansoor, N., Randazzo, T., & Wahhaj, Z. (2021). Is son preference disappearing from Bangladesh? . *World Development*(140), 105353. Retrieved from https://doi.org/10.1016/j.worlddev.2020.105353

Asfaw, A., & von Braun, J. (2004). Is consumption insured against illness? Evidence on vulnerability of households to health shocks in rural Ethiopia. *Economic Development and Cultural Change, 53*(1), 115-129.

Atake, E. (2018). Health shocks in Sub-Saharan Africa: are the poor and uninsured households more vulnerable? *Health Econ Rev , 8*(26). Retrieved from https://doi.org/10.1186/s13561-018-0210-x

Bailey, M. J., & Goodman-Bacon, A. (2015). The War on Poverty's Experiment in Public Medicine: Community Health Centers and the Mortality of Older Americans. *The American Economic Review, 105*(3), 1067–1104. Retrieved from https://doi.org/10.1257/aer.20120070

Banerjee, A., & Duflo, E. (2011). *Poor economics.* New York: PublicAffairs.

BBS. (2019). *Household Income and Expenditure Survey 2016 Final Report.* Dhaka: Bangladesh Bureau of Statistics (BBS).

Begum, L., Grossman, P. J., & Islam, A. (2022). Parental gender bias and investment in children's health and education: evidence from Bangladesh. *Oxford Economic Papers, 74*(4), 1045–1062. . Retrieved from https://doi.org/10.1093/oep/gpac006

Belton, B., & Azad, A. (2012). The characteristics and status of pond aquaculture in Bangladesh. *Aquaculture, 358*, 196-204.

Belton, B., Haque, M. M., & Little, D. C. (2012). Does Size Matter? Reassessing the Relationship between Aquaculture and Poverty in Bangladesh. *The Journal of Development Studies, 48*(7), 904-922. Retrieved from https://doi.org/10.1080/00220388.2011.638049

Belton, B., van Asseldonk, I. J., & Thilsted, S. H. (2014). Faltering fisheries and ascendant aquaculture: implications for food and nutrition security in Bangladesh. *Food Policy, 44*, 77-87.

Belton, B., van Asseldonk, I., & Thilsted, S. (2014). Faltering fisheries and ascendant aquaculture: Implications for food and nutrition security in Bangladesh. *Food Policy, 44*, 77-87.

Bhalotra, S. (2007). Spending to save? State health expenditure and infant mortality in India. *Health Economics, 16*(9), 911–928.

Bhusal, U., & Sapkota, V. (2021). Predictors of health insurance enrolment and wealth-related inequality in Nepal: evidence from Multiple Indicator Cluster Survey (MICS) 2019. *BMJ Open, 11*(11), e050922. doi:10.1136/bmjopen-2021-050922. PMID: 34836898; PM

Bidani, B., & Ravallion, M. (1997). Decomposing social indicators using distributional data. *Journal of Econometrics, 77*(1), 125–139.

Black, R. E., Allen, L. H., Bhutta, Z. A., Caulfield, L. E., de Onis, M., Ezzati, M., . . . Rivera, J. (2008). Maternal and child undernutrition 1 - Maternal and child undernutrition: global and regional exposures and health consequences. *The Lancet (British Edition)* (371(9608)), 243–260. Retrieved from https://doi.org/10.1016/S0140-6736(07)61690-0

Black, R., Victora, C., Walker, S., & al., e. (2013). Maternal and child undernutrition and overweight in low-income and middle-income. *Lancet, 382 (9890)*, 427-451. Retrieved from https://doi.org/10.1016/S0140-6736(13)60937-X

Bogard, J., Marks, G., Mamun, A., & Thilsted, S. (2016). Non-farmed fish contribute to greater micronutrient intakes than farmed fish: results from an intra-household survey in rural Bangladesh. *Public Health Nutrition*, 1-10.

Bonfrer, I., & Gustafsson-Wright, E. (2017). Health shocks, coping strategies and foregone healthcare among agricultural households in Kenya. *Global Public Health, 12*(11), 1369-1390. doi:10.1080/17441692.2015.1130847

CDC. (2022). *Polio Vaccination*. Retrieved 01 2024, from https://www.cdc.gov/vaccines/vpd/polio/index.html

Chegere, M. J., & Stage, J. (2020). Agricultural production diversity, dietary diversity and nutritional status: Panel data evidence from Tanzania. *World Development, 129*. doi:https://doi.org/10.1016/j.worlddev.2019.104856.

Cleland, J., Conde-Agudelo, A., Peterson, H., Ross, J., & Tsui, A. (2012). Contraception and health. *The Lancet, 380*(9837), 149-156. Retrieved from https://doi.org/10.1016/S0140-6736(12)60609-6

Cooper, Z., Gibbons, S., Jones, S., & McGuire, A. (2010). Does hospital competition save lives? Evidence from the English NHS patient choice reforms. *Unpublished manuscript*. London School of Economics.

Corsi, D. J., Subramanyam, M. A., & Subramanian, S. V. (2011). Commentary: Measuring nutritional status of children. *International Journal of Epidemiology, 40*(4), 1030. Retrieved from https://doi.org/10.1093/ije/dyr108

Damme, W. V., Leemput, L. V., Hardeman, W., & Meessen, B. (2004). Out-of-pocket health expenditure and debt in poor households: Evidence from Cambodia. *Tropical Medicine & International Health, 9*(2), 273–280. doi:10.1046/j.1365-3156.2003.01194.x

Department of Fisheries (DoF), Bangladesh. (2017). *Yearbook of Fisheries Statistics of Bangladesh 2015-16.* Retrieved from http://fisheries.portal.gov.bd/sites/default/files/files/fisheries.portal.gov.bd/page/4cfbb3cc_c0c4_4f25_be21_b91f84bdc45c/Yearbook%20of%20Fisheries%20Statistics%20of%20Bangladesh%2C%202015-16.pdf

Department of Fisheries Bangladesh, DoF. (2018). *Yearbook of Fisheries Statistics of bangaldesh 2017-18.* Resources Survey System (FRSS), Department of Fisheries. Bangladesh : Ministry of Fisheries.

Dercon, S. (. (2004). *Insurance against Poverty (Oxford: .* Oxford University Press in collaboration with WIDER.

Dey, M. M., Paraguas, F. J., Kambewa, P., & Pemsl, D. E. (2010). The impact of integrated aquaculture-agriculture on small-scale farms in Southern Malawi . *Agricultural Economics, 41*(1), 67-79. Retrieved from https://doi.org/10.1111/j.1574-0862.2009.00426.x

DGHS. (2018). *Community Based Health Care, DGHS, Ministry of Health and Family Welfare, Bangaldesh*. Retrieved from http://www.communityclinic.gov.bd/about-us.php

DGHS. (2019). *Health Bulletin 2018.* Retrieved from https://old.dghs.gov.bd/images/docs/Publicaations/HB%202018%20final.pdf

DGHS. (2022). *Geocode registry. Online material, Directorate General of Health Services (DGHS), Ministry of Health and Family Welfare.* Retrieved from https://app.dghs.gov.bd/bbscode/pages/divReport

Diao, Y., Kodera, S., Anzai, D., Gomez-Tames, J., Rashed, E. A., & Hirata, A. (2021). Influence of population density, temperature, and absolute humidity on spread and decay durations of COVID-19: A comparative study of scenarios in China, England, German, and Japan. *One Health*(12), 100203–100203. doi:https://doi.org/10.1016/j.onehlt.2020.100203

Dietrichson, J., Ellegard, L. M., & Kjellsson, G. (2016). Patient Choice, Entry, and the Quality of Primary Care: Evidence from Swedish Reforms. *Working paper 2016: 36*. Department of Economics, Lund University.

Dillon, A., McGee, K., & Oseni, G. (2015). Agricultural production, dietary diversity and climate variability. *The Journal of Development Studies, 51*(8), 976-995.

Duggan, M. G. (2000). Hospital Ownership and Public Medical Spending. *NBER working paper no. 7789*.

Duryea, S., Lam, D., & Levison, D. (2007). Effects of economic shocks on children's employment and schooling in Brazil. *Journal of Development Economics, 84*(1), 188-214. doi:doi:10.1016/j.jdeveco.2006.11.004

Efriandi, T. (2021). Spatial access to health care: a case study on community health centers in Asmat District, Papua, Indonesia. *Journal of Public Health Policy, 42*(1), 113–126. Retrieved from https://doi.org/10.1057/s41271-020-00267-6

e-Jahan, K. M., Ahmed, M., & Belton, B. (2010). The impacts of aquaculture development on food security: lessons from Bangladesh. *Aquaculture Research, 41*(4), 481-495. Retrieved from https://doi.org/10.1111/j.1365-2109.2009.02337.x

FAO. (2014). *HLPE. Sustainable fisheries and aquaculture for food security and nutrition. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security.* Rome.

FAO, & WHO. (2014). *Country Nutrition Paper- Bangladesh.* 19-21 NOVEMBER 2014, Rome, Italy.

Farahani, M., Subramanian, S. V., & Canning, D. (2010). Effects of state-level public spending on health on the mortality probability in India. *Health Economics, 19*(11), 1361–1376.

Fiedler, J. L., Lividini, K., Drummond, E., & Thilsted, S. H. (2016). Strengthening the contribution of aquaculture to food and nutrition security: The potential of a vitamin A-rich, small fish in Bangladesh. *Aquaculture,, 452*, 291-303. Retrieved from https://doi.org/10.1016/j.aquaculture.2015.11.004

Fletschner, D. (2008). Women's Access to Credit: Does It Matter for Household Efficiency? *American Journal of Agricultural Economics, 90*(3), 669-683. Retrieved from https://onlinelibrary.wiley.com/doi/full/10.1111/j.1467-8276.2008.01143.x#:~:text=Constraints%20on%20women%20matter%3A%20in%20addition%20to%20the,households%20experienced%20an%20additional%2011%25%20drop%20in%20efficiency.

Flores, G., Krishnakumar, J., O'Donnell, O., & van Doorslaer, E. (2008). Coping with health-care costs: Implications for the measurement of catastrophic expenditures and poverty. *Health Economics, 17*(12), 1393–1412. doi:10.1002/hec.1338

Frison, S., Kerac, M., Checchi, F., & Prudhon, C. (2016). Anthropometric indices and measures to assess change in the nutritional status of a population: a systematic literature review. *BMC Nutrition, 76*(2). Retrieved from https://doi.org/10.1186/s40795-016-0104-4

García-Gómez, P., van Kippersluis, H., O'Donnell, O., & van Doorslaer, E. (2013). Long- term and spillover effects of health shocks on employment and income. *The Journal of Human Resources, 48*(4), 873–909. Retrieved from https://doi.org/10.3368/jhr.48.4.873

Gatakaa, H., Ombech, E., Omondi, R., Otiato, J., Waringa, V., Okomo, G., . . . Gwer, S. (2019). Expanding access to maternal, newborn and primary healthcare services through private-community-government partnership clinic models in rural Kenya: The Ubuntu-Afya kiosk model. *BMC Health Services Research, 19*(1), 914–914. Retrieved from https://doi.org/10.1186/s12913-019-4759-9

Gaynor, M., Ho, K., & Town, R. J. (2015). The Industrial Organization of Health-Care Markets. *Journal of Economic Literature, American Economic Association, 53*(2), 235-284. Retrieved from https://www.nber.org/papers/w19800

Gaynor, M., Moreno-Serra, R., & Propper, C. (2013). Death by market power: Reform, competition and patient outcomes in the British National Health Service. *American Economic Journal: Economic Policy, 5*(4), 134–66.

GBD 2016 Diarrhoeal Disease Collaborators. (2018). Estimates of the global, regional, and national morbidity, mortality, and aetiologies of diarrhoea in 195 countries: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Infectious Disease, 18*(11), 1211–1228. Retrieved from https://doi.org/10.1016/S1473-3099(18)30362-1

Gertler, P., & Gruber, J. (2002). Insuring consumption against illness. *American Economic Review, 92*(1), 51-70.

Giedion, U., Alfonso, E., & Diaz, Y. (2013). *Review, The Impact of Universal Coverage Schemes in the Developing World: A review f the Existing Evidence.* Washington DC: The World Bank.

Grimm, M., Hartwig, R., & Jay, J. (2011). Investment decisions of small entrepreneurs in a context of strong sharing norms . Retrieved from Retrieved from https://www.utwente.nl/igs/research/conferences/2012/microinsurance/Full%20papers%20and%20presentations/Full%20papers%201B/Grimm_full%20paper%20Session_1b.pdf

Gupta, S., Verhoeven, M., & Tiongson, E. (2002). The effectiveness of government spending on education and health care in developing and transition economies. *European Journal of Political Economy, 18*(4), 717-737.

Haddad, L. (2000). A Conceptual Framework for Assessing Agriculture–Nutrition Linkages. *Food and Nutrition Bulletin, 21*(4), 367-373. Retrieved from https://doi.org/10.1177/156482650002100405

Haileamlak, A. (2018). What Factors Affect Health Seeking Behavior? . *Ethiopian Journal of Health Scince, 28*(2). doi:10.4314/ejhs.v28i2.1.

Haque, A. B., & Dey, M. M. (2017). Impacts of community-based fish culture in seasonal floodplains on income, food security and employment in Bangladesh. *Food Security, 9*(1), 25-38. Retrieved from https://doi.org/10.1007/s12571-016-0629-z

Hawkes, C., & Ruel, M. T. (2006). Overview: Understanding the links between agriculture and health. *13(1)*. International Food Policy Research Institute (IFPRI).

Headey, D., Hoddinott, J., Ali, D., Tesfaye, R., & Dereje, M. (2015). The other Asian enigma: Explaining the rapid reduction of undernutrition in Bangladesh. *World Development, 66*, 749-761. Retrieved from https://doi.org/10.1016/j.worlddev.2014.09.022

Heltberg, R., & Lund, N. (2009). Shocks, coping, and outcomes for Pakistan's poor: Health risks predominate. *Journal of Development Studies, 45*(6), 889-910. doi:10.1080/00220380902802214

Holland, C., & Rammohan, A. (2019). Rural women's empowerment and children's food and nutrition security in Bangladesh. *World Development, 124*. Retrieved from https://doi.org/10.1016/j.worlddev.2019.104648

Imai, K. S., Annim, S. K., Kulkarni, V. S., & Gaiha, R. (2014). Women's Empowerment and Prevalence of Stunted and Underweight Children in Rural India. *World Development*(62), 88–105. Retrieved from https://doi.org/10.1016/j.worlddev.2014.05.001

Islam, A., von Braun, J., Thorne-Lyman, A., & Ahmed, A. U. (2018). Farm diversification and food and nutrition security in Bangladesh: empirical evidence from nationally representative household panel data. *Food Security, 10*, 701-720. doi:doi.org/10.1007/

Islam, M. T. (2019). *Health security in rural Bangladesh needs a bottom-up approach*. Retrieved from https://blogs.lse.ac.uk/southasia/2019/11/13/health-security-in-rural-bangladesh-needs-a-bottom-up-approach/

Jahan, K. M., Ahmed, M., & Belton, B. (2010). The impacts of aquaculture development on food security: Lessons from Bangladesh. *Aquaculture Research, 41*(4), 481–495.

Jakaria, M., Bakshi, R. K., & Hasan, M. M. (2022). Is maternal employment detrimental to children's nutritional status? Evidence from Bangladesh. *Review of Development Economics, 26*(1), 85–111. Retrieved from https://doi.org/10.1111/rode.12819

Jones, A. D., Shrinivas, A., & Bezner-Kerr, R. (2014). Farm production diversity is associated with greater household dietary diversity in Malawi: findings from nationally representative data. *Food Policy, 46*, 1-12.

Karim, M., Ullah, H., Castine, S., Islam, M. M., Keus, H. J., Kunda, M., . . . Phillips, M. (2017). Carp–mola productivity and fish consumption in small-scale homestead aquaculture in Bangladesh. *Aquaculture International, 25*(2), 867–879. Retrieved from https://doi.org/10.1007/s10499-016-0078-x

Katz, M. (2013). Provider competition and healthcare quality: More bang for the buck? *International Journal of Industrial Organization, 31*(5), 612-625. Retrieved from https://doi.org/10.1016/j.ijindorg.2013.02.001

Kawarazuka, N., & Béné, C. (2010). Linking small-scale fisheries and aquaculture to household nutritional security: an overview. *Food Security, 2*(4), 343–357. Retrieved from https://doi.org/10.1007/s12571-010-0079-y

Kawarazuka, N., & Béné, C. (2011). The potential role of small fish species in improving micronutrient deficiencies in developing countries: building evidence. *Public Health Nutrition, 14*(11), 1927–1938. Retrieved from https://doi.org/10.1017/S1368980011000814

Kenjiro, Y. (2005). Why illness causes more serious economic damage than crop failure in rural Cambodia. *Development and Change, 36*(4), 759-783. doi:10.1111/j.0012-155X.2005.00433.x

Kessler, D., & McClellan, M. (2000). Is hospital competition socially wasteful? *Quarterly Journal of Economics, 15*(2), 577–615.

Khan, F., Bedi, A. S., & Sparrow, R. (2015). Sickness and Death: Economic Consequences and Coping Strategies of the Urban Poor in Bangladesh . *World Development, 72*(August), 255–266. Retrieved from https://doi.org/10.1016/j.worlddev.2015.03.008

Kim, C. Y., Piamonte, B., Allen, R., & Thakur, K. T. (2023). Threat of resurgence or hope for global eradication of poliovirus? *Current Opinion in Neurology, 36*(3), 229-237. doi:10.1097/WCO.0000000000001156

Kose, E., O'Keefe, S. M., & Rosales-Rueda, M. (2022). Does the Delivery of Primary Health Care Improve Birth Outcomes? Evidence from the Rollout of Community Health Centers. *Working*

paper. NATIONAL BUREAU OF ECONOMIC RESEARCH. Retrieved from https://www.nber.org/papers/w30047

Kranton, R. E. (2003). Competition and the incentive to produce high quality. *Economica, 70*, 385–404.

Kumar, N., Harris, J., & Rawat, R. (2015). If They Grow It, Will They Eat and Grow? Evidence from Zambia on Agricultural Diversity and Child Undernutrition. *The Journal of Development Studies,, 51*(8), 1060-1077,. doi:10.1080/00220388.2015.1018901

Lakdawalla, D., & Philipson, T. (2006). The nonprofit sector and industry performance. *ournal of Public Economics, 90*, 1681-1698.

Leive, A., & Xu, K. (2008). Coping with out-of-pocket health payments: Empirical evidence from 15 African countries. *Bulletin of the World Health Organization, 86*(11), 849–856. Retrieved from https://doi.org/10.2471/BLT.07.049403

Lindelow, M., & Wagstaff, A. (2005). *Health shocks in china: Are the poor and uninsured less protected?* World Bank Policy Research Working Paper.

Liu, M., & Ma, Q.-P. (2022). The impact of saving rate on economic growth in Asian countries. *National Accounting Review, 4*(4), 412–427. Retrieved from https://doi.org/10.3934/NAR.2022023

Lovo, S., & Veronesi, M. (2019). Crop Diversification and Child Health: Empirical Evidence From Tanzania. *Ecological Economics,, 158(C)*, 168-179.

Lycette, M., & White, K. (1989). Improving womens access to credit in Latin America and the Caribbean: policy and project recommendations. Retrieved from https://www.semanticscholar.org/paper/Improving-womens-access-to-credit-in-Latin-America-Lycette-White/bc182f0e49b6fd622a36303bbb0de4120095ba88

Mamun, S., & Mascie-Taylor, C. G. (2019). Double burden of malnutrition (DBM) and Anaemia under the Same Roof: A Bangladesh perspective. *Medical Science, 7*(2).

McCauley, H., Lowe, K., Furtado, N., Mangiaterra, V., & van den Broek, N. (2022). Essential components of postnatal care–a systematic literature review and development of signal functions to guide monitoring and evaluation. *BMC Pregnancy and Childbirth, 22*(1), 448.

McIntyre, D., Thiede, M., Dahlgren, G., & Whitehead, M. (2006). What are the economic consequences for households of illness and of paying for health care in low- and middle-income country contexts? *Social Science & Medicine (1982), 62*(4), 858–865. Retrieved from https://doi.org/10.1016/j.socscimed.2005.07.001

Michaux, K. D., Hou, K., Karakochuk, C. D., Whitfield, K. C., Ly, S., Verbowski, V., . . . Green, T. J. (2019). Effect of enhanced homestead food production on anaemia Cambodian women and children: A cluster randomized controlled trial. *Maternal and Child Nutrition, 15*(S3). Retrieved from https://doi.org/10.1111/mcn.12757

Miharti, S., Wittek, R., Los, B., & Heyse, L. (2022). Community Health Center Efficiency. The Impact of Organization Design and Local Context: The Case of Indonesia. *International journal of health policy and management*, 1197-1207. Retrieved from https://doi.org/10.34172/ijhpm.2021.19

Mirelman, A. J., Trujillo, A. J., Niessen, L. W., Ahmed, S., Khan, J. A., & Peters, D. H. (2019). Household coping strategies after an adult noncommunicable disease death in Bangladesh. *The*

International Journal of Health Planning and Management, 34(1), 203-208. Retrieved from https://doi.org/10.1002/hpm.2637

Mitra, S., Palmer, M., Mont, D., & Groce, N. (2016). Can households cope with health shocks in Vietnam? *Health Economics, 25*(7), 888-907.

Muurlink, O., Uzzaman, N., Boorman, R. J., Binte Kibria, S., Best, T., & Taylor-Robinson, A. W. (2023). Village doctors: a national telephone survey of Bangladesh's lay medical practitioners. *BMC Health Services Research, 23*(1), 964. Retrieved from https://doi.org/10.1186/s12913-023-09972-w

Nahar, Q., Choudhury, S., faruk, M. O., Sultana, S., & Siddique, M. A. (2013). *Desirable Dietary Pattern for Bangladesh.* Dhaka, bangladesh.

Nam, J., Oh, S., & Park, E. (2022). The Association Between Adequate Prenatal Care and Severe Maternal Morbidity Among Teenage Pregnancies: A Population-Based Cohort Study. *Front Public Health, 10*, 782143. doi:10.3389/fpubh.2022.782143.

Nguyen, T.-T., Nguyen, T. T., & Grote, U. (2020). Multiple shocks and households' choice of coping strategies in rural Cambodia. *Ecological Economics, 167*, 106442. Retrieved from https://doi.org/10.1016/j.ecolecon.2019.106442

NIPORT. (2020). *Bangladesh Demographic and Health Survey 2017-18.* Retrieved from https://www.dhsprogram.com/pubs/pdf/FR344/FR344.pdf

Pachón, H., Simondon, K. B., Fall, S. T., Menon, P., Ruel, M. T., Hotz, C., . . . Brown, D. L. (2007). Constraints on the Delivery of Animal-Source Foods to Infants and Young Children: Case Studies from Five Countries. *Food and Nutrition Bulletin, 28*(2), 215–229. Retrieved from https://doi.org/10.1177/156482650702800211

Pellegrini, L., & L, T. (2014). 6.Crop diversification, dietary diversity and agricultural income: empirical evidence from eight developing countries. *Canadian Journal Of Development Studies, 35*(2), 211-227.

Pitt, M. M., & Khandker, S. R. (1998). The impact of Group-Based Credit Programs on Poor Households in Bangladesh: Does the Gender of Participants Matter? *The Journal of Political Economy, 106*(5), 958–996. Retrieved from https://doi.org/10.1086/250037

Pitt, M. M., Khandker, S. R., Chowdhury, O. H., & & Millimet, D. L. (2003). Credit programs for the poor and the health status of children in rural bangladesh. *International Economic Review (Philadelphia), 44*(1), 87–118. Retrieved from https://doi.org/10.1111/1468-2354.t0

Prasad, J. B., Pezhhan, A., & Patil, S. H. (2021). Effect of wealth, social inequality, Mother's BMI, and education level on child malnutrition in India. *Diabetes & Metabolic Syndrome Clinical Research & Review, 15*(6), 102304–102304. Retrieved from https://doi.org/10.1

Propper, C., Bloom, N., Seiler, S., & Van Reenen, J. (2010). The impact of competition on management quality: Evidence from public hospitals. *Working Paper No. 10/237*. Centre for Market and Public Organisation, University of Bristol.

Propper, C., Burgess, S., & Gossage, D. (2003). Competition and quality: Evidence from the NHS internal market 1991-1999. *Unpublished paper: University of Bristol*.

Rahman, M., Khan, N., Rahman, A., Alam, M., & Khan, A. (2022). Long-term effects of caesarean delivery on health and behavioural outcomes of the mother and child in Bangladesh. *Journal of Health, Population and Nutrition, 41*(1), 1-7.

Rahman, R. (2020). Private sector healthcare in Bangladesh: Implications for social justice and the right to healthcare. *Global Public Health,, 17*(2), 285-296. Retrieved from https://doi.org/10.1080/17441692.2020.1858136

Rahman, S., & Salim, R. (2013). Six decades of total factor productivity change and sources of growth in Bangladesh agriculture (1948–2008). *Journal of Agricultural Economics, 64*(2), 275-294.

Riaz, B. K., Ali, L., Ahmad, S. A., Islam, M. Z., Ahmed, K. R., & Hossain, S. (2020). Community clinics in Bangladesh: A unique example of public-private partnership. *Heliyon, 6*(5), e03950. Retrieved from https://doi.org/10.1016/j.heliyon.2020.e03950

Ricketts, T. C., & Holmes, G. M. (2007). Mortality and Physician Supply: Does Region Hold the Key to the Paradox. *Health Services Research, 42*(4), 2233-2251. Retrieved from https://onlinelibrary.wiley.com/doi/epdf/10.1111/j.1475-6773.2007.00728.x

Sakeah, E., Bawah, A. A., Asuming, P. O., Debpuur, C., Welaga, P., Awine, T., . . . Oduro, A. R. (2023). Impact of community health interventions on maternal and child health indicators in the upper east region of Ghana. *BMC Pregnancy and Childbirth, 23*(1), 298–298. Retrieved from https://doi.org/10.1186/s12884-023-05577-7

Saquib, N., Saquib, J., Ahmed, T., Khanam, M. A., & Cullen, M. R. (2012). Cardiovascular diseases and Type 2 Diabetes in Bangladesh: A systematic review and meta-analysis of studies between 1995 and 2010. *BMC Public Health, 12*(1), 434–434. Retrieved from https://doi.org/10.1186/1471-2458-12-434

Sarker, A. R., Sheikh, N., Mahumud, R. A., & Sultana, M. (2018). Determinants of adolescent maternal healthcare utilization in Bangladesh. *Public Health (London), 157*, 94–103. . Retrieved from https://doi.org/10.1016/j.puhe.2018.01.010

Shekar, M., Heaver, R., & Lee, Y.-K. (2005). *Repositioning nutrition as central to development [electronic resource] : a strategy for large scale action.* Washington, D.C.: World Bank.

Shively, G., & Sununtnasuk, C. (2015). Agricultural Diversity and Child Stunting in Nepal. *The Journal of Development Studies, 51*, 1078-1096. doi:10.1080/00220388.2015.1018900.

Shohel, T. A., Niner, S., & Gunawardana, S. (2021). How the persistence of patriarchy undermines the financial empowerment of women microfinance borrowers? Evidence from a southern sub-district of Bangladesh. *PloS One, 16(4), 16*(4), e0250000–e0250000. Retrieved from https://doi.org/10.1371/journal.pone.0250000

Sk, R. (2020). Does delivery in private hospitals contribute largely to Caesarean Section births? A path analysis using generalised structural equation modelling. *PLoS One, 15*(10), e0239649. doi:10.1371/journal.pone.0239649. PMID: 33031397; PMCID: PMC75

Sraboni, E., Malapit, H., Quisumbing, A., & Ahmed, A. (2014). Women's empowerment in agriculture: what role for food security in Bangladesh? *World Development*(61), 11–52. Retrieved from https://doi.org/10.1016/j.worlddev.2014.03.025

Sutradhar, S. (2020). The impact of remittances on economic growth in Bangladesh, India, Pakistan and Sri Lanka. *International Journal of Economics and Policy Studies, 14*, 275–295 . Retrieved from https://doi.org/10.1007/s42495-020-00034-1

Taruvinga, A., Muchenje, V., & Mushunje, A. (2013). Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts, South Africa. *International Journal of Development and Sustainability, 2*(4).

The World Bank. (2016, October 17). *Learning from Bangladesh's journey toward ending poverty*. Retrieved from https://www.worldbank.org/en/news/speech/2016/10/17/learning-bangladesh-journey-toward-ending-poverty

The World Bank. (2019). *Social Safety Nets in Bangladesh Help Reduce Poverty and Improve Human Capital*. Retrieved from https://www.worldbank.org/en/news/feature/2019/04/29/social-safety-nets-in-bangladesh-help-reduce-poverty-and-improve-human-capital

The World Bank. (2022). *World Bank national accounts data, and OECD National Accounts data files*. Retrieved from https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=BD&name_desc=false

The World Bank. (2022). *World Bank Open Data*. Retrieved from https://www.who.int/data/gho

UN. (2019). *Decade of action on nutrition 2016–2025*. Retrieved from https://www.un.org/nutrition/about

UNDP. (2015). *What are the Sustainable Development Goals?* Retrieved from United Nations Development Programme: https://www.undp.org/sustainable-development-goals?utm_source=EN&utm_medium=GSR&utm_content=US_UNDP_PaidSearch_Brand_English&utm_campaign=CENTRAL&c_src=CENTRAL&c_src2=GSR&gclid=Cj0KCQjwlOmLBhCHARIsAGiJg7n_GRecrx9vh9nKelHNQw8hHz_BKDihQVZ571fXTJputvZkAm-C75

UNDP. (2022). *The SDGs in Actions*. Retrieved from https://www.undp.org/sustainable-development-goals

UNICEF. (2013). *Improving child nutrition: The achievable imperative for global progress.* United Nations Children's Fund.

UNICEF. (2020). *New insights: 21st century malnutrition*. Retrieved from https://www.unicef.org/globalinsight/stories/new-insights-21st-century-malnutrition

UNICEF. (2020). *Nutrition for every child: UNICEF nutrition strategy 2020-2030.* New York. Retrieved from https://www.unicef.org/media/92031/file/UNICEF%20Nutrition%20Strategy%202020-2030.pdf

UNICEF. (2023). *Early childhood nutrition: Preventing malnutrition in infants and young children*. Retrieved from https://www.unicef.org/nutrition/early-childhood-nutrition

United Nations. (2016). *Sustainable Development Goals.* Retrieved from Available from: https://sustainabledevelopment.un.org

United Nations. (2023). *Community Clinic Based Primary Health Care Services: A Unique Participatory Approach to Universal Health Coverage (UHC)*. Retrieved from https://sdgs.un.org/partnerships/community-clinic-based-primary-health-care-services-unique-participatory-approach

Verbowski, V., Talukder, Z., Hou, K., Sok Hoing, L., Michaux, K., Anderson, V., . . . Barr, S. I. (2017). Effect of enhanced homestead food production and aquaculture on dietary intakes of women and children in rural Cambodia: A cluster randomized controlled trial. *Maternal and Child Nutrition, 14*(3). Retrieved from https://doi.org/10.1111/mcn.12581

Vogel, J., Jung, J., Lavin, T., Simpson, G., Kluwgant, D., Abalos, E., . . . Galadanci, H. (2023). Neglected medium-term and long-term consequences of labour and childbirth: a systematic

analysis of the burden. *The Lancet Global Health, 12*(2), e317-e330. Retrieved from https://doi.org/10.1016/S2214-109X(23)00454-0

Volpp, K. G., Williams, S. V., Waldfogel, J., Silber, J. H., Schwartz, J. S., & Pauly, M. V. (2003). Market reform in New Jersey and the effect on mortality from acute myocardial infarction. *Health Services Research, 38*(2), 515–533.

Wagstaff, A. (2007). The economic consequences of health shocks: Evidence from Vietnam. *Journal of Health Economics, 26*(1), 82–100. Retrieved from https://doi.org/10.1016/j.jhealeco.2006.07.001

Wagstaff, A., & Lindelow, M. (2010). *Are health shocks different? Evidence from a multi-shock survey in Laos* . World Bank Policy Research Working Paper.

Wagstaff, A., & Lindelow, M. (2014). Are health shocks different? Evidence from a multishock survey in Laos. *Health Economics, 23*, 706-718.

Wang, K.-M., Lee, Y.-M., Lin, C.-L., & Tsai, Y.-C. (2018). The effects of health shocks on life insurance consumption, economic growth, and health expenditure: A dynamic time and space analysis. *Sustainable Cities and Society*(37), 34-56. Retrieved from https://doi.org/10.1016/j.scs.2017.10.032

WB. (2024). *World Bank Open Data*. Retrieved from https://data.worldbank.org/indicator/SH.MED.BEDS.ZS?locations=BD

Wemakor, A., Garti, H., Azongo, T., Garti, H., & Atosona, A. (2018). Young maternal age is a risk factor for child undernutrition in Tamale Metropolis, Ghana. *BMC Research Notes, 11*(1), 877-877. Retrieved from https://doi.org/10.1186/s13104-018-3980-7

WHO. (1978). Declaration of Alma-Ata: International Conference on Primary Health Care . Alma-Ata.

WHO. (2010). *Nutrition Landscape Information System (NLIS), Country Profile Indicators, Interpretation Guide.* Geneva.

WHO. (2016). Strategic Action Plan to reduce the double burden of malnutrition in the South-East Asia Region 2016-2025.

WHO. (2019). *World Polio Day: Bangladesh continues efforts to sustain the polio-free status*. Retrieved from https://www.who.int/bangladesh/news/detail/28-10-2019-world-polio-day-bangladesh-continues-efforts-to-sustain-the-polio-free-status

WHO. (2021). *Bangladesh: Community health workers at the heart of a stronger health system and the fight against COVID-19*. Retrieved April 2023, from https://www.who.int/news-room/feature-stories/detail/bangladesh-community-health-workers-at-the-heart-of-a-stronger-health-system-and-the-fight-against-covid-19

WHO. (2021). *New global targets to prevent maternal deaths*. Retrieved from https://www.who.int/news/item/05-10-2021-new-global-targets-to-prevent-maternal-deaths#:~:text=Globally%2C%20these%20are%20for%3A%2090%25%20pregnant%20women%20to,of%20countries%2C%20with%20two-thirds%20occurring%20in%20Sub-Saharan%20Africa.

WHO. (2022). *WHO Bangladesh Country Cooperation Strategy: 2020-2024.* Dhaka. Retrieved from https://www.who.int/publications/i/item/9789290209478

WHO. (2023). *Primary health care*. Retrieved from https://www.who.int/health-topics/primary-health-care#tab=tab_2

WHO. (2023). *Universal health coverage (UHC)*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/universal-health-coverage-(uhc)

Wilson, J. Q. (1989). *Bureaucracy.* Washington DC: Basic Books.

World Bank. (2016). Retrieved from www.worldbank.org: https://www.worldbank.org/en/results/2016/10/07/bangladesh-strengthening-bangladeshs-environment-natural-resource-management

World Bank. (2016b). *Program brief: allowances for widow, deserted and destitute women.* Dhaka. Retrieved from https://documents1.worldbank.org/curated/en/994221552537440138/pdf/135277-BRI-PUBLIC-13-3-2019-9-15-58-ProgrambriefonWAF.pdf#:~:text=Widows%20and%20divorced%20women%20in%20Bangladesh%20represent%20about,be%20highly%20vulnerable%20to%20poverty%20and%20soci

World Bank. (2023). *Defying the odds: Bangladesh's journey of transformation and resilience*. Retrieved from https://www.worldbank.org/en/news/opinion/2023/03/01/defying-the-odds-bangladesh-s-journey-of-transformation-and-resilience

World Bank. (2024). *World Bank Open Data*. Retrieved from The World Bank: https://data.worldbank.org/

World Health Organization. (2006). *WHO child growth standards [electronic resource] : length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age : methods and development.* . Geneva: World Health Organization.

World Vision, B. (2021). *Community Clinic Policy Brief.* Retrieved from https://www.wvi.org/publications/policy-briefing/bangladesh/community-clinic-policy-brief

Yaya, S., Bishwajit, G., Ekholuenetale, M., & Shah, V. (2017). Awareness and utilization of community clinic services among women in rural areas in Bangladesh: A cross-sectional study. *PloS One, 12*(10), e0187303–e0187303. Retrieved from https://doi.org/10.1371/journal.p

Yi, J., Yuan, Y., & Zhao, S. (2019). Differential responses to market competition by private and public hospitals in China: a longitudinal analysis. *The Lancet, 394*(1), s37. Retrieved from https://doi.org/10.1016/S0140-6736(19)32373-6

Yu, C., Binns, C. W., & Lee, A. H. (2016). Comparison of breastfeeding rates and health outcomes for infants receiving care from hospital outpatient clinic and community health centres in China. *Journal of Child Health Care, 20*(3), 286–293. Retrieved from https://doi.org/10.1177/1367493515587058