RESEARCH REPORT

IMPACT OF MIGRATION ON THE NUTRITION CONDITION OF CHILDREN UNDER FIVE YEARS OF AGE IN THE RURAL HOUSEHOLDS OF BANGLADESH

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List of Acronyms

BIHS	Bangladesh Integrated Household Survey
BMET	Bureau of Manpower Employment and Training
BNNC	Bangladesh National Nutrition Council
BOESL	Bangladesh Overseas Employment and Services Limited
EW & OE	Ministry of Expatriates' Welfare and Overseas Employment
FAO	Food and Agriculture Organization
FSNSP	Food Security and Nutritional Surveillance Project
HAZ	Height for age z scores indicating children's nutrition
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IOM	International Organization for Migration
MHFW	Ministry of Health and Welfare
NPAN 2	National Action Plan for Nutrition (2016-2025)
NFNSP	National Food and Nutrition Security Policy of Bangladesh
WAZ	Weight for age z scores indicating children's nutrition
WFP	World Food Programme
WHO	World Health Organization
WHZ	Weight for height z scores indicating children's nutrition

Abstract

This study examines the role of migration (both internal and international migration) on the nutritional status of children under five years of age in rural households in Bangladesh. Using both OLS and IV regression methods on BIHS Dataset (2015), this study provides empirical evidence on the relationship between migration and nutrition in rural areas of Bangladesh. Five methods were employed to check for the robustness of the findings and examine the variations in the magnitude of nutritional indicators across these different models. Also, two different instruments ('District wise sex ratio in 2011' and 'Percentage of international migrant households in districts in 2011) were used to deal with endogeneity problems with migration and international migration.

Findings reveal that living in a migrant household increases the children's Weight-for-age z score (indicator of underweight) by 0.9 to 2.5 standard deviations and Height-for-age z score (indicator of stunting) by 1.4 to 2.2 standard deviations, compared to children living in non-migrant households. However, the magnitude of the findings changes and increases when the focus is riveted on 'international migration' exclusively. Living in an international migrant household increases the child z score by 1.7 to 4.5 standard deviations for Weight-for-age and 2.8 to 3.8 standard deviations for Height-for-age z-scores compared to children living in non-migrant households.

This study significantly contributes to the prevailing literature on the migration-nutrition nexus in Bangladesh from a nationally representative dataset. It establishes a direct and positive relationship between children under five years of age living in international migrant households and their higher Weight-for-age and Height-for-age z scores compared to non-migrant. Unlike this study, few studies on nutrition and migration in Bangladesh either deal with particular regions or lack rigorous quantitative exercise.

CHAPTER 1
INTRODUCTION

Migration, specifically international migration from Bangladesh, has been a widely discussed topic because of its contribution to the national economy through remittances in recent years. The impact of remittances has been widely discussed by economists, academics, and researchers in literature (Adams & Page, 2005; Beaudouin, 2006; Raihan, Sugiyarto, Bazlul, & Jha, 2009; Chowdhury, 2011; Barai, 2012; Siddique, Selvanathan, & Selvanathan, 2012; Jolliffe, Sharif, Gimenez, & Ahmed, 2013; Hatemi-J & Uddin, 2014; Headey, Hoddint, Ali, Tesfaye, & Dereje, 2015; Osmani, Ahmed, Hossain, & Huq, 2016; and Siddiqui, Neelim, Shabab, & Hasan, 2018). Even internal migration from rural to urban areas has acted as a coping mechanism or risk-minimising strategy for the rural poor to sustain their livelihoods (Headey et al., 2015; Osmani et al., 2016; Siddiqui et al., 2018). Therefore, both international and internal migration contributed to reducing poverty to some extent and increasing the income levels of households in Bangladesh (Jolliffe, Sharif, Gimenez, & Ahmed, 2013; Marshall & Rahman, 2013; Hatemi-J & Uddin, 2014; Osmani et al., 2016; Siddiqui et al., 2018). However, malnutrition among children, adolescents, and women has been a complex issue for Bangladesh since its independence. Recently, the country has progressed in decreasing malnutrition among the people through various government policies and achieved the nutrition objective of the Millennium Development Goals (Headey et al., 2015; Osmani et al., 2016; Nisbett, Davis, Yosef, & Akhtar, 2017; BDHS, 2017-18).

The current malnutrition status of Bangladesh is that about 22.6 per cent of children under five years of age are underweight, 28 per cent of children are stunted, 9.8 per cent of children are wasted, and 2.4 per cent of children are overweight, according to the Multiple Indicator Cluster Survey, 2019 (BBS & UNICEF, 2019, p.218). Bangladesh has established itself as a paradox out of the so-called ‘Asian Enigma’ by reducing the underweight and stunting rate among children under five in the past two decades (Headey et al., 2015). According to the Global Nutrition Report 2020, Bangladesh is on target for achieving two targets of SDG 2 (out of eight) to ensure nutrition equity with 35 other countries.

Table 1.1: Comparison of Malnutrition Status of Children of Countries and Regions in the World (in %)

Countries and Regions	Stunting (height-for-age Z score, HAZ<-2.00)	Underweight (weight-for-age Z score, WAZ<-2.00)	Wasting (weight-for-height Z score, HZ<-2.00)
Bangladesh, 2018	30.8	21.9	8.4
India, 2017	34.7	33.4	17.3
Pakistan, 2018	37.6	23.1	7.1
Nepal, 2016	36.0	27.2	9.6
South-Asia, 2019	33.0	28.3	14.8
Sub-Saharan Africa, 2019	33.0	17.7	6.8
Low-Income Countries, 2019	34.0	18.1	6.6
Lower Middle Income, 2019	30.1	20.6	10.9

Source: World Bank 2020 and Global Nutrition Report 2020.
(https://data.worldbank.org/indicator/SH.STA.MALN.ZS;
https://globalnutritionreport.org/resources/nutrition-profiles/asia/southern-asia/)

The process of nutritional change in Bangladesh has been multidimensional, yet wealth accumulation at the household level through economic development and the critical expansion of parental education and healthcare, improved sanitation system emerge as the four more critical factors in this change (Headey et al., 2015; Osmani et al., 2016; Nisbett et al., 2017). Remittances sent by international migrants have been termed as one of the major drivers of economic growth that contributes to poverty reduction (Nisbett et al., 2017; Jolliffe, Sharif et al., 2013). In brief, the relationship between growth, migration, and nutrition stands as a pro-poor economic growth supported by remittances from international migration that contributed to the improvement of the nutritional condition of children in rural households of Bangladesh (Headey et al., 2015; Osmani et al., 2016; Nisbett et al., 2017). However, this depicts an indirect relationship between migration and nutritional outcomes.

The estimated percentage of migrants in the total population of Bangladesh aged 15 years or older is 19.3 per cent (2.1 million migrants) (LFS 2016-17, p.155). If we divide the migration between rural and urban areas, about 12.6 million (39.0 per cent) migrants live in urban areas, and 8.5 million migrants live in rural areas (10.1 per cent). Moreover, the number of international migrant workers in 2016-17 was 905,000 or 0.905 million, sending 12,769.45 million US dollars as remittance (Bangladesh Economic Review, 2018, p.35). Under Goal-17 and indicator 17.3.2 of the SDG, the volume of remittances (in USD) as a proportion (in percentage terms) of total GDP is considered a consistent development indicator related to migration (IOM, 2020a). Generally, remittance as a percentage of GDP lies between 7 to 8 per cent (IOM, 2020a, p.24); this value was 5.11 per cent in 2016-17 (Bangladesh Economic Review, 2018; p.36). This indicator clearly aligns with the corresponding Seventh Five-Year Plan (7FYP) pointer to measure the “productive use of remittances” to ensure macroeconomic stability and economic growth (IOM, 2020a).

Although the impact of migration is complex (Beaudouin, 2006), remittances sent by migrants through income effect can contribute directly to improving a family's nutritional condition (Azzarri & Zezza, 2011; Davis & Brazil, 2016). However, the effect of remittances on nutrition is closely intertwined with other dimensions of migration, like new attitudes and knowledge by returning migrants and the absence of household members or parents concerning child care and food production (Hildebrandt & McKenzie, 2005; Beaudouin, 2006; Mu & Brauw, 2015; Thow, Fanzo, & Negin, 2016; Jayatissa & Wickramage, 2016; Davis & Brazil, 2016).

'Migration', both internal and short-term international, greatly impacts the socio-economic development of Bangladesh (Barai, 2012; Osmani et al., 2016; Siddiqui et al., 2018). Although international migration and remittance earnings from it have been acknowledged as a growth tool, the impact of rural to urban migration on the economy is rarely acknowledged (Siddiqui et al., 2018). Adams and Page (2005) analysed the data of 71 developing countries and found that international migration and remittance reduce the level, depth and severity of poverty in developing countries. In Bangladesh, both internal and international migration have been increasing in current years, and it has been contributing to reducing poverty (Jolliffe et al., 2013; Marshall & Rahman, 2013; Hatemi-J & Uddin, 2014; Osmani et al., 2016; Siddiqui et al., 2018). This research report, therefore, aims to find out whether migration has also contributed to improving the 'nutrition condition of children under five years of age in rural areas of Bangladesh.

1.1 Research Question(s)

Although many researchers have discussed migration based on poverty reduction, income generation, coping strategy, and economic growth, its direct impact on the nutritional condition of the children of the migrated families has not been discussed properly in Bangladesh. The rapid reduction of stunting in the last two decades has been regarded as the most sustained reduction in child undernutrition compared to its South Asian neighbours despite the absence of any highly effective community-based nutrition programmes and weak governance arrangements for nutrition delivery (Headey et al., 2015; Nisbett et al., 2017). Both Nisbett et al. (2017) and Heady et al. (2015) emphasised that extensive economic and social development workers as nutrition-sensitive drivers such as pro-poor economic growth, improved agricultural production and diversification, expansion of non-farm business and manufacturing sector along with international remittances from labour migration and NGO and government sectors combined effort in improving maternal healthcare and reducing fertility rate and rapid gain in education; all these factors have worked together to make this rapid reduction of undernutrition in Bangladesh sustainable. However, the decomposition of these different nutrition-sensitive factors has not been widely exercised. Islam, Khan, and

Mondal (2019) used multivariate logistic regression analyses and found no association between parental migration and nutritional disorders. Fujii, Shonchoy, and Xu (2018) explained the channels between electricity access and nutritional improvement in children in those houses. Therefore, there exists a vacuum in research which could assist in developing a direct and causal relationship between migration and its impact on children's nutrition in those households. However, this research fills the current gap in estimating a quantitative and direct relationship between 'migration and nutrition' literature on Bangladesh by investing the following research questions:

Research Questions	Policy Interventions
i. Whether migration (both internal and international combined) improve the nutrition condition of children living in those households?	The findings could assist in implementing the Second National Plan of Action for Nutrition (NPAN2) 2016-25 and the National Food and Nutrition Security Policy of Bangladesh (NFNSP) 2020 to plan nutrition-sensitive interventions at appropriate community levels.
ii. Whether international migration has a greater or lesser effect on reducing the undernutrition status of children living in those households?	To clarify and identify access to nutrition-sensitive social protection and safety nets across the life cycle with a focus on vulnerable groups and regions based on whether these groups gave an internal or international migrant member that could aid in efficient government resource allocation.

1.2 Objectives

This study aims to explore the impact of migration (both internal and international migration) on the nutritional status of children (under five years of age) in rural households of Bangladesh.

Is there any difference in the nutritional status of children under five years of age [weight–for–age–z-scores (WAZ), height-for-age-z-scores (HAZ)] among households with current migrant members (living away for six months or more) and with no migrant members? Here, the impact will be measured for both internal migrants (rural to urban) and international migrants (to other countries) combined as 'households with migrant members' and then comparing the impact of international migration for 'households with international migrant members'.

CHAPTER 2

OVERVIEW OF MIGRATION AND NUTRITION SITUATION OF BANGLADESH

2.1 Migration Situation in Bangladesh

'Migration,' although it is a prevalent word found in newspapers and international political news, this term does not have a universally accepted definition (IOM, 2020b). According to International Organization for Migration (IOM), 'Migrant' commonly refers to "a person who moves away from his or her place of usual residence, whether within a country or across an international border, temporarily or permanently, and for a variety of reasons" (IOM, 2020b). Hence, migrant workers, smuggled migrants, internally displaced persons, asylum seekers, and refugees all are part of the migration. In this study, ‘migrant’ is defined as migrant workers who have left Bangladesh to go abroad or have moved from rural areas to urban areas within Bangladesh for work or business purposes and are not asylum seekers or refugees. As the number of rural Bangladeshis going abroad for study is negligible, they are also not considered a migrant in this study.

According to UNDESA (2020), an estimated 272 million people, or about 3.5 per cent of the global population, were international migrants in 2019. The number of international migrants is growing at a faster rate; net migration from less developed to more developed regions is currently at around 2.8 million per year during the 2015-2020 period (UNDESA 2020; UN 2019).

Broadly, a purposeful geographical movement of people and workers towards divisions, districts, regions, and countries where industry and employment are available can be defined as 'migration' (Population Monograph, Volume 6, 2015). International migrants change their country of residence in search of better education, living condition, and economic prospect. An 'international migrant worker' can be defined "as someone who engages in a remunerated activity in a country of which he or she is not a national", according to International Law (World Bank, 2016). The International Labour Organization (ILO) defines a migrant worker as an "international migrant individual of working age and older who are either employed or unemployed in their current country of residence" (UN, 2019). However, 'international migrant workers' is a subset of international migrants, as international students, irregular migrants, and refugees are also part of total international migration (IOM, 2018). In 2018, out of 258 million international migrants, 150.3 million were migrant workers, and in 2019, three out of every four international migrants were of working age (20-64 years) (IOM, 2018; UNDESA, 2020).

On the other hand, the movement from rural areas to cities by underemployed and unemployed labourers from the local labour market to places where they could be fully employed is known as 'internal migration' (Population Monograph, Volume 6, 2015). Hence, 'Internal migrants' are those who have moved across administrative boundaries within national borders (World Bank, 2016).

2.2 The Drivers of Migration

Migration is a complex and multifaceted factor that can arise from an individual strategy to improve welfare and a collective household strategy to minimise the risk of uncertainty, especially in developing countries (FAO, IFAD, IOM, & WFP, 2018; Deb & Seck, 2009). According to FAO (2017), the volume of international migrants was 247 million in 2015, and the volume of internal migrants was 736 million. Moreover, by 2050, the migrants' number might increase to 1 billion due to environmental causes (FAO, 2017). Moreover, internal and international migration has become a critical coping strategy for the livelihood and employment of individuals and households in South Asian countries (Srivastava & Pandey, 2017).

The drivers of migration are influenced by a range of factors, like migrant's age, gender, ethnicity, education, employment status, and individual preferences (individual determinants) (Burrows & Kinney, 2016, cited in FAO, 2017). Moreover, household characteristics or micro-factors like household size and composition, cultural and social norms, assets base, age, gender, and education of the household's head, and finally macro-level conditions linked with socioeconomic, environmental, and political factors also influence individual's decision to migrate (Burrows & Kinney, 2016, cited in FAO, 2017; FAO, IFAD, IOM, & WFP, 2018).

In the case of Bangladesh, international migration occurs due to higher income prospects abroad, especially in gulf countries; also, greater population density and occurrence of frequent natural disasters (like a flood, riverbank erosion, cyclones, etc.) influence people to migrate (Van Hear, Bakewell, & Long, 2012; Siddiqui, 2001). In addition, the existence of social network through friends and families in the destination countries encourage people to migrate (Siddiqui, 2001; Afsar, 2009). In Bangladesh, about 0.27 per cent of people are migrants as a percentage of the total population (BMET, 2018). Most of the migrant population working abroad are less-skilled (48%) and semi-skilled workers (15%) (BMET, 2018).

It was found that among the labourers migrating from Bangladesh to the gulf states, about 90 per cent of men and 80 per cent of women already had one or more relatives abroad (Afsar, 2009), and about two-thirds of recruitment had been conducted through individual initiatives and social networks (Siddiqui, 2001). International migration to the Gulf States is a major part of the migration from Bangladesh from 1976 to July 2022. About 14,325,178 people were sent

around for work, who earned a total of 264,702.88 million USD, KSA, UAE, Oman, Qatar, Kuwait, Bahrain, Lebanon, Jordan, Libya, Malaysia and Singapore were the countries taking in the highest number of Bangladeshis to work in their countries (BMET, 2022).

Also, private recruitment agencies, individual recruiters, sub-agents of registered recruitment agencies, and travel agencies acted as mediating factors in shaping the nature of the migration flows from Bangladesh (Van Hear, Bakewell, & Long, 2012). In addition, Bangladesh Government's migration policies have encouraged people to migrate as workers through the Ministry of Expatriates' Welfare and Overseas Employment (EW & OE) and its department, the Bureau of Manpower Employment and Training (BMET), and Bangladesh Overseas Employment and Services Limited (BOESL). Also, by establishing the 'Expatriates Welfare Bank' (Probashi Kallyan Bank) to give aspiring workers loans with simple interest to go abroad and returnee migrants in investing productive activities (Srivastava & Pandey, 2017 & BMET, 2018).

Moreover, the Government of Bangladesh recognised overseas migration as a crucial area for employment generation and foreign reserve earnings (IOM, 2018). Remittance income increased from USD 10.9 billion in 2010 to USD 25.4 billion in 2020, with growth rates varying from 6.8 to 10.9 per cent during this period; also, remittance as a percentage of GDP is expected to remain consistent at 7.6 per cent in 2020 (IOM, 2020a). In addition, the government granted women to migrate as independent workers in 2003 (Van Hear, Bakewell, & Long, 2012) and adopted Overseas Employment Policy in 2006, which encouraged and increased overseas migrant employment from Bangladesh (BMET, 2018).

2.2.1 The Drivers of Internal Migration

The initial cost of international migration is large; hence, most international migrants come from non-poor and moderately poor households (Osmani et al., 2016). Also, moderately poor households who bear the migration cost by selling assets and borrowing from informal sources sometimes find it hard to recover the return (Osmani, 2016). Siddiqui et al.'s (2018) study on the panel data to assess the impact of migration over a period of ten years found that the average cost of an international male migrant was 342,254 taka, compared to 1,825 taka for an internal male migrant (pp.66-67). Therefore, there is a clear differentiation between internal and international migration based on households' assets, access to finance and bearing the migration cost. About 10 per cent of the global population has been accounted for as internal migrants, whereas only 3 per cent of the population is accounted for as internal migrants (FAO, IFAD, IOM, & WFP, 2018). Theoretically, reasons for internal migration can be broadly categorised into two groups i) Geographical push-pull models, under which relocation happens when the payoff is higher in the destination location than in origin because of the occurrence of natural disasters, lower wages, and employment opportunities, and

dissatisfactory social conditions (like the quality of public services, community/ethnic ties, crime levels and security issues); ii) Economic models, focused on productivity and livelihood differentials, developed by Lewis (1954) and Harris and Todaro (1970) (cited in Marshall & Rahman, 2013). However, the drivers of migration discussed in the literature focus primarily on wage and income differentials as the motivation for migration (Deb & Seck, 2009).

For Bangladesh, internal migration works as a livelihood strategy for rural households to avoid poverty and increase income within a short period (Hasan, 2019). However, Finan (2004) and Afsar (2005) (cited in Hasan, 2019) suggested that using internal migration as a temporary tool for livelihood had a limited scope of reducing poverty; it is more like a coping strategy to avoid economic misfortunes. That is why initial poverty rates among international migrant households were lowest in the panel data study by Siddiqui et al. (2018), while internal migrant households had higher poverty rates than non-migrant households. These two studies on Bangladesh provide solid evidence that international migrant households belong to the non-poor or moderately poor category. In contrast, most internal migrant households belong to moderately poor to extreme poor groups.

i. Harris-Todaro Model

According to this model, the migration process is an individual strategy based on a cost-benefit process, and people migrate from rural to urban areas when the expected wages in the urban sector is greater than wages in the rural sector (Deb & Seck, 2009). Around half of the poor internal migrants of Dhaka city had been agricultural labourers previously and were pulled from villages to Dhaka city because of greater job opportunities and lower growth of agrarian income (Afsar, 2003). Also, before migrating, the internal migrants contacted their relatives, friends, or acquaintances already living in Dhaka city, had information about their jobs before arrival, and secured their first job upon arrival (Afsar, 2003).

ii. Coping Strategy during Seasonal Poverty

Migration is also a household's coping strategy to ensure food security and nutrition (FAO, 2017). Notably, during seasonal poverty, internal migration works as a survival strategy to combat food and nutrition insecurity (Bryan, Chowdhury, & Mobarak, 2014; Paul, Hossain, & Ray, 2013; FAO, 2017). In the northwestern part of Bangladesh, a lack of job opportunities and low wages during the pre-harvest season (September–November) causes severe hunger and starvation (Paul, Hossain, & Ray, 2013; Finan, 2004). Thus, temporary migration works as a livelihood strategy and a coping mechanism for poor people in these areas to avoid economic misfortunes like losing fixed assets to repay debts (Finan, 2004).

2.2.2 Internal Migration in Bangladesh

In Bangladesh, the total number of internal migrants was estimated at 13.48 million, and 9.68 per cent of the total population in 2011 (Population and Housing Census, 2011).

Approximately 75 per cent of internal migration is rural-to-urban because the unemployed or underemployed youth of rural areas move to urban cities and towns looking for employment prospects and income aspirations (FAO, IFAD, IOM, & WFP, 2018). However, in the 2011 census, the internal migration rate declined to 9.7 per cent compared to previous Population Censuses (Table 2.1).

Table 2.1: Internal and International Migration Rate in Bangladesh

Indicators	2011	2004	1991
a. Internal migration rate (%)	9.7	9.34	10.02
b. Internal migration by Direction (%):			
Rural to Rural	4.2	2.99	8.6
Urban to Rural	0.36	0.38	1.42
Urban to Urban	0.85	26.41	28.04
Rural to Urban	4.29	4.79	5.62
c. International Migration Rate (%)	3.46	-	-

Source: Population and Housing Census, 2011.

Dhaka and Chattogram are the most common destination for internal migrants in Bangladesh because of higher work opportunities in the readymade garments industry, construction sector, and transport sector, especially as rickshaw pullers and household helpers (Afsar, 2003; Haider, 2010; Srivastava & Pandey, 2017). Therefore, it can be concluded that employment opportunities in major cities like Dhaka and Chattogram attract internal migrants from different parts of the country affected by poverty, natural disasters, lack of jobs in the rural areas, and lower wages to earn their livelihoods.

2.3 Nutrition Situation in Bangladesh

Malnutrition causes the deaths of 45 per cent of young children under five years of age worldwide (WHO, 2020). It also affects children's physical and mental development and reduces productivity in their adult life (FSNSP, 2015). Hence, eradicating malnutrition will protect those children from early death and morbidity and help a nation come out of the vicious circle of intergenerational poverty (FSNSP, 2015; Osmani et al., 2016).

Generally, there are three common indicators of malnutrition for children; they are stunting (low height-for-age), wasting (low weight-for-height), and underweight (low weight-for-age). According to the World Health Organization's (2010) guide, these three indicators are defined as:

i. **Underweight:** weight for age (WAZ) < –2 standard deviations (SD) of the WHO Child Growth Standards median: Mortality risk of children who are even mildly underweight increases drastically. It is difficult to interpret as it does not distinguish between stunted or wasted children. It may include children who are mildly undernourished in both of these indicators. Hence, it is a combined effect of chronic and acute malnutrition.

ii. **Stunting:** height for age (HAZ) < –2 SD of the WHO Child Growth Standards median: It reveals the chronic under-nutrition in children, resulting from long-time nutritional deprivation and infections since and even before birth. This condition often results in delayed mental development, poor schooling performance, reduced intellectual capacity, and the intergenerational cycle of malnutrition (Small women have a higher risk of delivering infants with low birth weights) (WHO, 2010; FSNSP, 2015).

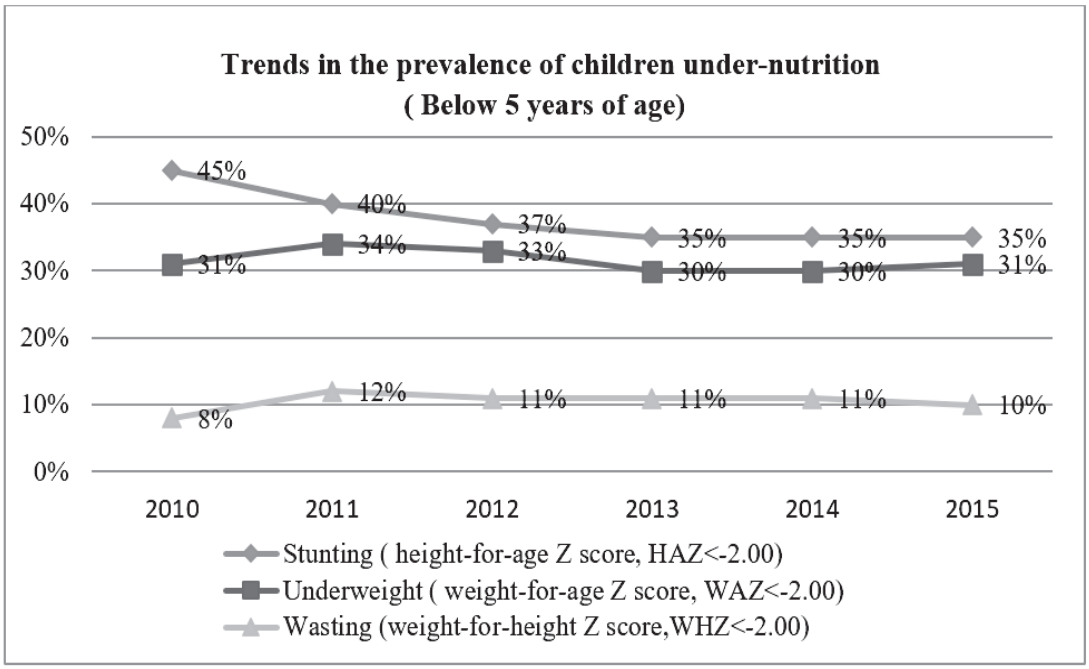
iii. **Wasting:** weight for height (WHZ) < –2 SD of the WHO Child Growth Standards median: It is a symptom of acute under-nutrition. It occurs due to insufficient food intake or a high incidence of infectious diseases (like diarrhoea), which worsen the functioning of the immune system in the future.

Bangladesh has made significant progress in improving its nutrition condition in the country in the past two decades (FSNSP, 2015; Osmani et al., 2016; Global Nutrition Report, 2020). The level of stunting among under-five children in Bangladesh has reduced from 35 per cent in 2015 to 31 per cent in 2017 (Figure 2.1), and the percentage of underweight children has also met the Health Population and Nutrition Sector Development Programme (HPNSDP) target in 2016 (FSNSP, 2015). Wealth accumulation or income increase of households, expansion of maternal education, community-based health care service delivery, and improvement in sanitation are the major factors that contributed to improving the nutrition condition of the country (Osmani et al., 2016).

According to USAID 2018 report, more than one-third (35 per cent) of all children (15.2 million in 2017) or about 5.5 million under five years of age suffered from stunting or chronic undernutrition. Besides, a cross-country study by Bredenkamp et al. (2014) on child undernutrition in 80 countries since 1990 showed that Bangladesh was one of the 11 countries where inequality in child nutrition was increasing with time. The state of undernutrition in Bangladesh from 2010 to 2015 is depicted in Figure 2.1, which clearly shows that malnutrition among children under five reduced significantly by 2015 in all three indicators. However, according to Bangladesh Demographic and Health Survey (BDHS) 2017-2018, the stunting rate declined to 31 per cent that year, and in 2019 it declined to 28 per cent, according to Multiple Indicator Cluster Survey 2019 (p.128). The underweight rate in children was 30 per cent to 34 per cent between 2010 and 2015, which declined dramatically to 22 per cent in 2017 (BDHS, 2017-18), and currently is at 22.6 per cent stated in MICS 2019. Wasting rate in children increased from 8 per cent in 2010 to 12 per cent in 2012, then remained at 22 per cent for the next consecutive years, then from 2015 it dropped to 10 per cent, then to 8 per cent following the BDHS 2017-18 survey and increased to 9.8 per cent in 2019 according to MICS data. According to the up-to-date statistics of the MICS 2019 survey on nutrition, the number of stunted children in Bangladesh in 2019 would be around 4.25 million; the number of underweight children is 3.43 million, and the number of wasted children is 1.48 million, which is a huge burden of malnutrition among children in numbers [1].

[1] Author's calculation based on children's population data by USAID 2018 and malnutrition data from Multiple Indicator Cluster Survey 2019, p.218.

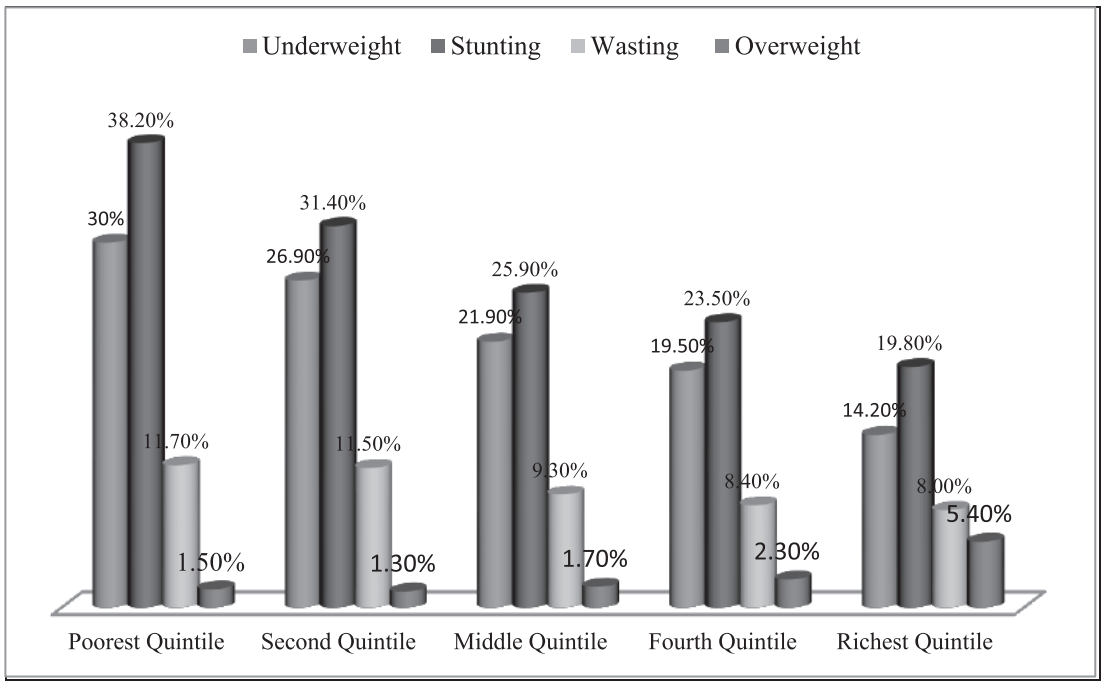
Figure 2.1: Trends in the Prevalence of Children Under-nutrition (Below 5 years of age)



Source: State of Food Security and Nutrition in Bangladesh 2015 Report, p.117 (from 2010 to 2015). Bangladesh Demographic & Health Survey 2017-18, p.42; Multiple Indicator Cluster Survey 2019, p.218.

Wasting rates in Bangladesh remain high; it reflects acute malnutrition in children and has been persistent in the last decade (Figure 2.1; Osmani et al., 2016, p.30). Another concern is the inequalities in nutritional outcomes between the children of poor and wealthy families, which seems to be increasing over time (Osmani, 2015 cited in Osmani et al., 2016). Figure 2.2 describes this inequality clearly; the stunting rate in the poorest quintile is 38.2 per cent, and the underweight rate is 30 per cent, almost twice as much as the wealthiest quintile. Across the population, in 2014, children in the poorest quintile were 2.5 times more likely to be stunted (50 per cent) than their peers in the wealthiest quintile (21 per cent) (NIPORT et al., 2015). Inequity in nutritional outcomes has become more significant over time, with the ratio of poorest to wealthiest rates increasing from 1.6 to 1.9 between 1996 and 2013 (Nisbett et al., 2017).

Figure 2.2: Inequality in Nutritional Outcomes based on Wealth of Households



Source: Multiple Indicator Cluster Survey, 2019, p.220.

Inequality in nutrition also varies between major divisions and districts. Table 2.2 points out that among eight divisions: Sylhet, Mymensingh, and Barishal are the top three divisions where malnutrition levels in the three indicators are really high. Also, the relationship between nutritional outcome and share of international migration rate in total population in these divisions is not straightforward.

Table 2.2: Division wise Malnutrition and International Migration Rate of Bangladesh

Indicators	Underweight/Weight for age (Under -2 SD)		Stunting/Height for age (Under -2 SD)		Wasting/Weight for height (Under -2 SD)		Percentage Share of International Migration
Division	Percentage	Mean	Percentage	Mean	Percentage	Mean	
Barishal	24.90	-1.3	30.60	-1.4	10.60	-0.7	6.90
Chattogram	23	-1.2	27.00	-1.3	10.40	-0.7	32.50
Dhaka	19.20	-1	28.00	-1.2	8.70	-0.4	27.50
Khulna	18.70	-1.1	20.60	-1.1	9.30	-0.7	13.40
Mymensigh	24.90	-1.3	33.30	-1.5	9.40	-0.7	missing
Rajshahi	23.30	-1.2	26.30	-1.3	9.50	-0.7	4.60
Rangpur	22.40	-1.2	26.60	-1.2	10.90	-0.7	2.70
Sylhet	32.10	-1.5	37.60	-1.6	11	-0.8	12.20

Source: Multiple Indicator Cluster Survey, 2019, p.218; Population Monograph, 2011, Volume 3, p.9

The logistic regression analysis done by Das and Gulshan (2017) identified a significant association between divisions and malnutrition. They also found that the Sylhet division is running far behind the other divisions in controlling malnutrition among children in Bangladesh. Nisbett et al. (2017) also concluded that between 2011 and 2014, in the country's eight administrative divisions, much more remarkable progress was observed in Khulna, Dhaka, and Rangpur divisions but poorer progress in Sylhet, where stunting actually increased (Nisbett et al., 2017).

The government of Bangladesh is seriously concerned about improving the nutrition condition of the country. That is why in 2015, for the first time, National Nutrition Policy was formed, and under this, the Second National Plan of Action for Nutrition (2016-2025) (NPAN -2) was adopted after the first one in 1997. Under the Sustainable Development Goal (SDG) targets, the Government of Bangladesh planned to reduce the prevalence of stunting among children under five by 40 per cent, which implies that the stunting rate among children should be 21.6 per cent by 2025, and the wasting rate should be less than 5 per cent with no increase in overweight over the same period (Multiple Indicator Cluster Survey by BBS, 2019, p.216; Osmani et al., 2016, p.32). Also, NPAN2 has set four targets to reduce malnutrition in children (among 15 targets in total to reduce various forms of malnutrition) by 2025. They are-

- Reduce stunting to 25 per cent among under 5 children
- Reduce wasting to less than 8 per cent among under 5 children
- Reduce the proportion of underweight among under-5 children to 15 per cent
- Reduce the rate of severe acute malnutrition (SAM) (WHZ < -3) among children under 5 years of age to less than 1 per cent (NPAN 2, MOH & FW, 2017, p.15-16)

The above discussions point out two things: i) the government has set planned targets to reduce malnutrition at all levels, especially among children, by the year 2025, and ii) to achieve those malnutrition reduction targets, policies and programmes should address the existing inequality of nutrition between quintiles and divisions.

CHAPTER 3

LITERATURE REVIEW

3.1 Impact of Migration on Nutrition Status of Children

The available literature on migration and nutritional outcomes reports both positive and negative impacts of migration on the nutritional status of children in households. Also, the internal and international migration impacts may have different effects (Osmani et al., 2016; Davis & Brazil, 2016). To understand how migration affects the nutritional status of children in households, we need to understand the channels through which migration and nutrition are connected. The effect of migration on the nutrition outcome of children is intertwined with remittance, which affects migrant households' income and expenditure. Also, the introduction of new health knowledge and perspective by returning migrants can influence households' child-rearing practices that affect children's nutrition. Finally, the absence of migrant household members for child care, limited time, and labour availability for food production and food preparation may adversely impact children's nutritional status (Thow et al., 2016). Hence, migration's impact on children's nutrition status can be positive, negative, or mixed based on these three dimensions.

This research is a step towards understanding the role of migration and remittances in children's nutrition and exploring the potential opportunities to improve nutrition in rural households in the background of growing remittance flow in Bangladesh.

3.2 Conceptual Framework: Channels through which Migration Affects Nutrition

Azzarri and Zezza (2010) explained five main channels through which migration can impact the various dimensions of household food security and nutrition:

i. Income and remittance effects through added income of the households, food consumption, and investment in health, water, and sanitation can impact the children's nutrition.

ii. Effects on household composition and decision making through possible female headship because of male members migration, where the females increase the allocation of household resources towards food and other inputs into child nutrition and health if the authority, decision-making, and bargaining power shift to the educated female members.

iii. Insurance and consumption smoothing effects on households can be ensuring stable access to food during seasonality, natural calamity, and crisis.

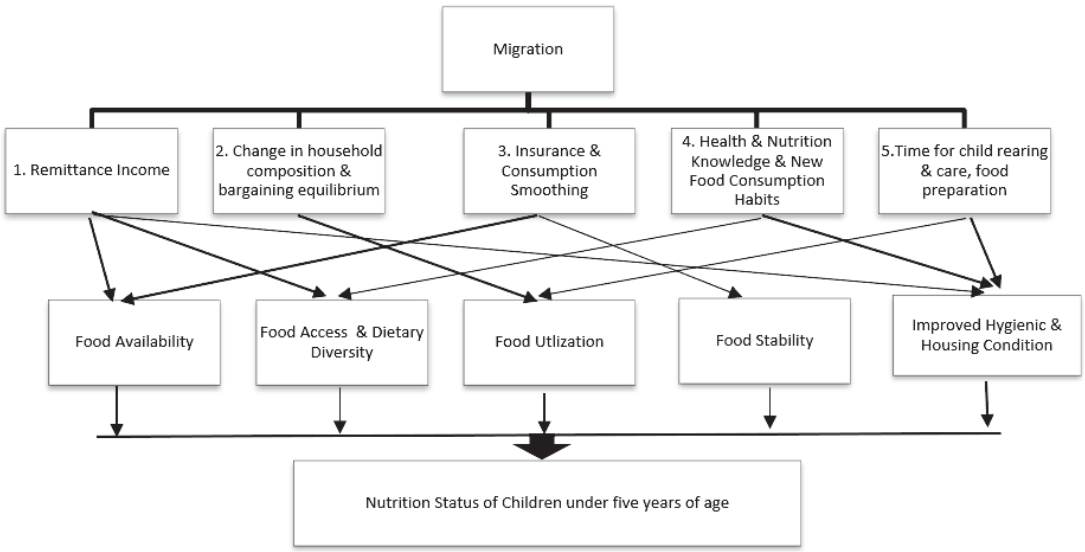
iv. Effects on improved knowledge of health and care practices where migrant families attain higher health outcomes with the same recourses because of better knowledge, and finally.

v. Effects on time allocation: The absence of migrant members, particularly male members, labour activities, household chores, caregiving, and food preparation, shifts to other members, particularly females. It may affect breastfeeding practices, time for nutritious food making, and children's vaccinations that change the nutritional status.

The causes of malnutrition or undernutrition are multifactorial. Malnutrition or undernutrition depends on factors related to households like food, insecurity, income, unemployment, and poor access to water and sanitation, factors related to the child caregiver, including caregiver's age, level of education and caregiver nutrition education, and finally, factors related to the child like the age and gender of the child, child illness, consumption of inadequate or a repetitive diet and low birth weight (Mkhize & Sibanda, 2020). Hence, the framework through which 'migration' affects 'nutrition in children under five years of age indeed works through these factors to have an impact.

In the following diagram, a simple conceptual framework depicting the relationship between migration and nutrition outcomes in children is provided after analysing the existing research studies and literature (Hildebrandt & McKenzie, 2005; Rossi, 2009; Antón, 2010; Azzarri & Zezza, 2010; Mu & Brauw, 2013; Headey et al., 2015; Thow et al., 2016; Davis & Brazil, 2016; Nisbett et al., 2017; Das & Gulshan, 2017; Islam, Khan & Mondal, 2019; Romano & Traverso, 2020; Mkhize & Sibanda, 2020).

Figure 3.1: Conceptual Framework between Migration and Children's Nutrition Status[2]



[2] This figure is constructed and adapted from Azzarri & Zezza, 2011; Mu & Brauw, 2013; Romano & Traverso, 2020; Headey et al., 2015

A fully-fledged analysis of the relationship between migration and its impact on the nutritional status of children under five years of age in rural Bangladesh is beyond the scope of this paper. However, we are certain that migration, specifically international migration, has helped households with food availability, access, and utilisation through a diversified and nutrient-rich diet (Romano & Traverso, 2020). Households' food and nutrition situation is influenced by migration in several ways. Identifying a causal relationship and unpacking the mechanism through which migration affects the nutrition level of children in households is a challenging methodological process (Zezza, Carletto, Davis, & Winters, 2011). By reviewing the international research papers on migration, food security and nutrition, and also research work on children's nutrition status in Bangladesh (Headey et al., 2015; Nisbett et al., 2017; Das & Gulshan, 2017; Islam et al., 2019), we have pointed out five channels that affect the food availability, food access and dietary diversity, food utilisation, food stability, and improved hygienic environment and conditions in the households. All these factors jointly impact the nutrition condition of children under five in those households.

The first channel is the income sent by migrants to the families, which offers a better economic condition to the households, thus increasing food availability and access. Also, with more money available, households could purchase a diversified diet rich in protein and vitamins (Mu & Brauw, 2015) that affects the nutrition condition of the children. Moreover, additional income helps households establish a better arrangement to access clean water and sanitation facilities that affect the household member's handwash practices before and after feeding a child and using the toilet. Thus, it affects the overall nutritional development of the children and members of the house (Nisbett et al., 2017; Islam et al., 2019).

The second channel is the change in the bargaining equilibrium in the households, in particular, when the migration of the male members shifts the decision of resource allocation to the females or the mothers who spend the resources on nutritious food and better health care, which results in a better nutritional outcome for the children (Azzarri & Zezza, 2011; Mu & Brauw, 2013, 2015; Holland & Rammohan, 2019).

The third most important channel is how remittances can provide stable access to food during shocks and seasonal crises, thus acting as a risk-diversification strategy in the absence of proper insurance or capital market (Azzarri & Zezza, 2010; Headey et al., 2015). Hence, young children (<5 years) in these households are not deprived of adequate and nutritious food during the crisis period and can maintain a proper nutrition level. Hence, remittance earnings from migration ensure both food availability and stability for children living in these households.

Another way by which migration influences nutrition level is through improved knowledge about food and sanitation termed as 'social remittance': which can alter the consumption pattern and housing condition of the households resulting in dietary diversity and hygiene conditions in the households (Levitt, 1998; Islam et al., 2019; Romano & Traverso, 2020).

Finally, through migration, fewer members are available to do household work, and childcare time, e.g., cooking a nutritious meal, monitoring eating habits, etc., becomes scarcer (Azzarri & Zezza, 2011; Mu & Brauw, 2015). It is known as the 'time effect' as less time for childcare, food preparation, and child nurture, particularly women's time, can adversely affect the nutritional status of children in those households (Azzarri & Zezza, 2011; Mu & Brauw, 2015).

This conceptual framework again establishes that the relationship between migration and nutritional outcome of children is complex, as the sign of this relationship counting on these five channels can shift between positive and negative at any time, depending on which channel poses a greater impact.

3.3 Positive Impact of Migration on Nutritional Outcome of Children

Broadly, the nutritional outcome of children in migrant households is affected by the remittance sent by the migrants. The migrants' remittances directly impact income distribution, poverty alleviation, and individual welfare in the recipient community (OECD, 2007; Fajnzylber & López, 2008; Osmani et al., 2016). Higher-income thorough remittances plays a significant role in addressing the food security of the left behind migrant households by increasing access to food and reducing the vulnerability of families in times of crisis, which results in reducing malnutrition (Antón, 2010; de Brauw, 2011; Thow et al., 2016). Also, a rise in income motivates couples of international migrant families to have fewer children, and increased investments in children's health and education result in reductions in neonatal and infant mortality, illnesses, low birth weight, and underweight among young children (Hildebrandt & McKenzie, 2005; Davis & Brazil, 2016). Also, a great deal of literature has discussed the impact of migration on poverty and income inequality, human capital investment (i.e., education), increased investment in health services, and strengthening food security of the households (Adams & Page, 2005; OECD, 2007; Acosta et al., 2007; Fajnzylber & López (ed.), 2008; Tchantchane et al., 2013, Acharya & Leon-Gonzalez, 2012; Regmi & Paudel, 2016; Romano & Traverso, 2020). However, in this research paper, the main focus is on those pieces of literature that discuss the impact of migration and remittance on children's nutritional status (Frank & Hummer, 2002; Hildebrandt & McKenzie, 2005; López-Córdova, 2006; World Bank, 2006; Acosta et al., 2007; Rossi, 2009; Azzarri & Zezza, 2010; Antón, 2010; Ponce, Olivié, & Onofa, 2011; Davis & Brazil, 2016).

Some studies show that short-term nutritional outcomes (weight-for-height, WHZ) and medium-term health outcomes (weight-for-age, WAZ) definitely improve when a household member migrates and sends remittance. Antón's study (2010) on children in Ecuador showed that receiving remittances, on average, increases the weight-for-age score by 0.60 SD and weight-for-height score by 0.74 SD. Furthermore, parental migration increased the WAZ scores of rural children in China between 0.08 and 0.2 standard deviations (Mu & de Brauw, 2013). While migration had positive coefficients for both HAZ and BMIZ-scores, they were not statically significant. However, this study focused on rural to urban migration or internal migration. Their main argument is that nutritional outcomes changed because of increased access to tap water in migrant households through an income effect. Children in migrant families may have lower infant mortality and a higher birth weight compared to non-migrant families. The likelihood of infant mortality in the first year of children's birth is reduced by 3 to 4.5 per cent in Mexico in migrant households (Hildebrandt & McKenzie, 2005). Also, a one-standard-deviation increase in household migration lowered the infant mortality rate by 1.8 per cent and raised the birth weights of children by 140 grams (Hildebrandt & McKenzie, 2005). This effect is larger than the effect of a mother's schooling on infant mortality and birth weight.

Azzarri and Zezza (2011) proved that children living in households and communities with higher international migration access had better nutritional status than other Tajik children. Through improved access to food (amount of kilocalories consumed) and improved breastfeeding practices (duration of exclusive breastfeeding), children living in households with international migrants had a higher z-score of height-for-age (HAZ) by 0.2 standard deviations.

Romano and Traversos (2020) paper on Bangladesh clearly states that international migration and remittance sent by those migrants have improved those households' food and nutrition security through increasing diversified and energetic diet consumption (food items containing higher animal proteins and micro-nutrients). Although they did not particularly focus on children's nutrition, their findings suggest that the availability of an adequate and nutritious diet positively impacts all household members, including women and children.

Islam, Khan, and Mondal (2019) investigated the impact of parental migration on nutritional disorders of left-behind children (LBC) in Bangladesh using multivariate logistic regression analyses. They found no negative effect of parental migration on stunting, wasting, and underweight LBC in Bangladesh. Moreover, the study found maternal educational status and household economic condition were significant factors in determining the nutritional development of children. Hence, in the case of Bangladesh, remittance sent back home acts as an offsetting factor to mitigate the negative impact of the lack of direct care caused by parental migration.

Nisbett et al. (2017) credited the pro-poor economic growth through agricultural production and diversification, support of NGOs in income generation and delivering essential services, expansion of employment opportunities through non-farm business and manufacturing sectors, and remittances from labour migration in improving the children's nutritional condition in Bangladesh from 1997 to 2011. Besides, Fuji et al. (2018) provided evidence that access to electricity in rural areas of Bangladesh improved the HAZ score of children by 0.15 points. This positive impact was recorded due to increased wealth and reduced fertility. Therefore, these two studies on children's nutritional status in Bangladesh indirectly prove that additional income via migration and its usage has positively impacted children's nutrition status.

3.4 Negative Impact of Migration on Nutritional Outcome of Children

The migration of a family member and income earned through remittance does not always positively impact children's nutritional status. A few pieces of literature have pointed out the decrease in nutritional status of children under five years of age because of migration, especially the migration of the parents of the children can disrupt family life (McKenzie & Sasin, 2007). The study by Davis and Brazil (2016) on left-behind children of Guatemala (children aged or below three years of age) found that the father's international migration in the previous year decreases children's height for age z scores (HAZ) by 0.427 per cent. Also, compared to a non-migrant, non-remittance receiving household, father's international migration increases the children's stunted state ($HAZ \leq -2$) by 22.1 per cent. This study pointed out that when migrant fathers of left behind young children took a long time to establish themselves in the foreign destinations and could not send a substantial amount of remittance, then the remittance sent had no effect on improving the physical stature of those children.

Conversely, Jayatissa and Wickramage's (2016) study on left-behind children (under five years of age) in Sri Lanka showed that stunting and underweight are higher among children whose mothers are migrant workers. However, if the child's father is a migrant worker, the likelihood of being stunted is lowered by 0.11 percentage points.

Hildebrandt and McKenzie's study (2005) concluded that the impact of migration is different on nutrition among children in Mexico in terms of short-term and long-term. They found that children in migrant households had lower infant mortality rates and higher birth weight. However, the children of migrants were less breastfed, lower vaccinated, or less taken to a doctor in their first year of life compared to non-migrants. Hence, if parents of a child migrate, then their absence may have longer-term adverse effects on the health outcomes of those children. Moreover, households with a single parent or single grandparent and with both migrated parents had large negative marginal effects on the children's weight-for-height score (or higher likelihood of stunting) in Thailand (Cameron & Lim, 2007).

Therefore, it can clearly be stated that parental migration of a father or a mother or both parents; these three scenarios have different impacts on the nutritional outcome of the children. In the absence of a migrant father or mother, only one adult is left behind to care for and be and provide for the children. As a result, a lack of proper childcare practices and a reduction in time for cooking a nutritious meals for children make the children more vulnerable to illness (Jayatissa & Wickramage, 2016; Mu & Brauw, 2015). Also, a reduction in breastfeeding by a working mother, who had engaged herself in wage labour or farm maintenance activities to compensate for the absence of labour in the households or as a coping strategy to survive until the father sends meaningful remittances, may deteriorate the nutritional outcomes of children (Hildebrandt & McKenzie, 2005; Davis & Brazil, 2016).

3.5 Mixed Impact of Migration on Nutritional Outcome of Children

Be and Brauws study (2015) on the impact of migration on children in rural china found that parental migration only improves the weight of the children (WAZ), but it had no significant effect on children's height (HAZ). On the other hand, Anton's (2010) study on Ecuador found that receiving remittances increases the WAZ score by 0.60 and WHZ score by 0.74 standard deviations and is significant, suggesting that remittances had a positive effect on short- and middle-term nutritional status. The HAZ score of the children in the remittance recipient families was insignificant, indicating that it did not help reduce stunting or improve the long-term nutritional status of children living in remittance-receiving households in Ecuador.

The study by Ponce et al. (2011) on Ecuador explained precisely why migration's effect on nutritional outcomes of children varies between positive and negative and, in some cases, mixed impacts. They found that remittances significantly impacted increasing health (de-worming and vaccination) expenditure, medical expenditure, and health knowledge as preventive and emergency measures. However, it did not significantly impact long-term child health variables.

The discussion above clearly states that migration (internal-international) does not have a direct positive impact on the nutritional status of the children of these households. The effect varies depending on the migrating person, whether the migrant is a father or mother or both parents. (Also, the length of time of migration, whether long or short and how long it takes for the migrant to establish in the destination and send a substantial amount of remittance to compensate for one's absence.) Furthermore, it also depends on the condition of the migrant households, whether these households have enough members to cater to the household's work, cooking food, and childcare time, and whether the gender of the household head changes due to migration. Therefore, the study results on the impact of migration on nutritional outcomes may vary in different communities, regions, countries, and times and situations.

3.5.1 Income Effect: Does Migration Affect Nutrition Only Through Income?

The income effects of migration are dominantly discussed in the literature as households use migration as a strategy to increase their incomes and escape poverty (Azzari & Zezza, 2011). Global and regional analyses, as well as country case studies of Romano and Traverso (2020), Osmani (2016), Davis and Brazil (2016), Mu and De Brauw (2013), Antón (2010), De Brauw (2011), Adams and Page (2005) and many more, have discussed the income effect of migration through remittance. Remittances largely affect nutrition by increasing total household income and expenditure, specifically expenditure on nutritious food (Thow et al., 2016). However, Mu & De Brauw (2013) explained that there are three effects of migration: i) income effect, ii) time effect, and iii) change in intra-household bargain.

As discussed in the previous sections, migrated person earnings sent as remittance helped households increase food consumption and better healthcare and sanitation practices that improved the nutritional status of overall households, including children. On the other hand, the absence of a migrant member can reduce childcare time and food preparation time, as the burden of household chores, local production, and farming shifts to other members, especially mothers who struggle in doing all these works and also care for the children (Jayatissa & Wickramage, 2016; Davis & Brazil, 2016; Mu & de Brauw, 2013). Therefore, this time effect may compromise child nutrition. Finally, if the household head or the father migrates, the decision-making power and female leadership of spending the remittance money might affect child nutrition and health (Azzari & Zezza, 2011; Mu & de Brauw, 2013). In some cases, this change in intra-household bargaining and female headship increases the allocation of household resources towards food and inputs that increases child nutrition and health (Haddad, Alderman, Appleton, Song, & Yohannes, 2003; cited in Azzari & Zezza, 2010). On the other hand, more burden on the female or mother for taking care of other responsibilities and in the absence of receiving a substantial amount of remittance income may negatively impact the nutritional status of children (Cameron & Lim, 2007; Hildebrandt & McKenzie, 2005; Jayatissa & Wickramage, 2016; Davis & Brazil, 2016).

Therefore, it can be concluded that migration may have a positive effect primarily provided through remittances; however, it is not simple to term it as only income effect (Rossi, 2009). Through migrant members, the households may gather new information and new attitudes that may increase the household's health knowledge, resulting in a positive effect on children's health (Hildebrandt & McKenzie, 2005; Frank & Hummer, 2002; Rossi, 2009). Households with large migrant networks can have better access to nutrition information than non-migrant households, which can positively impact nutritional indicators even without migration (Mu & de Brauw, 2015). It was termed as 'social remittances' by Levitt (1998), and he also stated that this effect depends largely on the frequency and existing means of contact between the migrant and households.

Sikder and Higgins' (2017), in their study of "remittances and social resilience of migrant households in rural Bangladesh", used 'social resilience' as a conceptual tool. The purpose was to investigate how households use monetary remittances to enhance their ability to respond to challenges, build economic, human, and cultural capital, and plan for the future. Hence, they viewed 'remittances sent by the migrants' as a key livelihood strategy in enhancing the capacity of migrant households to maintain stability in the face of social, economic, and environmental changes. Another interesting study finding is that "male-headed households tend to spend remittances on building economic capital, such as land for agricultural production or housing construction. On the other hand, female-headed households prefer investing in activities, such as education, that enhance human capital" (p.17).

In conclusion, it can be stated that migration and remittance can positively impact under-nutrition only when do migrant households use that remittance to improve their dietary quality and move beyond meeting sufficient calorie consumption (Thow et al., 2016). As Jayatissa and Wickramage (2016) mentioned, the nutritional status of the left-behind children is a complex interplay of underlying social determinants and cultural gradients; hence only focusing on better food purchasing power supported by remittances may not be a sustainable solution. Developing sound policies for building skills, capacities, and preparedness of migrant families in better utilising and investing remittances for poverty alleviation policy and disseminating knowledge, and encouraging migrant families to continue investing in sanitation, hygiene, and nutritional foods would support in sustaining the positive effect of remittance on nutritional status of children (Jayatissa & Wickramage, 2016; Thow et al., 2016).

CHAPTER 4
DATA & METHODOLOGY

4.1 Data

The data for this paper are drawn from the Bangladesh Integrated Household Survey (BIHS) 2015 (Second round survey). It was carried out by the Policy Research and Strategy Support Program (PRSSP) for Food Security and Agricultural Development, funded by the United States Agency for International Development (USAID), and implemented by the International Food Policy Research Institute (IFPRI). It is a comprehensive and nationally representative household survey, and it was designed after consulting the Household Income and Expenditure Survey (HIES) conducted in Bangladesh. It covers the rural households of Bangladesh across seven administrative divisions: Barishal, Chattogram, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet. Additionally, it includes USAID-supported Feed the Future (FTF) zones in southern Bangladesh for assessing the performance of the programme. The IFPRI-PRSSP original research plan consists of three rounds of the BIHS. The first round of the BIHS was conducted from November 2011 to March 2012, and the second BIHS round was from January to June 2015, administered on the same sample of households surveyed in the baseline creating a two-round panel (i.e., longitudinal surveys). For this study, we used the second round of the BIHS dataset.

This dataset collected a total sample size of 6,500 households in 325 primary sampling units (PSUs) or villages using a sound and appropriate statistical method. In the first stage of sampling, the total BIHS sample of 325 PSUs was allocated among the eight strata (seven divisions and the FTF ZOI). The distribution goes as follows: 21 PSUs in Barishal, 48 in Chattogram, 87 in Dhaka, 27 in Khulna, 29 in Rajshahi, 27 in Rangpur, 36 in Sylhet, and 50 in the FTF ZOI. In the second stage, 20 households were randomly selected from each PSU (Ahmed, 2016).

The final sample frame of the FTF zone includes 2,040 households (1,000 households in the original FTF sample and 1,040 additional sample households) in 102 PSUs belonging to 73 Upazilas (Ahmed, 2016). In this study, the data of the FTF zones are not included to avoid the FTF programme's impact on the nutritional status of the households. The total sample size, excluding the FTF zone, stands at 4,460 households, representing the rural households of Bangladesh. However, only 1,903 households from this dataset had children under five years of age. So, the final sample size used in the analysis is 1,903 (Table 4.1).

Also, data from the Population and Housing Census 2011 is used for generating variables such as district-wise estimates of poverty, sex ratio by districts, percentage share of elderly

persons in district population by districts, and percentage share of international migrant households in total households by districts (from Population Monograph of Bangladesh Volume 3, Volume 4, Volume 9 and Volume 11). In addition to this, district-wise bank branch numbers were excerpted from the district statistics of 2011 by BBS.

Information on migration was collected from "Module V: Migration, remittances, transfers, and other income" of the BIHS second-round questionnaire. The information on the profile of current migrants and their destinations based on which internal and international migrant households were selected from Module V1. This dataset defined migrants as individuals of households who were abroad at the time of the interview and lived away for six months or more.

We defined a household as an internal migrant or international migrant household when any household reported at least one migrant in section V1. A total of 463 households (roughly 10 per cent of all households) are thus defined as migrant households. Of the migrant households, 340 households are identified to have internal migrant members, while 123 households have at least one member who was an international migrant. If viewed from the gender perspective, around 81 per cent of all migrants were male. In our analysis, four households were exempted because there was no information on relevant variables.

Table 4.1: Summary of Dataset

Sl. No.	Migration status of all rural households (National Representative)	Number of all rural households in BIHS 2015	Number of all rural households with children under five years of age
1	Non-migrant households	4,032	1,754
2	Internal-migrant households	336	98
3	International-migrant households	123	51
4	Migrant households (both internal & international)	459	149
5	Total households	4,491	1,903

Source: Author's calculation based on BIHS Second Round Survey 2015, excluding FTF zone.
Note: Column 4 describes the dataset used for this study.

The survey questionnaire included a detailed module on anthropometric information in Module W. We drew the information on children's age, height, weight, birth order, and mother's id for all children under five years of age from Module W2. It obtained information on 1,903 children less than five years of age. Then, ENA (Emergency Nutrition Assessment) software (version July/15) was used to calculate the Z-scores of height-for-age (HAZ) and weight-for-age (WAZ) of all those children (ENA, 2011).

From that, we had to discard 144 observations that were not measured properly. With values beyond ±6 in the height-for-age z-score distribution and weight-for-age z-score distribution (which are outside the plausible range for this indicator), some observations were also dropped because of missing information on the mother's height, ending up with a final sample of 1,848 children.

4.1.1 Profile of Migrants

In the dataset, about 81 per cent (369) of migrants were male, and around 20 per cent (90) were female. Most of the female migrants (91.1 per cent) experienced internal migration, and only eight females out of 123 migrants had gone for international migration. Among male migrants, 68.8 per cent were internal migrants, and 31.2 per cent were international migrants. There are not significant variations between the education level of internal and international migrants, although the completion of primary education and secondary education is higher in international migrants compared to internal migrants (Table 4.2).

Table 4.2: Education Level of Migrants

Level of Education	Internal Migrant (%)	International Migrant (%)
Never attended school	17.56	15.45
Completed primary education	16.07	21.14
Completed SSC/Dakhil	6.85	8.13
Completed HSC/Alim	11.01	7.32

Source: Author's calculation from BIHS Second Round Survey 2015.

In the dataset, the major international destinations for international Bangladeshi migrants are middle-east countries; the only two exceptions are Malaysia and Singapore.

Table 4.3: Major Destinations of the International Migrants

Sl. No.	Destination	International Migrants
1	Oman	25 (20.33%)
2	Saudi Arabia	21 (17.07%)
3	Malaysia	17 (13.82%)
4	UAE	16 (13.01%)
5	Qatar	9 (7.32%)
6	Singapore	7 (5.69%)
7	Others	28 (22.76%)

Source: Author's calculation from BIHS Second Round Survey 2015.

Also, for internal migrants, the top destinations are Dhaka, Chattogram, Sylhet, and areas near Dhaka. About 44.35 per cent of internal migrants chose Dhaka as their destination (Table 4.4) because of the availability of work here. It becomes more evident when we look at Table 4.5, which represents migration's purposes. Employment is the top-most reason for both internal (56.85 per cent) and international (88.62 per cent) migration.

Table 4.4: Major Destinations of the Internal Migrants

Sl. No.	Destination	Internal Migrants
1.	Dhaka	149 (44.35%)
2.	Chattogram	47 (13.99%)
3.	Sylhet	17 (5.06 %)
4.	Brahmanbaria	8 (2.38%)
5.	Gazipur	8 (2.38%)
6.	Others	107 (31.84%)

Source: Author's calculation from BIHS Second Round Survey 2015.

Purposes of internal migration are diversified and several reasons other than employment like business or self-appointed work (13.10 per cent), getting an education (9.82 per cent), escaping violence (3.87 per cent), and marriage (5.65 per cent) play a role. However, purposes of international migrants in this dataset only concentrated on employment (88.62 per cent) and business or self-appointed work (4.07 per cent).

Table 4.5: Purposes of Internal and International Migration

Sl. No.	Purpose of Migration	Internal Migrant	International Migrant
1	Employment	191(56.85%)	109(88.62%)
2	Business/self-appointed work	44(13.10%)	5(4.07%)
3	Education	33(9.82%)	2(1.63%)
4	Marriage	19(5.65%)	0
5	Escape war/violence	13(3.87%)	1(0.81%)
6	Escape drought/famine	2(0.60%)	0
7	Healthcare	0	1(0.81%)
8	Others	34(10.12%)	5(4.07%)
	Total	336	123

Source: Author's calculation from BIHS Second Round Survey 2015.

4.1.2 Description of Variables

Mean values of the variables that distinguish the characteristics of migrant households from non-migrant households are given below. These variables can be divided into four large categories: The characteristics of the mother and children included in the sample (age, height, weight, education, etc.); characteristics of household-head and household composition (age, sex of household head, household size, income, land asset, etc.); household's access to facilities (sanitary latrine, garbage disposal, etc.); and community variables where the household is located (District wise Sex Ratio in 2011, percentage of international migrant households by district 2011, percentage of elderly persons in district population 2011, District wise bank branches in 2011). The means for the main variables used in our analysis are shown separately for migrants (combining both internal and international migrant households) and non-migrant households, in Table 4.6 at the household level, and in Table 4.7 for children international migrant and non-migrant households.

Table 4.6: Mean Values of Main Variables for Children under 5 Years Old by Households' Migration Status

Variables	Households with no migrant members	Households with at least one migrant member	Difference in mean values	p-values	t-statistics	Combined mean
Weight for age z score (WAZ)	-1.50	-1.54	0.04	0.71	-0.4	-1.51
Weight for height z score (WHZ)	-0.99	-1.13	0.14	0.21	-1.3	-1.00
Height for age z score (HAZ)	-1.44	-1.33	-0.11	0.40	(-0.85)	-1.43
Gender of child: male 0, female1	0.47	0.51	-0.05	0.29	(-1.06)	0.47
Child age in months	29.52	27.90	1.62	0.28	-1.1	29.39
Child age in months square	1166.90	1051.62	115.30	0.20	-1.3	1157.98
Age of the mother	26.69	25.78	0.910*	0.03	-2.2	26.62
Height of the mother (cm)	150.96	150.98	-0.02	0.97	(-0.04)	150.97
Weight of the mother (kg)	48.16	47.97	0.19	0.81	-0.2	48.15
Mother's age at marriage	17.61	16.90	0.711**	0.00	-3.0	17.56
Years of education of the mother	5.31	5.76	-0.45	0.14	(-1.49)	5.34
Household Head is female	0.13	0.50	-0.367***	0.00	(-11.78)	0.16
Birth Order of the child	2.34	2.33	0.01	0.92	-0.1	2.34
Number of children below 15 years of age in household	2.44	2.55	-0.10	0.31	(-1.02)	2.45
Number of adults above 15 years of age in household	2.88	2.70	0.18	0.17	-1.4	2.86
Household has sanitary latrine	0.44	0.32	0.115**	0.01	-2.7	0.43
Household disposes garbage in a systematic way	0.30	0.25	0.05	0.23	-1.2	0.30
Distance of household to nearest town	8.97	8.80	0.17	0.83	-0.2	8.95
Age of household head	39.84	40.90	-1.06	0.36	(-0.91)	39.92
Age of household head square	1753.51	1951.49	-198.00	0.07	(-1.79)	1768.62
Household head has primary education	0.43	0.58	-0.153***	0.00	(-3.55)	0.44
Household head has secondary education	0.09	0.08	0.01	0.78	-0.3	0.09
District wise sex ratio in 2011(share male/female)	98.57	98.85	-0.28	0.48	(-0.70)	98.60
Percentage of international migrant households by district 2011	8.61	9.12	-0.51	0.42	(-0.81)	8.65
Percentage of elderly persons in district population 2011	7.64	7.74	-0.10	0.30	(-1.03)	7.65
Household's total yearly income	178013.80	206842.00	-28828.20	0.18	(-1.34)	180244.50
Land amount owned by household in 2011 (decimal)	92.87	94.00	-1.13	0.93	(-0.08)	92.96
Log of total income of household	11.69	11.70	-0.01	0.89	(-0.14)	11.69
Log of total land owned by household	3.30	3.52	-0.22	0.16	(-1.40)	3.32
District wise bank branches in 2011	209.35	193.34	16.01	0.25	-1.2	208.11

Notes: *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively.
Source: Author's calculation from BIHS Second Round Survey 2015.

Table 4.6 shows that migrant households have more female headship (50 per cent) compared to non-migrant households (13.28 per cent), supporting the existing literature. Age (40.9 years) and primary education attainment level (58 per cent) of household heads in migrant households are higher than non-migrant households, which stand at 39.84 years and 43 per cent, respectively, although the differences are not significant. Migrant household's endowments, such as land amount holding (94 decimals) in the year 2011 and household total yearly income (2,06,842.00 BDT), are higher compared to non-migrant households (92.87 decimals and 1,78,013.80), respectively. However, the differences are not significant in the t-test. We found significant differences between migrant and non-migrant households in these variables: mother's age, mother's age at marriage, household head is female, household has a sanitary latrine, and household head has primary education.

In Table 4.7, we present the mean values between non-migrant households and international migrant households. The difference in nutritional indicators is a bit higher compared to the previous table (Table 4.6). We see that the WAZ score and the HAZ score are lower in houses with international migrant members, reflecting lower underweight and stunting rates of children in those households.

Table 4.7: Mean Values of Main Variables by Household Migration Status for Children under Five Years of Age (Non-migrant and International Migrant Households)

Variables	Households with no migrant members	Households with international migrant members	Difference in mean values	p-value	t-statistic	Combined mean
Weight for age z score (WAZ)	-1.50	-1.36	-0.1	0.37	(-0.89)	-1.50
Weight for height z score (WHZ)	-0.99	-1.12	0.1	0.49	-0.7	-0.99
Height for age z score (HAZ)	-1.44	-1.04	-0.4	0.05	(-1.93)	-1.43
Gender of child: male 0, female1	0.46	0.49	0.0	0.73	(-0.35)	0.47
Child age in months	29.52	29.00	0.5	0.83	-0.21	29.50
Child age in months square	1166.90	1113.49	53.4	0.72	-0.36	1165.41
Age of the mother	26.69	26.43	0.3	0.71	-0.37	26.68
Height of the mother (cm)	150.96	152.04	-1.1	0.19	(-1.31)	150.99
Weight of the mother (kg)	48.16	49.60	-1.4	0.27	(-1.10)	48.20
Mother's age at marriage	17.61	17.12	0.5	0.21	-1.26	17.60
Years of education of the mother	5.31	5.78	-0.5	0.35	(-0.93)	5.32
Household head is female	0.13	0.71	-0.576***	0.00	(-11.45)	0.15
Birth order of the child	2.34	2.45	-0.1	0.58	(-0.55)	2.34
Number of children below 15 years of age in household	2.44	2.53	-0.1	0.60	(-0.53)	2.44
Number of adults above 15 years of age in household	2.88	2.47	0.4	0.06	-1.9	2.86
Household has sanitary latrine	0.44	0.39	0.0	0.49	-0.68	0.44

(Contd. Table 4.7)

Variables	Households with no migrant members	Households with international migrant members	Difference in mean values	p-value	t-statistic	Combined mean
Household disposes garbage in a systematic way	0.30	0.27	0.0	0.61	-0.51	0.30
Distance of household to nearest town	8.97	8.87	0.1	0.94	-0.08	8.96
Age of household head	39.84	38.77	1.1	0.58	-0.56	39.81
Age of household head square	1753.51	1775.02	-21.5	0.91	(-0.12)	1754.10
Household gead has primary education	0.43	0.55	-0.1	0.09	(-1.72)	0.43
Household head has secondary education	0.09	0.06	0.0	0.47	-0.72	0.09
District wise sex ratio in 2011 (share male/female)	98.57	99.14	-0.6	0.38	(-0.87)	98.59
Percentage of international migrant households by district 2011	8.61	11.93	-3.318**	0.00	(-3.17)	8.71
Percentage of elderly persons in district population 2011	7.64	7.71	-0.1	0.67	(-0.42)	7.64
Households total yearly income	178013.80	148416.60	29597.2	0.37	-0.9	177187.00
Land amount owned by household in 2011 (decimal)	92.87	104.91	-12.0	0.59	(-0.53)	93.21
Log of total income of household	11.69	11.60	0.1	0.51	-0.66	11.69
Log of total land owned by household	3.30	3.77	-0.5	0.07	(-1.78)	3.31
District wise bank branches in 2011	209.35	200.37	9.0	0.69	-0.39	209.10

Notes: *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively.
Source: Author's calculation from BIHS Second Round Survey 2015.

In Table 4.7, we can see that the average height, weight, and years of education of the mother in an international migrant household (152.04 cm, 49.6 kg, and 5.78 years) are slightly higher than a mother living in a non-migrant household (150.96 cm, 48.16 kg, and 5.31years). In international migrant households, female headship is about 71 per cent compared to 13 per cent in non-migrant households, and the difference is significant at a 1 per cent level. In our dataset, households with no migrant members dwell in districts where the percentage of international migrant households is, on average, lower by 3.32 percentage point (significant at 1 per cent level) than households with international migrant members, according to district statistics 2011 (Population and Housing Census).

4.2 Estimation Strategy

To estimate the effect of various determining factors on a child's nutritional status Y, one may proceed by estimating the following equation:

$$Y_i = \alpha + \beta * Migration_i + \gamma * X_i + \delta * F_i + \Omega * K_i + \varepsilon_i \quad (1)$$

where Y measures height-for-age z-scores (HAZ), and weight-for-age z-scores (WAZ) for children under five years of age. Migration measures the migration status of the household level, whether households have international migrant members, internal migrant members, or non-migrant members. The migration variable was introduced in two forms as binary variables. As a measure of household-level migration, we use the variable 'migrant households' vs 'non-migrant households' which takes value 1 if the household has any member who was a member of the household in the past five years and currently a migrant (living away for six months or more) either within the country or abroad (both internal and international migration) and 0 otherwise, i.e., households which members did not migrate at all. The other variable is 'international migrant households' vs 'non-migrant households; which assumes value 1 for only international migration (if any member of the households chose international migration) and 0 for those households whose members did not migrate.

X_i denotes a vector of demographic characteristics of the child (gender, age in months, and age in months squared, birth order of the child) and the mother (height, age, education, and age of mother's first marriage). F_i describes household characteristics like education and gender of the household head, the size of the household, number of adults in the household, household access to facilities, location of regions, income, and land owned by the household in 2011. Other regional variables, K_i, also included district-wise sex ratio in 2011 (share male/female), district-wise bank branches in 2011, percentage share of international migrant households in total households by districts in 2011, and percentage share of elderly persons in the district population in 2011. Most of these variables are standard for models of this type and are clearly related to commonly accepted conceptual frameworks for nutrition analysis (Deb & Seck, 2009; Antón, 2010; Azzarri & Zezza, 2011; Davis & Brazil, 2016; Osmani et al., 2016).

A HAZ score (height-for-age z-scores) lower than -2 indicates that a child is stunted (an indicator of long-term malnutrition). In contrast, a score lower than -3 is generally used to identify severe stunting. A WAZ score (weight-for-age z scores) lower than -2 indicates that a child is underweight. A score lower than -3 is generally used to identify a severe underweight case reflecting the combined effect of chronic and acute malnutrition.

This study utilised anthropometric information on children under five (Module W2) for 1,903 children under five years of age. Later, we had to exclude 66 children who were not measured appropriately as their height-for-age z-score and weight-for-age z–score values scored higher than 6 or lower than -6 in the dataset (which are outside the plausible range for this indicator). Also, some observations were dropped because of incomplete information, ending up with a final sample of 1,848 children.

In our sample, 34.84 per cent of children under five (644 children) are stunted, and 10.55 per cent are severely stunted (195 children). In addition, in our sample, 32.73 per cent of children under five (605) are underweight, and 7.79 per cent are severely underweight (144), which is similar to the national statistics (Figure 2.1).

4.2.1 Dealing with Endogeneity

The fact that the independent variable 'migration' may be influenced by unobservable household factors is a significant consideration when attempting to capture the empirical relationship between nutrition and migration (Azzarri & Zezza, 2011; Davis & Brazil, 2016). It means that factors or characteristics that affect 'the decision of migration' can also be related to the nutrition outcome of children under five years of age in this case and may be included in the error term. Thus, the issue of endogeneity arises. As a result, an ordinary least squares (OLS) estimation of Eq. (1) is likely to be biased, and it will be difficult to establish causality because of endogeneity.

McKenzie and Sasin (2007) mentioned three sources of endogeneity in migration-related research works: i) reverse causality (an outcome that influences migration and nutrition at the same time, ii) selection bias (migrants might be self-select, which makes them different from non-migrant inherently) and iii) omitted variable bias (unobservable characteristics of self-selection, for example, "crop failure" that could affect nutrition as income of households reduce and also cause migration at the same time).

The instrumental variables (IV) technique appears to be effective one in dealing with the presence of endogeneity in this study. Since we used the 2015 BIHS second-round survey data in this study, a cross-sectional dataset, IV estimation strategies performed well in this particular case (McKenzie & Sasin, 2007).

In the instrumental variable approach, the suspected endogenous variable – Migration (in our case, 'migration' indicates the combination of households with both internal and international migrants and 'international migration' indicates only households with international migrants) – is 'instrumented' by isolating the movements in migration that are uncorrelated with the nutritional outcome of children under five years of age, using variables or linear combination of variables, Zi that predicts past migration but has no impact on the outcome variable, nutrition (equation 2).

For the single endogenous regressor 'migration', the two-stage least square (2SLS) technique is applied to the OLS model to deal with the biased estimation of β McKenzie and Sasin (2007), Azzarri and Zezza (2011), and Kurt Schmidheiny's (2019) guidelines. The 2SLS model for the study is:

$$M_i^* = \alpha_1 + \beta_1 * Z_i(instrument) + \gamma_1 * X_i + \partial_1 * F_i + \Omega_1 * K_i + u_1$$

(First-stage equation) (2)

$$Y_i = \alpha_i + \beta_i * M_i^* + \gamma_i * X_i + \partial_i * F_i + \Omega_i * K_i + v_i$$

(Second stage equation where M_i^* is predicted from first stage equation) (3)

where i = 1, . . . , n, , X_i, F_i, K_i are vectors of exogenous variables, Z_i is a vector of instruments that satisfy the requirements of instrumental exogeneity, and relevance, γ ,∂ and Ω are vectors of structural parameters. The model is jointly estimated and is derived under the assumption that u_1 and v_i are independently and identically distributed multivariate normal for all observations (Azzarri & Zezza, 2011).

As stated earlier, instruments need to satisfy two conditions: instrumental relevance (valid instruments are highly correlated with the endogenous regressors even after controlling for the exogenous regressors) and instrumental exogeneity (valid instruments are uncorrelated with the error term) (Schmidheiny, 2019). The IV method requires appropriate instruments that affect the intervention in question (migration in rural households) but not the outcomes of interest (nutrition) for obtaining unbiased estimates of impacts. However, finding suitable instruments (also for migration) is challenging as it varies across different countries and settings (Hossain, Yoshino, & Taghizadeh-Hesary, 2021). Azzari and Zezza (2011) chose two instruments, i) the share of males/females of age 20–39 migration at the district level and ii) measuring the number of households speaking Russian as the second language at the PSU level for establishing the relationship between migration and the nutritional outcome of the children. Davis and Brazil (2016) used the cost of living adjusted average wage rate for non-skilled workers in US migration destinations as their instrument. The logic behind choosing these instruments involves that migration networks and US destination wage rates affect a father's decision to migrate and each household's remittance level; however, it cannot independently affect the nutrition status of children. Osmani et al., (2016) used the network effect as an instrument for remittance in the Bangladeshi context, as the network '*strongly impact the propensity to work abroad*'.

Antón (2010) also used social networks and the available number of Western Union (money transfer) offices at the province level in Ecuador as instruments. He used the proportion of households with migrants in 2003 by the province as a proxy for the existence of the social network abroad and quoted the works of Acosta (2006); Acosta, Fajnzylber, and Lopez (2007); Amuedo-Dorantes, Pozo, and Sainz (2007, as cited in Antón, 2010), and Pffeifer and Taylor (2007) (as cited in Antón, 2010) to establish the presence of migrants from the same community in a foreign country as a network effect. On the other hand, Mu and de Brauw (2015) used the interaction terms between wage growth by gender in provincial capital cities and initial village migrant networks as instrumental variables to account for parental migration selection in China. Niimi and Özden (Chapter 3 in Fajnzylber & López (eds), 2008) used three migration instruments, the passport costs as a share of GDP per capita, the dependency ratio, i.e., the ratio of dependents to the working-age population, and the population density in each country, on their detailed study on the effect of remittance in Latin America.

After exploring the vast literature on migration and nutritional outcomes, this study used district-wise sex ratio in 2011 (share of male/female) as an instrument for 'migration' (both

internal and international migration against no migration) and two instruments for international migration; i) district wise sex ratio in 2011 and ii) the percentage of the international migrant households at districts in our study.

Female migrant workers from Bangladesh still constitute a negligible proportion of the total international migration, although the annual trend has risen consistently since 2000 (Siddiqui et al., 2018; BMET, 2019). In the study 'Impact of Migration on Poverty and Growth of Bangladesh' in 2018 by Siddiqui et al. (2018), the authors clearly stated that "*those households who have more male members have a higher chance of participating in the international or internal migrant labour markets*" (p.36). Hence, the sex of the household members plays a crucial role in migration decisions. It justifies the use of 'sex ratio' as an instrumental variable for instrumenting 'migration' because a district with a higher proportion of male over female affect migration decision; furthermore, the sex ratio at the district level should not impact the nutrition level of children (Headey et al., 2015). In explaining the rapid reduction of undernutrition in Bangladesh, the study by Headey et al. (2015) didn't find the sex ratio as an indicator of nutrition determinants. Therefore, using district wise sex ratio in 2011(share male/female) as an instrument in this study has merits from the above discussions (Azzari & Zezza, 2011). We used an additional instrumental variable, the percentage share of international migrant households in districts, to instrument 'international migration'.

Earlier studies by Osmani et al. (2016) and Antón (2010) suggested that the presence of migrants from the same community or villages in a foreign country lowers the costs of going abroad from the local community. Moreover, it influences the inclination and ability of household members to work abroad. Hence, the percentage share of international migrant households in districts is a valid proxy for 'social network' that influences the propensity to work abroad from the communities, which qualifies its relevance as an instrument.

In this study, we used 'sex ratio' and 'the share of international migrant households in total households by districts' as our two instruments, as these two can influence the decision of international migration but cannot affect the anthropometric or nutritional indicators of children in those households. Instrumental relevance in the present context implies that the variation in the instrument is related to the variation in the migration. In addition, it must satisfy the exclusion restriction, i.e., the instrument must be uncorrelated with the nutritional outcome of children. The instruments utilised in this study pass the statistical tests of validity. The lower panel of each table reported in Chapter 5 (Table 5.1 to Table 5.8 except Table 5.7, which reports first stage regression) showed various diagnostic tests for validating the results presented in this study. In cases when we have used more than one instrument, we performed Sargan-Hansen J statistic for testing over-identifying restrictions. Also, in order to check the relevance of the instruments: F statistic for weak identification, Kleibergen-Paap rk LM statistic, Anderson canon. corr. LM statistic, Cragg-Donald Wald F statistic, Kleibergen-Paap Wald rk F statistic, and Endogeneity test of regressors (χ^2) are performed. Thus, the instruments satisfy the characteristics expected of valid exclusion restrictions; that is, they are good predictors of household migration but do not directly influence child malnutrition other than via migration.

CHAPTER 5
RESULTS

The regression results show a positive effect of both migration and international migration on children's nutrition indicators for HAZ (stunting) and WAZ (wasting) scores. The regression results support the positive impact of international migration on reducing stunting and wasting in children. Although the magnitude varies across specifications, the sign and significance of the main variables remain the same.

In this study, five methods were applied to check for the robustness of results involving the effect of migration on the nutrition condition of children in rural households of Bangladesh.

i. Method 1 (OLS): The OLS is presented as the first method where the dependent variable is children's nutritional status measured by HAZ (stunting) and WAZ (underweight), which depend on the migration status of rural households (migrant households/international migrant households=1, non-migrant households/no internal migrant households=0) and other independent variables like the characteristics of the mothers of the children, household's status, and other community characteristics. However, like other coefficient estimates by the OLS, the coefficient of migration 'β' is also biased here because of the potential endogeneity problem since the decision of 'migration' may depend on households' characteristics that also affect the nutrition condition of children in those households.

ii. Method 2: In the second column, we used the IV 2SLS (two-stage least square) technique where district wise sex ratio (share male/female) in 2011 is used as the sole instrument for 'migration' (combination of both internal and international migration) to deal with the problem of endogeneity and satisfies the two conditions, namely instrumental relevance and instrumental exogeneity.

iii. Method 3: In the third column, IV 2SLS (two-stage least square) technique is used with the same instrument [district wise sex ratio in 2011]. However, in order to account for the correlation of nutrition status between children within rural households based on migration, we clustered standard errors at the union level since the number of migrant households varies depending on the households' location and is heterogeneous in nature.

iv. Method 4: In the fourth column, we used IV Probit 2SLS technique using district wise sex ratio as here 'migration status of rural households' is an observed binary variable. Moreover, according to Mckenzie and Sasin (2007), both 'instrumental variable (IV) regression' and 'IV Probit procedures' yield similar results, although the latter addresses some additional biases. According to Bontemps and Nauges (2017), the IV Probit estimates are virtually unbiased for sample sizes of 500 and 1,000. Since the sample size in this survey is large for this study (1903 households), using IV Probit 2SLS fits well because of the binary dependent variable and endogenous regressors. It also showed robustness in establishing the relationship between migration and children's nutritional status.

v. Method 5: In the final and fifth Models, we used IV 2SLS with the same instrument but used non-robust standard error (SE) for the model. Unless stated, all of these methods used robust standard errors to tackle for heterogeneity. Closer inspection reveals that model 2 and model 5 yield the same coefficients but differ in the standard errors. The reason for using robust standard errors in model 2 and simply (non-robust) standard errors in Model 5 is to inspect whether the significance of the variables changes across the models. However, to increase the efficiency of the result, the last model used normal standard errors as Croux, Dhaene, and Hoorelbeke (2004) stated that, "if autocorrelation and heteroscedasticity are absent, non-robust standard errors are more efficient than the robust standard errors" (p.1).

The analysis done on these five models is presented in 9 tables (Table 5.1 to Table 5.9) in the following sections. Before discussing the results, it is important to explain the models described in those tables. Also, in our original research proposal, we wanted to measure the impact of migration on rural households on the three nutritional indicators WAZ (underweight), HAZ (stunting), and WHZ (wasting). However, after we ran the regression analysis using STATA/SE 14.1, it was observed that wasting or WHZ (weight-for-height-z score) had no significant change between non-migrant, international migrant or migrant households' children under five years of age. One possible explanation for this is that 'wasting' is usually the result of inadequate nutrient intake or disease. Its prevalence may shift seasonally in response to changes in the availability of food and disease prevalence (MICS, 2019). Also, the wasting rate in Bangladesh has remained constant at a national average of 11 per cent (Figure 2.1) from 2012 to 2015. That is why we could not find any significant impact of it due to migration.

So, the results in this section are presented in the following format:

a) From Table 5.1 to Table 5.3, the impact of migration (both internal and international migrant households combined) on the nutritional outcome of children compared to the non-migrant households is shown by HAZ (Height-for-age z scores) or stunting, then WAZ (Weight-for-age z scores) or underweight by using OLS and IV (2SLS) models where Table 5.3 reports the First Stage regression results of the IV models.

b) From Table 5.4 to Table 5.6, the impact of international migration on the nutritional outcome of children compared to the children of non-migrant households is shown by HAZ (Height-for-age z scores) or stunting, then WAZ (Weight-for-age z scores) or underweight by using OLS and IV (2SLS) models where Table 5.6 reports the First Stage regression results of the IV models.

c) From Table 5.1 to 5.6 for the IV models, the instrument was the same, 'District wise Sex Ratio in 2011(share male/female)'. However, from Table 5.7 to 5.9, we presented the impact of international migration on children's nutritional indictor of HAZ (Height-for-age z scores) [in Table 5.7] or stunting, then WAZ (Weight-for-age z scores) [in Table 5.8] using two instruments: sex ratio in districts in 2011 and international migrant households in districts in 2011. Here table 5.9 reports the First stage regression results for the IV models.

5.1 Econometric Results

Estimation results for HAZ and WAZ are presented in Tables 5.1 and 5.2 for the combined impact of migration and in Tables 5.4 and 5.5 for the impact of international migration consecutively and commented in detail below.

5.1.1 Regression Results of Combined Effect of Migration (Both Internal and International) on Children's Nutritional Indicators of HAZ Score and WAZ Score

First, OLS and IV estimates for HAZ, the long-term indicator of nutritional deprivation, are presented in Table 5.1. According to OLS estimates, migration (internal and international combined) has no significant effect on children's nutritional status in those households. However, child age in months, Child age in months (squared), height and weight of the mother, years of education of the mother, household size, female headship of the households, and having sanitary latrine in the households are found statistically significant for the HAZ score. For example, an additional height of the mother by 1 cm results in an increase of 0.0415 SD in the z-score and an additional weight of the mother by 1 kg can increase 0.0094 SD in the z-score. This result is supported by the study of Das and Gulshan (2017) on children under five in Bangladesh, where they found that the factors significantly associated with stunting include: age of child, place of residence, division, father's education, mother's education, father's

occupation, mother's occupation, mother's BMI, wealth index, toilet facility, number of living children and birth order. Moreover, Islam, Khan and Mondal's study (2018) on 23,042 left-behind children under five years of age because of parental migration also claimed that household's wealth status and maternal educational status significantly influence the nutritional development of the children. Usage of sanitary latrine declined the stunting rate among children in Bangladesh (Headey et al. 2015; Nisbett et al. 2017, p.24), which is found significant in our study too.

The most surprising outcome of this study is that although the mother's education, height, and weight contribute to improving the z score of HAZ, the coefficient of female headship in the household is negative and significant. One possible explanation is that the mean age of male heads in our sample is 40.78 years, whereas the mean age of female heads is 35.37 years. So, male-headed households are more experienced, and also their level of secondary and higher education (9 percentages in total for secondary education and one percentage in higher education) is much higher than female head households (4 percentages in total has secondary education and zero percentage in higher education). Therefore, female headship might not bring the positive outcome that was expected in improving the nutritional indicators of children.

Table 5a: Summary of the Stunting and Underweight in the Current Dataset

Range of the z scores	HAZ (Height-for-age z scores)/ Stunting				WAZ (Weight-for-age z scores)/ Underweight			
	Households with no migrant members	Households with international migrant member	Households with at least one migrant member	Combined	Households with no migrant members	Households with international migrant member	Households with at least one migrant member	Combined
z score>2	30	0	2	32	6	1	1	7
0≤ z score≤2	201	16	26	227	134	5	10	144
-2≤ z score<0	885	15	60	945	1004	30	88	1092
-3≤ z score<-2	412	15	37	449	434	8	27	461
z score<-3	177	3	18	195	127	5	17	144
Total observations of children	1705	49	143	1848	1705	49	143	1848

Table 5a shows that out of total 1,848 children measured for calculating nutrition indicators, 644 (449+195) were stunted (HAZ score less than -2), and 195 children were severely stunted (HAZ score less than -3); 605 were underweight (WAZ score less than -2) and 144 children were chronic underweight (WAZ score less than -3) in our dataset (from total 1903 children, measurements of 55 children were not included in the main analysis as the z score was unrealistic like <-6 and >6, and missing values of important variables like mother's height and weight were observed).

All the IV estimates show a positive impact of migration in improving the z score of the HAZ (lowering stunting rate) in children by 2.21 SD for Model 2 and 5, by 1.46 SD for the

IV Probit 2SLS model (model 4), and by 2.05 SD for Model 3, the IV 2SLS clustered within unions. Hence, it is conspicuous that for all the IV 2SLS specifications, migration increases the z score of the HAZ (lowers the stunting rate), ranging from 1.46 SD to 2.2 SD, and the estimates are significant. In percentage, we found that stunting rate of children in non-migrant households' is 31.87 per cent (412+177=589/1848*100) and underweight rate is 30.35 per cent (434+127=561/1848*100). Contrarily, the stunting rate in households with migrant members (both internal or international migrant members from the household) is 2.97 per cent (37+18=55/1848*100), and underweight is 2.38 per cent (27+17=44/1848*100) in the total dataset. The stunting rate of children living in international migrant households is 0.97 per cent (15+3=18/1848*100), and underweight rate is 0.70 per cent (8+5=13/1848*100) in the total dataset."

The post-estimation statistics to check the strength of the instruments like: F-test of the excluding IVs in the first stage, F statistic for weak identification, and F-test of joint significance of the instruments; all of these values are well above 10 that are presented at the end of table 5.1. Hence, according to the rule of thumb indicated in the literature by Staiger and Stock (1997), we reject the hypothesis that the instrument is weak. The Cragg-Donald Wald F statistic and Kleibergen-Paap rk F statistic examine the identification of the equation as a whole. This shows that the instrument, 'District wise Sex Ratio in 2011 (share male/female)', is significant to the endogenous variable, migration (internal and international migration combined, suggesting that the instrument is relevant (Schmidheiny, 2019). Anderson canon. corr. LM statistic checks for the under-identification of the equation. The null hypothesis is that equation (2) is under-identified when we reject the null hypothesis, which means that equation is not under identified (Baum, Schaffer, & Stillman, 2007, p.486). Our result for this statistic, 17.534 (p value 0.000), suggests that we can reject the null hypothesis and that our IV model 5 is not under identified. In Model 2 and Model 3, where we used IV to estimate the impact of migration on nutrition, Kleibergen-Paap rk LM statistic (p-value) for under identification was done to check the fully robust testing. According to Baum, Schaffer, & Stillman (2007, p.486), Kleibergen–Paap rk statistic is more appropriate when using robust standard errors in all regressions, as it generalises the Cragg-Donald statistic to the case of non-i.i.d. errors, allowing for heteroskedasticity, autocorrelation, and cluster robust statistics.

This also suggests that the IV models used in the study are not under identified. Furthermore, the Sargan-Hansen J stats results in the second stage regression reject the null hypothesis that instrument is properly excluded. Thus, from both statistical and logical grounds, we can claim that district level sex ratio is a valid instrument.

Moreover, results of the Endogeneity test of regressors (χ^2) suggest that the independent variable 'migration' is actually an endogenous variable. Thus, the OLS estimate is biased and using IV methods was the best possible solution to deal with this biasness.

Table 5.1: Regression Estimates Specifying the Impact of Migration

(Both Internal & International Combined) On Children Nutritional Status of HAZ (Height-for-age z scores) or Indication of Stunting [Instrument: District wise Sex Ratio in 2011(share male/female)]

Variables	(Model- 1) OLS regression	(Model- 2) IV (2SLS)	(Model- 3) IV (2SLS) (clustered within unions)	(Model- 4) IV Probit 2SLS	Model- (5) IV (2SLS) (non-robust SE)
Migrant and non-Migrant households :1 migrant;	0.128	2.218*	2.045*	1.461***	2.218*
0 non-migrant	(0.144)	(1.199)	(1.113)	(0.496)	(1.323)
Gender of child: male 0; female1	0.0487	0.0244	0.0296	0.0274	0.0244
	(0.0610)	(0.0671)	(0.0743)	(0.0630)	(0.0675)
Child age in months	-0.107***	-0.110***	-0.110***	-0.109***	-0.110***
	(0.00788)	(0.00837)	(0.00846)	(0.00803)	(0.00799)
Child age in months (squared)	0.00136***	0.00141***	0.00141***	0.00140***	0.00141***
	(0.000120)	(0.000129)	(0.000129)	(0.000123)	(0.000130)
Age of the mother	0.00531	0.0121	0.0125	0.0102	0.0121
	(0.00711)	(0.00844)	(0.00848)	(0.00757)	(0.00856)
Height of the mother (cm)	0.0415***	0.0395***	0.0398***	0.0398***	0.0395***
	(0.00655)	(0.00709)	(0.00793)	(0.00675)	(0.00658)
Weight of the mother (kg)	0.00947**	0.0119**	0.0104**	0.0120***	0.0119***
	(0.00416)	(0.00474)	(0.00464)	(0.00427)	(0.00457)
Mother's age at marriage	-0.00180	0.00972	0.00763	0.00545	0.00972
	(0.0113)	(0.0137)	(0.0127)	(0.0119)	(0.0144)
Years of education of the mother	0.0416***	0.0422***	0.0359***	0.0443***	0.0422***
	(0.0107)	(0.0114)	(0.0118)	(0.0109)	(0.0115)
Household Head is female	-0.0512	-0.492*	-0.395	-0.323**	-0.492*
	(0.0885)	(0.270)	(0.249)	(0.137)	(0.294)
Size of the Household	-0.0180	-0.0528**	-0.0694***	-0.0378**	-0.0528**
	(0.0134)	(0.0241)	(0.0257)	(0.0151)	(0.0263)
Household has sanitary latrine	0.126*	0.224**	0.200**	0.193***	0.224**
	(0.0654)	(0.0910)	(0.0943)	(0.0695)	(0.0933)
Household disposes garbage in a systematic way	-0.0461	0.0106		-0.0100	0.0106
	(0.0679)	(0.0789)		(0.0708)	(0.0815)
Percentage of elderly persons in districts population 2011	-0.0212	-0.0328	-0.0274	-0.0200	-0.0328
	(0.0277)	(0.0297)	(0.0328)	(0.0281)	(0.0325)
Percentage of poverty rate by districts in 2011	0.000908	0.00547	0.00486	0.00397	0.00547
	(0.00256)	(0.00390)	(0.00350)	(0.00292)	(0.00405)
Distance of household to nearest town	-0.00372	-0.00488	-0.00513	-0.00446	-0.00488
	(0.00335)	(0.00379)	(0.00369)	(0.00355)	(0.00402)
Literacy status of Household head	0.0218	-0.00780	-0.00499	0.00206	-0.00780
	(0.0279)	(0.0347)	(0.0389)	(0.0297)	(0.0349)
Whether the mother of the child was lactating	0.105	0.0831	0.0774	0.0827	0.0831
	(0.0706)	(0.0749)	(0.0743)	(0.0716)	(0.0788)
Households access to electricity	0.00665	-0.0447		-0.0173	-0.0447
	(0.0666)	(0.0770)		(0.0705)	(0.0800)
Log of total income of household	-0.0182	-0.0219	-0.0228	-0.0238	-0.0219
	(0.0338)	(0.0372)	(0.0372)	(0.0353)	(0.0360)
Poor Housing	-0.171	-0.256			-0.256
	(0.188)	(0.216)			(0.210)
Average Housing	-0.0361	-0.0832			-0.0832
	(0.176)	(0.198)			(0.195)
Good Housing	0.0167	-0.0114			-0.0114
	(0.200)	(0.220)			(0.219)
District wise bank branches in 2011	0.000113	0.000317	0.000245	0.000225	0.000317
	(0.000189)	(0.000243)	(0.000257)	(0.000201)	(0.000259)
Constant	-6.659***	-6.604***		-6.745***	-6.604***
	(1.091)	(1.177)		(1.122)	(1.091)
Observations	1,759	1,759	1,759	1,759	1,759
R-squared	0.225	0.097	0.102	0.171	0.097

(Contd. Table 5.1)

Variables	(Model- 1) OLS regression	(Model- 2) IV (2SLS)	(Model- 3) IV (2SLS) (clustered within unions)	(Model- 4) IV Probit 2SLS	Model- (5) IV (2SLS) (non-robust SE)
F-test	17.44***			19.44***	
F-test of excluding IVs		13.77***	10.05***		17.46***
(p-value)		(0.000)	(0.001)		(0.000)
F statistic for weak identification		13.77***	10.05***		17.46***
Kleibergen-Paap rk LM statistic (p-value)		12.93***	7.31***		
		(0.000)	(0.007)		
Anderson canon. corr. LM statistic (p-value)					17.534***
					(0.000)
Cragg-Donald Wald F statistic		17.46	21.43		17.46
		(Less than 10%)	(Less than 10%)		(Less than 10%)
Kleibergen-Paap Wald rk F statistic		13.77	10.05		
		(10-15%)	(10-15%)		
Sargan-Hansen J statistic		0.000	0.000		0.000
		(Exactly identified)	(Exactly identified)		(Exactly identified)
Endogeneity test of regressors (χ^2)		3.613**	2.804*		2.935*
		(0.057)	(0.094)		(0.086)

Notes: 1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. Hence, IV specification for both Column 2 and Column 5 are similar; however, in column 2 we have used robust standard error, and in column 5 we used normal standard error. 3) Over identification test of all instruments (Sargan-Hansen J-stat being 0.000) shows that equation is exactly identified since only one instrument is used.

Table 5.2 shows that having a migrant member in households (both internal or international) increases the Weight-for-age z scores or WAZ of children in those families. However, OLS estimates (Model-1) show the opposite result as the sign of the coefficient is negative in this case. Since the OLS yields a biased estimate of the coefficients in the presence of endogenous regressors, this study will focus on the IV results, which are valid. All the IV specifications (models 2 to 5) report a positive association between having a migrant family member and improved wasting status of children in those households.

Moreover, more variables in our models have a significant effect on underweight (WAZ) compared to stunting (HAZ) rate in children. In table 5.1, we see that variables Child age in months, Child age in months (squared), height and weight of the mother, years of education of the mother, size of the household, whether household head is female, and whether household has sanitary latrine, all these variables are statistically significant in improving the HAZ score, which is also true for WAZ score in children too. Besides other variables like percentage of poverty rate in districts, literacy rate of household heads, and the housing condition of the households measured by Cashpor Index (poor housing condition if the index is 2, average housing condition if the index is 3, and good housing condition of the index is 4) also have significant effects on wasting status among children.

Models 2, 4, and 5 presented in table 5.2 show that female children have, on average, lower WAZ (weight) compared to male children. Also, female headship, increasing household size, lower literacy rate of the household heads, and poor housing conditions of the household decline or negatively affect the weight for age z score. On the other hand, children's age in months, height, weight and years of education of the mother, access of household to a sanitary latrine, lower poverty rate in the districts where household lives are significantly and positively

related with the weight for age z scores (WAZ) of children. The crucial point involves having a migrant member in the household, on average, increases the WAZ score of children by 2.55 SD in Model 2, 2.22 SD in Model 3, 2.55 SD in Model 5 and only 0.96 SD in model 4 in the rural households of Bangladesh. Across these models, the salient feature is that though the magnitude of the WAZ score ranges from 0.96 to 2.55, the sign (positive) remains the same across the model specifications.

Similar to Table 5.1, we also performed the post-estimation tests for instrumental relevance and exogeneity for the instrument 'District wise Sex Ratio in 2011(share male/female)' for Table 5.2 to confirm the nexus between WAZ score and migration status. The interpretation of the post-estimation statistic follows from table 5.1. The test results reported at the end of table 5.2 suggest that our included instrument fulfils the conditions of instrumental relevance (F-test of the excluding IVs in the first stage, F statistic for weak identification, the Cragg-Donald Wald F statistic, and Kleibergen-Paap rk F statistic) and exogeneity (Sargan-Hansen J statistic), as they are good predictors of the endogenous regressor (migration) while not being related to the outcome variables (WAZ score or nutrition), not even through unobserved characteristics that would influence the nutritional status of children in those households. Also, Kleibergen-Paap rk LM statistic (p-value) and Anderson canon. corr. LM statistic (p-value) for Model 2, Model 3 and Model 5 respectively suggest that these models are not under identified. For Model 4 (IV Probit 2 SLS), the F-test of overall significance shows that these linear regression models provide a better fit to the data. Endogeneity test of regressors (χ^2) confirms that 'migration' is indeed affected with the endogeneity problem.

Table 5.2: Regression Estimates Specifying the Impact of Migration

(Both Internal & International Combined) on Children Nutritional Status of WAZ (Weight-for-age z scores) or Indication of Underweight

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 3) IV (2SLS) clustered within unions Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female) non-robust SE
Migrant and non-Migrant households: 1 migrant; 0 non-migrant	-0.0608	2.551**	2.224**	0.955**	2.551**
	(0.101)	(1.137)	(0.916)	(0.408)	(1.117)
Gender of child: male 0; female1	-0.0724	-0.103*	-0.0952	-0.0914*	-0.103*
	(0.0462)	(0.0563)	(0.0589)	(0.0480)	(0.0570)
Child age in months	-0.0468***	-0.0503***	-0.0500***	-0.0487***	-0.0503***
	(0.00568)	(0.00664)	(0.00665)	(0.00584)	(0.00675)
Child age in months (squared)	0.000519***	0.000580***	0.000576***	0.000554***	0.000580***
	(8.76e-05)	(0.000105)	(0.000102)	(9.07e-05)	(0.000110)
Age of the mother	-0.00654	0.00198	0.00208	-0.00263	0.00198
	(0.00529)	(0.00722)	(0.00644)	(0.00570)	(0.00723)

(Contd. Table 5.2)

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 3) IV (2SLS) clustered within unions Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female) non-robust SE
Height of the mother (cm)	0.0196***	0.0172***	0.0179***	0.0181***	0.0172***
	(0.00455)	(0.00559)	(0.00567)	(0.00472)	(0.00555)
Weight of the mother (kg)	0.0251***	0.0281***	0.0261***	0.0274***	0.0281***
	(0.00311)	(0.00407)	(0.00402)	(0.00323)	(0.00386)
Mother's age at marriage	-0.00346	0.0109	0.00843	0.00219	0.0109
	(0.00870)	(0.0118)	(0.0114)	(0.00912)	(0.0121)
Years of education of the mother	0.0415***	0.0423***	0.0347***	0.0441***	0.0423***
	(0.00810)	(0.00945)	(0.00993)	(0.00819)	(0.00967)
Household Head is female	0.0571	-0.494*	-0.359*	-0.146	-0.494**
	(0.0653)	(0.253)	(0.205)	(0.106)	(0.248)
Size of the Household	0.00277	-0.0408*	-0.0585***	-0.0122	-0.0408*
	(0.00963)	(0.0226)	(0.0227)	(0.0118)	(0.0222)
Household has sanitary latrine	0.0600	0.183**	0.142*	0.108**	0.183**
	(0.0476)	(0.0807)	(0.0747)	(0.0522)	(0.0788)
Household disposes garbage in a systematic way	-0.0342	0.0366		-0.00854	0.0366
	(0.0505)	(0.0691)		(0.0541)	(0.0688)
Percentage of elderly persons in districts population 2011	-0.00775	-0.0223	-0.0125	-0.00237	-0.0223
	(0.0213)	(0.0269)	(0.0266)	(0.0216)	(0.0274)
Percentage of poverty rate by districts in 2011	0.00309	0.00880**	0.00767**	0.00546**	0.00880**
	(0.00200)	(0.00363)	(0.00309)	(0.00229)	(0.00342)
Distance of household to nearest town	-0.00327	-0.00472	-0.00453	-0.00367	-0.00472
	(0.00280)	(0.00358)	(0.00404)	(0.00306)	(0.00339)
Literacy status of Household head	-0.0212	-0.0582**	-0.0529*	-0.0371*	-0.0582**
	(0.0197)	(0.0296)	(0.0286)	(0.0214)	(0.0295)
Whether the mother of the child was lactating	0.000961	-0.0260	-0.0360	-0.0216	-0.0260
	(0.0534)	(0.0659)	(0.0689)	(0.0556)	(0.0665)
Household's access to electricity	-0.0208	-0.0850		-0.0373	-0.0850
	(0.0505)	(0.0652)		(0.0532)	(0.0675)
Log of total income of household	-0.0193	-0.0239	-0.0242	-0.0255	-0.0239
	(0.0262)	(0.0319)	(0.0297)	(0.0273)	(0.0304)
Poor Housing	-0.384***	-0.490***			-0.490***
	(0.140)	(0.183)			(0.177)
Average Housing	-0.188	-0.247			-0.247
	(0.132)	(0.167)			(0.165)
Good Housing	-0.141	-0.176			-0.176
	(0.150)	(0.188)			(0.185)
District wise bank branches in 2011	-5.50e-06	0.000249	0.000143	6.52e-05	0.000249
	(0.0cash00158)	(0.000236)	(0.000236)	(0.000169)	(0.000219)
Constant	-4.370***	-4.301***		-4.602***	-4.301***
	(0.771)	(0.943)		(0.788)	(0.921)
Observations	1,759	1,759	1,759	1,759	1,759
R-squared	0.211	-0.146	-0.106	0.150	-0.146
F-test	17.67***			18.56***	

(Contd. Table 5.2)

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 3) IV (2SLS) clustered within unions Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female) non-robust SE
F-test of excluding IVs		13.77***	10.05***		17.46***
(p-value)		(0.000)	(0.001)		(0.000)
F statistic for weak identification		13.77***	10.05***		17.46***
Kleibergen-Paap rk LM statistic (p-value)		12.93*** (0.000)	7.31*** (0.007)		
Anderson canon. corr. LM statistic (p-value)					17.534*** (0.000)
Cragg-Donald Wald F statistic		17.46 (Less than 10%)	21.43 (Less than 10%)		17.46 (Less than 10%)
Kleibergen-Paap Wald rk F statistic		13.77 (10-15%)	10.05 (10-15%)		
Sargan-Hansen J statistic		0.000 (exactly identified)	0.000 (exactly identified)		0.000 (exactly identified)
Endogeneity test of regressors (χ^2)		8.451*** (0.003)	6.438*** (0.011)		8.022*** (0.005)

Notes: 1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. Hence, IV specification for both Column 2 and Column 5 are similar; however, in column 2 we have used robust standard error, and in column 5 we used normal standard error. 3) Over identification test of all instruments (Sargan-Hansen J-stat being 0.000) shows that equation is exactly identified since only one instrument is used.

Table 5.3 reports the first-stage IV regression results concerning the determinants of the migration of rural households in Bangladesh. It shows that, as expected, the instrument "District wise Sex Ratio in 2011" has a statistically significant and positive effect on migration within Bangladesh or abroad. The other variables that are positively linked with migration are: female household headship, size of the household, literacy status of household head, households access to electricity, percentage of elderly persons in districts population 2011, and district wise bank branches in 2011. On the other hand, age of the mother, mother's age at marriage, household's access to a sanitary latrine and percentage of poverty rate by districts in 2011, these variables showed negative signs in the first stage regression.

Table 5.3: First-stage Regression Estimates for IV 2SLS Regression Models and Probit 2SLS Regression: Determinants of Migration (Both Internal & International Combined)

Variables	IV 2SLS Regression Models			Probit 2SLS Regression Model
	Model-2	Model-3	Model-5	Model-4
Instrument	0.007***	0.008***	0.007***	0.063***
District wise Sex Ratio	(0.002)	(0.003)	(0.002)	(0.015)
in 2011(share male/female)				
Gender of child: male 0; female1	0.012	0.012	0.012	0.089
	(0.012)	(0.013)	(0.012)	(0.102)
Child age in months	0.001	0.001	0.001	0.008
	(0.001)	(0.001)	(0.001)	(0.012)
Child age in months (squared)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Age of the mother	-0.003**	-0.004**	-0.003**	-0.032***
	(0.001)	(0.002)	(0.001)	(0.012)
Height of the mother (cm)	0.001	0.001	0.001	0.010
	(0.001)	(0.001)	(0.001)	(0.01)
Weight of the mother (kg)	-0.001	-0.001	-0.001*	-0.011*
	(0.001)	(0.001)	(0.001)	(0.007)
Mother's age at marriage	-0.005***	-0.005**	-0.005**	-0.048**
	(0.002)	(0.002)	(0.002)	(0.02)
Years of education	-0.001	0.001	-0.001	-0.003
of the mother	(0.002)	(0.002)	(0.002)	(0.018)
Household Head is female	0.218***	0.201***	0.218***	1.321***
	(0.025)	(0.036)	(0.017)	(0.121)
Size of the Household	0.018***	0.022***	0.018***	0.139***
	(0.003)	(0.005)	(0.003)	(0.02)
Household has sanitary latrine	-0.051***	-0.051***	-0.051***	-0.389***
	(0.012)	(0.015)	(0.013)	(0.111)
Household disposes	-0.023*		-0.023*	-0.217*
garbage in a systematic way	(0.014)		(0.013)	(0.117)
Percentage of elderly persons	0.025***	0.025***	0.025***	0.209***
in districts population 2011	(0.008)	(0.01)	(0.007)	(0.061)
Percentage of poverty rate	-0.002***	-0.002***	-0.002***	-0.016***
by districts in 2011	(0.001)	(0.001)	(0.001)	(0.004)
Distance of household	0.001	0.001	0.001	0.006
to nearest town	(0.001)	(0.001)	(0.001)	(0.006)
Literacy status of	0.015***	0.015**	0.015***	0.123***
Household head	(0.005)	(0.006)	(0.005)	(0.048)
Whether the mother of the	0.013	0.014	0.013	0.114
child was lactating	(0.014)	(0.016)	(0.014)	(0.121)
Household's access to electricity	0.023*		0.023*	0.152
	(0.013)		(0.013)	(0.116)
Log of total income of household	0.001	0.001	0.001	-0.006
	(0.007)	(0.007)	(0.007)	(0.055)
Cashpor index				
2. Poor housing	0.032		0.032	
	(0.033)		(0.037)	
3. Average housing	0.022		0.022	
	(0.029)		(0.035)	
4. Good housing	0.017		0.017	
	(0.036)		(0.039)	
District wise bank branches in 2011	0.000***	0.000**	0.000***	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.911***		-0.911***	-9.704***
	(0.299)		(0.289)	(2.461)

Notes: 1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. Hence, IV specification for both Column 2 and Column 5 are similar, however in column 2 we have used robust standard error, and in column 5 we used normal standard error.

5.1.2 Regression Results of International Migration on Children's Nutritional Indicators of HAZ Score and WAZ Score

In this section, we discuss the effect of having an international migrant as a household member on children's nutritional indicators of HAZ (stunting rate) and WAZ (wasting rate). The previous studies showed mixed results in terms of impact. Azzari and Zezza (2011) concluded that *"living in a household with migrants [in Tajikistan] increases the child z-score by 0.2 standard deviations among the children in the lower part of the HAZ distribution"* (p.66). However, the effect and magnitude of migration on children's nutritional status vary across countries, type of migration, and the situation of the households' decision-making process. Thow et al. (2016) did a systematic review of 20 studies examining the effect of remittance income on food consumption, dietary intake, and nutritional status. It also showed that only three out of 20 studies indicated that remittances reduced underweight (weight for age) among children younger than 5 years of age but had a limited effect on chronic undernutrition (stunting). Only 2 studies, one in El Salvador and the other in Nigeria, found a positive effect on stunting (Thow et al., 2016). Islam et al.'s study (2018) didn't establish a direct relationship between parental migration with children's nutritional status in the Bangladesh context; rather, it concluded that it does not have any negative impact on stunting, wasting and underweight of left-behind children. On the contrary, mother's educational status and household's wealth condition are the significant factors of the nutritional development of children in Bangladesh (Islam et al., 2018; Das & Gulshan, 2017; Headey et al., 2015).

However, the impact of international migration on children's nutritional indicators on HAZ (in Table 5.4) and on WAZ (in Table 5.5) is positive and significant across all the specifications of IV models used in this study. In model 1, the OLS estimates are biased and not significant. The results show that having an international migrant as a household member can increase the HAZ score of the children in the households by roughly 3.8 SD (models 2, 3, and 5) and 2.8 SD for model 4. Like previous studies, years of education, height and weight of the mother, household's access to sanitary latrine, and children's age in months are significant and positively associated with improving the z score of the stunting rate in children (Headey et al. 2015); Al Masud & Hamza, 2018). Remittance income invested in sanitation and education may have had a positive impact, although we couldn't prove any direct relationship between these variables and migration.

Table 5.4: Regression Estimates Specifying the Impact of International Migration on Children Nutritional Status of HAZ (Height-for-Age Z Scores)

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 3) IV (2SLS) clustered within unions Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female) non-robust SE
International migrant and non-migrant households: international migrant 1, non-migrant 0	0.319	3.848**	3.848*	2.865***	3.848**
	(0.220)	(1.912)	(2.037)	(1.007)	(1.912)
Gender of child: male 0; female1	0.0402	0.0313	0.0313	0.0301	0.0313
	(0.0619)	(0.0680)	(0.0736)	(0.0653)	(0.0679)
Child age in months	-0.104***	-0.107***	-0.107***	-0.106***	-0.107***
	(0.00789)	(0.00839)	(0.00871)	(0.00813)	(0.00804)
Child age in months (squared)	0.00134***	0.00138***	0.00138***	0.00138***	0.00138***
	(0.000122)	(0.000131)	(0.000127)	(0.000127)	(0.000132)
Age of the mother	0.00445	0.00887	0.00887	0.00784	0.00887
	(0.00735)	(0.00820)	(0.00849)	(0.00772)	(0.00802)
Height of the mother (cm)	0.0389***	0.0354***	0.0354***	0.0361***	0.0354***
	(0.00672)	(0.00722)	(0.00766)	(0.00692)	(0.00694)
Weight of the mother (kg)	0.0110**	0.0125***	0.0125**	0.0126***	0.0125***
	(0.00433)	(0.00482)	(0.00557)	(0.00450)	(0.00449)
Mother's age at marriage	0.00166	0.00634	0.00634	0.00518	0.00634
	(0.0114)	(0.0128)	(0.0132)	(0.0121)	(0.0130)
Years of education of the mother	0.0420***	0.0456***	0.0456***	0.0457***	0.0456***
	(0.0109)	(0.0117)	(0.0130)	(0.0111)	(0.0119)
Household Head is female	-0.0503	-0.502*	-0.502	-0.372**	-0.502*
	(0.0923)	(0.267)	(0.325)	(0.163)	(0.264)
Size of the Household	-0.0179	-0.0358**	-0.0358***	-0.0295**	-0.0358**
	(0.0133)	(0.0161)	(0.0136)	(0.0142)	(0.0179)
Household has sanitary latrine	0.118*	0.158**	0.158	0.149**	0.158**
	(0.0657)	(0.0737)	(0.0992)	(0.0675)	(0.0753)
Percentage of elderly persons in districts population 2011	-0.0210	-0.0141	-0.0141	-0.0123	-0.0141
	(0.0293)	(0.0324)	(0.0524)	(0.0307)	(0.0344)
Percentage of poverty rate by districts in 2011	0.000454	0.000991	0.000991	0.000882	0.000991
	(0.00273)	(0.00300)	(0.00383)	(0.00287)	(0.00302)
Distance of household to nearest town	-0.00483	-0.00581	-0.00581	-0.00536	-0.00581
	(0.00353)	(0.00377)	(0.00398)	(0.00361)	(0.00415)
Literacy status of Household head	0.0298	0.0118	0.0118	0.0162	0.0118
	(0.0280)	(0.0324)	(0.0348)	(0.0298)	(0.0318)
Household's access to electricity	-0.0410	-0.0670	-0.0670	-0.0550	-0.0670
	(0.0674)	(0.0728)	(0.0679)	(0.0701)	(0.0764)
Log of total income of household	-0.0123	-0.00698	-0.00698	-0.0101	-0.00698
	(0.0351)	(0.0390)	(0.0407)	(0.0374)	(0.0373)
Poor Housing	-0.146	-0.240	-0.240		-0.240
	(0.189)	(0.204)	(0.210)		(0.214)
Average Housing	-0.0636	-0.147	-0.147		-0.147
	(0.177)	(0.190)	(0.179)		(0.202)

(Contd. Table 5.4)

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 3) IV (2SLS) clustered within unions Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female) non-robust SE
Good Housing	-0.0123	-0.0985	-0.0985		-0.0985
	(0.199)	(0.220)	(0.237)		(0.228)
Percentage of international migrant households by district 2011	0.00106	-0.000249	-0.000249	0.000665	-0.000249
	(0.00471)	(0.00533)	(0.00935)	(0.00502)	(0.00541)
District wise bank branches in 2011	5.28e-05	0.000213	0.000213	0.000143	0.000213
	(0.000205)	(0.000256)	(0.000285)	(0.000225)	(0.000262)
Constant	-6.332***	-5.986***	-5.986***	-6.228***	-5.986***
	(1.121)	(1.194)	(1.442)	(1.149)	(1.146)
Observations	1,673	1,673	1,673	1,673	1,673
R-squared	0.223	0.070	0.070	0.143	0.070
F-test	17.30***			19.14***	
F-test of excluding IVs		13.64***	12.56***		20.65***
(p-value)		(0.002)	(0.001)		(0.000)
F statistic for weak identification		13.64***	12.56***		20.65***
Kleibergen-Paap rk LM statistic (p-value)		13.61***	8.61***		
		(0.002)	(0.003)		
Anderson canon. corr. LM statistic (p-value)					20.69***
					(0.000)
Cragg-Donald Wald F statistic		20.65	20.65		20.65
		(Less than 10%)	(Less than 10%)		(Less than 10%)
Kleibergen-Paap Wald rk F statistic		13.64	12.56		
		(10-15%)	(10-15%)		
Sargan-Hansen J statistic		0.000	0.000		0.000
		(exactly identified)	(exactly identified)		(exactly identified)
Endogeneity test of regressors (χ^2)		5.091**	2.767*		4.126**
		(0.024)	(0.096)		(0.042)

Notes: 1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. 3) Hence, IV specification for both Column 2 and Column 5 are similar, however, in column 2, we have used robust standard error, and in column 5 we used normal standard error. Over identification test of all instruments (Sargan-Hansen J-stat being 0.000) shows that equation is exactly identified since only one instrument is used.

In Table 5.5, the IV estimates show that children under five years of age living in a household with an international migrant as a member has a higher height-for-age z score by 4.5 SD in Model 2, 3, and 5. The HAZ score is lower in Model-4 as the increase of z score is noted as 1.7 SD in this result. However, the overall results suggest that international migration has had a significant and positive impact on increasing the nutrition level of children in rural households of Bangladesh.

Table 5.5: Regression Estimates Specifying the Impact of International Migration on Children Nutritional Status of WAZ (Weight-for-age z scores)

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 3) IV (2SLS) clustered within unions Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female) non-robust SE
International migrant and non-migrant households: international migrant 1, non-migrant 0	0.00528	4.580**	4.580***	1.703**	4.580***
	(0.178)	(1.787)	(1.708)	(0.772)	(1.668)
Gender of child: male 0; female1	-0.0778*	-0.0893	-0.0893	-0.0891*	-0.0893
	(0.0473)	(0.0592)	(0.0673)	(0.0493)	(0.0592)
Child age in months	-0.0465***	-0.0505***	-0.0505***	-0.0487***	-0.0505***
	(0.00571)	(0.00702)	(0.00779)	(0.00593)	(0.00702)
Child age in months (squared)	0.000518***	0.000573***	0.000573***	0.000550***	0.000573***
	(8.88e-05)	(0.000111)	(0.000119)	(9.27e-05)	(0.000115)
Age of the mother	-0.00691	-0.00118	-0.00118	-0.00454	-0.00118
	(0.00547)	(0.00705)	(0.00603)	(0.00572)	(0.00700)
Height of the mother (cm)	0.0204***	0.0159***	0.0159***	0.0182***	0.0159***
	(0.00472)	(0.00584)	(0.00540)	(0.00492)	(0.00605)
Weight of the mother (kg)	0.0253***	0.0272***	0.0272***	0.0270***	0.0272***
	(0.00325)	(0.00442)	(0.00456)	(0.00342)	(0.00392)
Mother's age at marriage	-0.000935	0.00513	0.00513	0.00171	0.00513
	(0.00878)	(0.0115)	(0.0132)	(0.00928)	(0.0113)
Years of education of the mother	0.0404***	0.0451***	0.0451***	0.0439***	0.0451***
	(0.00828)	(0.00979)	(0.0122)	(0.00836)	(0.0104)
Household Head is female	0.0464	-0.540**	-0.540**	-0.163	-0.540**
	(0.0686)	(0.244)	(0.266)	(0.121)	(0.231)
Size of the Household	0.00164	-0.0215	-0.0215*	-0.00536	-0.0215
	(0.00981)	(0.0138)	(0.0122)	(0.0104)	(0.0156)
Household has sanitary latrine	0.0633	0.115*	0.115	0.0832*	0.115*
	(0.0488)	(0.0655)	(0.0720)	(0.0503)	(0.0657)
Percentage of elderly persons in districts population 2011	-0.0114	-0.00243	-0.00243	0.000312	-0.00243
	(0.0229)	(0.0303)	(0.0502)	(0.0236)	(0.0300)
Percentage of poverty rate by districts in 2011	0.00296	0.00366	0.00366	0.00324	0.00366
	(0.00209)	(0.00265)	(0.00327)	(0.00220)	(0.00263)
Distance of household to nearest town	-0.00285	-0.00412	-0.00412	-0.00294	-0.00412
	(0.00296)	(0.00341)	(0.00372)	(0.00306)	(0.00362)
Literacy status of Household head	-0.0219	-0.0453	-0.0453	-0.0320	-0.0453
	(0.0200)	(0.0277)	(0.0330)	(0.0213)	(0.0277)
Household's access to electricity	-0.0345	-0.0682	-0.0682	-0.0389	-0.0682
	(0.0514)	(0.0632)	(0.0628)	(0.0535)	(0.0667)
Log of total income of household	-0.00597	0.000880	0.000880	-0.00678	0.000880
	(0.0268)	(0.0339)	(0.0299)	(0.0282)	(0.0325)
Poor Housing	-0.409***	-0.531***	-0.531***		-0.531***
	(0.141)	(0.160)	(0.120)		(0.187)
Average Housing	-0.222*	-0.330**	-0.330**		-0.330*
	(0.132)	(0.147)	(0.138)		(0.177)
Good Housing	-0.154	-0.266	-0.266		-0.266
	(0.151)	(0.179)	(0.170)		(0.199)
Percentage of international migrant households by district 2011	-6.65e-05	-0.00177	-0.00177	0.000289	-0.00177
	(0.00370)	(0.00488)	(0.00684)	(0.00388)	(0.00472)
District wise bank branches in 2011	-1.97e-05	0.000188	0.000188	5.03e-06	0.000188
	(0.000171)	(0.000247)	(0.000239)	(0.000183)	(0.000229)
Constant	-4.611***	-4.163***	-4.163***	-4.749***	-4.163***
	(0.797)	(0.962)	(0.857)	(0.812)	(0.999)
Observations	1,673	1,673	1,673	1,673	1,673
R-squared	0.213	-0.236	-0.236	0.144	-0.236
F-test	17.55***			18.99***	

(Contd. Table 5.5)

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 3) IV (2SLS) clustered within unions Instrument: District wise Sex Ratio in 2011(share male/female)	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Instrument: District wise Sex Ratio in 2011(share male/female) non-robust SE
F-test of excluding IVs		13.64***	12.56***		20.65***
(p-value)		(0.002)	(0.001)		(0.000)
F statistic for weak identification		13.64***	12.56***		20.65***
Kleibergen-Paap rk LM statistic		13.61***	8.61***		
(p-value)		(0.002)	(0.003)		
Anderson canon. corr. LM statistic					20.69***
(p-value)					(0.000)
Cragg-Donald Wald F statistic		20.65	20.65		20.65
		(Less than 10%)	(Less than 10%)		(Less than 10%)
Kleibergen-Paap Wald rk F statistic		13.64 (10-15%)	12.56 (10-15%)		
Sargan-Hansen J statistic		0.000 (exactly identified)	0.000 (exactly identified)		0.000 (exactly identified)
Endogeneity test of regressors (χ^2)		12.842** (0.000)	7.049*** (0.008)		11.97*** (0.001)

Notes:1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. Hence, IV specification for both Column 2 and Column 5 are similar; however, in column 2 we have used robust standard error, and in column 5 we used normal standard error. 3) Over identification test of all instruments (Sargan-Hansen J-stat being 0.000) shows that equation is exactly identified since only one instrument is used.

For the WAZ scores of children reported in Table 5.5, height and weight of the mother along with educational status and children's age in months are found to be positive and significant. A female child experiences a decline in WAZ score by 0.08 SD on average according to Model 4 (significant at 10 per cent level). This finding is important and has a strong implication in the Bangladeshi context, which can be explained by the son preference hypothesis-situations where parents prefer sons to daughters. Son Preference has strongly influenced the realised fertility decision of Bangladesh in the last century (Chowdhury & Bairagi, 1990) and still impacts it, though the trend is deteriorating (Asadullah, M. N., Mansoor, N., Randazzo, T., & Wahhaj, Z., 2021). The lower weight (WAZ) of the female children compared to the male children (Table 5.2 and 5.5) results from depriving female children of nutrition. Though the extent of deprivation could not affect the height of female children, it managed to reduce their weight significantly. Moreover, the female-headed households also endure decreases in WAZ score by 0.54 SD (in models 2, 3, and 5), and the WAZ score declines by 0.53 SD if the housing condition is poor (indicated by Cashpor index 2). Access to sanitary latrines has a positive significant effect in improving the weight for age z scores on average by 0.11 SD (in models 2 and 5) and 0.08 SD (in Model 4), although the significance level is 10 per cent.

The first stage regression estimates reported in table 5.6 for calculating the impact of international migration clearly show that the instrument "District wise Sex Ratio in 2011 (share male/female)" used as a proxy for international migration is significant even at 1 per

cent level. Therefore, it is a valid instrument, and the gender of the household head, Literacy rate of the household head, size of the household, percentage of elderly persons in districts population 2011, percentage of international migrant households by district 2011, district wise bank branches in 2011, and housing condition of the households; all these variables are significant and positively related with the international migration.

Table 5.6: First-stage IV Regression Estimates for IV 2SLS Regression Models and Probit 2SLS Regression: Determinants of International Migration

Variables	IV 2SLS Regression Models			Probit 2SLS Regression Model
	Model-2	Model-3	Model-5	Model-4
Instrument	0.007***	0.007***	0.007***	0.126***
District wise Sex Ratio	(0.002)	(0.002)	(0.001)	(0.028)
in 2011(share male/female)				
Gender of child: male 0; female1	0.002	0.002	0.002	0.019
	(0.008)	(0.009)	(0.008)	(0.157)
Child age in months	0.001	0.001	0.001	0.013
	(0.001)	(0.001)	(0.001)	(0.019)
Child age in months (squared)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Age of the mother	-0.001	-0.001*	-0.001	-0.031*
	(0.001)	(0.001)	(0.001)	(0.018)
Height of the mother (cm)	0.001	0.001	0.001	0.021
	(0.001)	(0.001)	(0.001)	(0.016)
Weight of the mother (kg)	-0.001	-0.001	-0.001	-0.008
	(0.001)	(0.001)	(0.001)	(0.009)
Mother's age at marriage	-0.001	-0.001	-0.001	-0.021
	(0.001)	(0.002)	(0.001)	(0.031)
Years of education	-0.001	-0.001	-0.001	-0.029
of the mother	(0.001)	(0.001)	(0.001)	(0.03)
Household Head is female	0.127***	0.127***	0.127***	1.513***
	(0.023)	(0.037)	(0.011)	(0.184)
Size of the Household	0.005***	0.005**	0.005***	0.106***
	(0.002)	(0.002)	(0.002)	(0.03)
Household has sanitary latrine	-0.012	-0.012	-0.012	-0.176
	(0.008)	(0.012)	(0.008)	(0.166)
Percentage of elderly persons	0.011**	0.011	0.011**	0.268***
in districts population 2011	(0.005)	(0.008)	(0.005)	(0.102)
Percentage of poverty rate	0.000	0.000	0.000	-0.011
by districts in 2011	(0.000)	(0.000)	(0.000)	(0.008)
Distance of household	0.000	0.000	0.000	0.008
to nearest town	(0.000)	(0.000)	(0.000)	(0.01)
Literacy status of	0.006*	0.006	0.006	0.134*
Household head	(0.003)	(0.004)	(0.003)	(0.076)
Household's access to electricity	0.006	0.006	0.006	0.091
	(0.008)	(0.007)	(0.009)	(0.182)
Log of total income of household	-0.002	-0.002	-0.002	-0.089
	(0.004)	(0.003)	(0.004)	(0.084)
Cashpor index				
2. Poor housing	0.023***	0.023	0.023	
	(0.011)	(0.015)	(0.024)	
3. Average housing	0.025***	0.025**	0.025	
	(0.008)	(0.011)	(0.023)	
4. Good housing	0.025	0.025	0.025	
	(0.017)	(0.016)	(0.026)	
Percentage of international	0.003***	0.003***	0.003***	0.056***
migrant households by district 2011	(0.001)	(0.001)	(0.001)	(0.016)
District wise bank branches in 2011	0.000***	0.000***	0.000***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.001)
Constant	-0.856***	-0.856***	-0.856***	-18.517***
	(0.238)	(0.27)	(0.212)	(4.188)

Notes: 1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. Hence, IV specification for both Column 2 and Column 5 are similar; however, in column 2 we have used robust standard error, and in column 5 we used normal standard error.

5.2 Another IV Specification using Both Sex Ratio at District Level & Percentage of International Migrant Households in Districts as the Instrument Variables

In this section, we used the same five models for exploring the impact of international migration on children's nutritional indictor HAZ (stunting) and WAZ (wasting), with a different instrument for the analysis. In equation (2) (in Chapter 4), the instrument Z_i, is now replaced with two instruments: the district wise sex ratio and the percentage of international migrant households in the districts in 2011. Thus, these partially capture the 'network effect' of international migration, as discussed earlier.

Table 5.7 reports the impact of international migration on the HAZ score or stunting rate of the children in those households. The OLS model yields insignificant coefficients on the migration variable. However, these point estimates are likely to be biased because it does not account for the endogeneity of migration.

The IV models (Model 2 to Model 5) yield significant and positive impact of international migration, as living in a household with international migration increases the z score on average by 2.9 SD (for Model 2, 3, and 5) and 3.2 SD (for model 4). This result is similar to the result we got in Table 5.4 (using the single instrument only), although the magnitude is lesser than before (in table 5.4, the increase in HAZ ranges from 2.8 to 3.8 SD points)

Table 5.7: Regression Estimates Specifying the Impact of International Migration on Children's Nutritional Status of HAZ (Height-for-age z scores)

[Instruments: Sex Ratio in Districts & International Migrant Household's in Districts in 2011]

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS)	(Model- 3) IV (2SLS) clustered within unions	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Non-robust SE
International migrant and non-migrant households: international migrant 1, non-migrant 0	0.331	2.951**	2.951*	3.271**	2.951**
	(0.213)	(1.418)	(1.718)	(1.543)	(1.437)
Gender of child: male 0; female1	0.0518	0.0414	0.0414	0.0364	0.0414
	(0.0607)	(0.0642)	(0.0671)	(0.0654)	(0.0643)
Child age in months	-0.102***	-0.105***	-0.105***	-0.105***	-0.105***
	(0.00779)	(0.00800)	(0.00828)	(0.00814)	(0.00754)
Child age in months (squared)	0.00131***	0.00135***	0.00135***	0.00136***	0.00135***
	(0.000120)	(0.000124)	(0.000117)	(0.000126)	(0.000124)
Age of the mother	0.0286	0.0359	0.0359	0.0354	0.0359
	(0.0707)	(0.0734)	(0.0768)	(0.0746)	(0.0633)
Height of the mother (cm)	-0.000429	-0.000535	-0.000535	-0.000521	-0.000535
	(0.00124)	(0.00130)	(0.00135)	(0.00132)	(0.00113)
Weight of the mother (kg)	0.0387***	0.0364***	0.0364***	0.0359***	0.0364***
	(0.00663)	(0.00684)	(0.00737)	(0.00701)	(0.00641)
Mother's age at marriage	0.0122***	0.0112**	0.0112**	0.0117***	0.0112***
	(0.00419)	(0.00443)	(0.00518)	(0.00447)	(0.00417)
Years of education of the mother	0.00223	0.00626	0.00626	0.00706	0.00626
	(0.0111)	(0.0121)	(0.0109)	(0.0125)	(0.0125)
Household Head is female	0.0454***	0.0459***	0.0459***	0.0464***	0.0459***
	(0.0105)	(0.0106)	(0.0114)	(0.0106)	(0.0106)
Size of the Household	-0.0193	-0.0224*	-0.0224**	-0.0215*	-0.0224
	(0.0131)	(0.0128)	(0.00956)	(0.0126)	(0.0139)
Household has sanitary latrine	0.0950	0.135**	0.135	0.138**	0.135*
	(0.0642)	(0.0673)	(0.0893)	(0.0675)	(0.0691)
Percentage of elderly persons in districts population 2011	-0.0134	-0.0185	-0.0185	-0.0123	-0.0185
	(0.0277)	(0.0297)	(0.0428)	(0.0299)	(0.0313)
Percentage of poverty rate by districts in 2011	-0.000321	-0.000484	-0.000484	-0.000235	-0.000484
	(0.00269)	(0.00281)	(0.00330)	(0.00284)	(0.00286)

(Contd. Table 5.7)

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS)	(Model- 3) IV (2SLS) clustered within unions	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Non-robust SE
Household's source	-0.0493	-0.134	-0.134		-0.134
of drinking water	(0.107)	(0.113)	(0.107)		(0.141)
Log of total income of household	0.00413	0.00516	0.00516	0.00368	0.00516
	(0.0340)	(0.0358)	(0.0371)	(0.0363)	(0.0351)
Log of total land owned	0.0100				
by household in 2011	(0.0193)				
Household's access to electricity	-0.0304	-0.0572	-0.0572	-0.0629	-0.0572
	(0.0660)	(0.0691)	(0.0625)	(0.0707)	(0.0717)
Poor Housing	-0.117	-0.171	-0.171		-0.171
	(0.189)	(0.189)	(0.209)		(0.198)
Average Housing	-0.0567	-0.112	-0.112		-0.112
	(0.176)	(0.178)	(0.181)		(0.189)
Good Housing	-0.0123	-0.0781	-0.0781		-0.0781
	(0.198)	(0.206)	(0.243)		(0.214)
District wise bank branches in 2011	9.09e-05	0.000138	0.000138	0.000140	0.000138
	(0.000186)	(0.000202)	(0.000247)	(0.000205)	(0.000222)
Constant	-6.905***	-6.546***	-6.546***	-6.787***	-6.546***
	(1.388)	(1.458)	(1.736)	(1.473)	(1.338)
Observations	1,732	1,743	1,743	1,743	1,743
R-squared	0.222	0.132	0.132	0.108	0.132
F-test	18.74***			22.10***	
F-test of excluding IVs		11.29***	12.63***		16.20***
(p-value)		(0.000)	(0.000)		(0.000)
F statistic for weak identification		11.29***	12.63***		16.20***
Kleibergen-Paap rk LM statistic (p-value)		22.22***	12.07***		
		(0.000)	(0.002)		
Anderson canon. corr. LM statistic (p-value)					32.23***
					(0.000)
Cragg-Donald Wald F statistic		16.20	16.20		16.20
		(10-15%)	(10-15%)		(10-15%)
Kleibergen-Paap Wald rk F statistic		11.29	12.63		
		(15-20%)	(10-15%)		
Sargan-Hansen J statistic		0.930	0.377		0.89
(P-value)		(0.335)	(0.539)		(0.346)
Endogeneity test of regressors ($\chi 2$)		4.501**	2.701*		3.752**
		(0.034)	(0.10)		(0.05)

Notes: 1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. Hence, IV specification for both Column 2 and Column 5 are similar; however, in column 2 we have used robust standard error, and in column 5 we used normal standard error. 3) Over identification test of all instruments (Sargan-Hansen J-stat being 0.000) shows that equation is exactly identified since only one instrument is used.

Table 5.7 shows that the correlation between international migration and anthropometric status of HAZ score differs by estimation strategy: Age-specific variables like children's age and mother's age at marriage are statistically significant for the z-scores in OLS and IV models. The height of the mother, which was found significant for HAZ score in Table 5.1 and in Table 5.4, is now not significant anymore. The weight of the mother, the household headship, size of the household, and household's access to sanitary latrine are statistically significant. However, female headship in Table 5.7 reports raising the z score by 0.045 SD in both the OLS and IV models, whereas increasing household size reduces the z score by 0.02 SD in the IV models 2, 3, and 4.

Table 5.8: Regression Estimates Specifying the Impact of International Migration on Children's Nutritional Status of WAZ (weight-for-age z scores)

[Instruments: Sex Ratio in Districts & International Migrant Households in Districts in 2011]

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS)	(Model- 3) IV (2SLS) clustered within unions	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Non-robust SE
International migrant and non-migrant households: international migrant 1, non-migrant 0	0.0408	3.281***	2.951*	3.195**	3.281***
	(0.173)	(1.199)	(1.718)	(1.304)	(1.187)
Gender of child: male 0; female1	-0.0578	-0.0668	0.0414	-0.0728	-0.0668
	(0.0466)	(0.0528)	(0.0671)	(0.0529)	(0.0531)
Child age in months	-0.0466***	-0.0494***	-0.105***	-0.0500***	-0.0494***
	(0.00562)	(0.00633)	(0.00828)	(0.00636)	(0.00623)
Child age in months (squared)	0.000514***	0.000562***	0.00135***	0.000571***	0.000562***
	(8.72e-05)	(9.97e-05)	(0.000117)	(0.000100)	(0.000102)
Age of the mother	0.0502	0.0550	0.0359	0.0533	0.0550
	(0.0506)	(0.0559)	(0.0768)	(0.0564)	(0.0523)
Height of the mother (cm)	-0.00107	-0.00114	-0.000535	-0.00110	-0.00114
	(0.000892)	(0.000998)	(0.00135)	(0.00101)	(0.000937)
Weight of the mother (kg)	0.0212***	0.0189***	0.0364***	0.0185***	0.0189***
	(0.00470)	(0.00520)	(0.00737)	(0.00523)	(0.00529)
Mother's age at marriage	0.0260***	0.0253***	0.0112**	0.0263***	0.0253***
	(0.00318)	(0.00385)	(0.00518)	(0.00381)	(0.00345)
Years of education of the mother	0.000201	0.00587	0.00626	0.00635	0.00587
	(0.00862)	(0.0104)	(0.0109)	(0.0104)	(0.0103)
Household Head is female	0.0353***	0.0346***	0.0459***	0.0364***	0.0346***
	(0.00802)	(0.00876)	(0.0114)	(0.00860)	(0.00878)
Size of the Household	-0.00225	-0.00628	-0.0224**	-0.00410	-0.00628
	(0.00973)	(0.0103)	(0.00956)	(0.0100)	(0.0115)
Household has sanitary latrine	0.0452	0.0898	0.135	0.0877	0.0898
	(0.0474)	(0.0555)	(0.0893)	(0.0543)	(0.0571)
Percentage of elderly persons in districts population 2011	-0.00631	-0.0133	-0.0185	5.63e-05	-0.0133
	(0.0223)	(0.0267)	(0.0428)	(0.0258)	(0.0258)
Percentage of poverty rate by districts in 2011	0.00217	0.00192	-0.000484	0.00216	0.00192
	(0.00204)	(0.00233)	(0.00330)	(0.00232)	(0.00236)
Household's source of drinking water	-0.0168	-0.122	-0.134		-0.122
	(0.0905)	(0.0974)	(0.107)		(0.117)
Log of total income of household	-0.00309	0.000832	0.00516	-0.00284	0.000832
	(0.0261)	(0.0297)	(0.0371)	(0.0297)	(0.0290)
Log of total land owned by household in 2011	0.0122				
	(0.0146)				
Household's access to electricity	-0.0361	-0.0641	-0.0572	-0.0609	-0.0641
	(0.0504)	(0.0570)	(0.0625)	(0.0577)	(0.0592)
Poor Housing	-0.314**	-0.377**	-0.171		-0.377**
	(0.154)	(0.155)	(0.209)		(0.163)
Average Housing	-0.131	-0.198	-0.112		-0.198
	(0.146)	(0.145)	(0.181)		(0.156)
Good Housing	-0.0667	-0.151	-0.0781		-0.151
	(0.162)	(0.170)	(0.243)		(0.177)
District wise bank branches in 2011	-2.23e-05	3.01e-05	0.000138	1.79e-06	3.01e-05
	(0.000159)	(0.000182)	(0.000247)	(0.000182)	(0.000184)
Constant	-5.720***	-5.339***	-6.546***	-5.732***	-5.339***
	(1.051)	(1.176)	(1.736)	(1.156)	(1.105)
Observations	1,732	1,743	1,743	1,743	1,743
R-squared	0.213	-0.025	0.132		-0.025
F-test	19.27***			20.62***	
F-test of excluding IVs		11.29***	12.63***		16.20***
(p-value)		(0.000)	(0.000)		(0.000)
F statistic for weak identification		11.29***	12.63***		16.20***
Kleibergen-Paap rk LM statistic (p-value)		22.22***	12.46***		
		(0.000)	(0.002)		

(Contd. Table 5.8)

Variables	(Model -1) OLS regression	(Model- 2) IV (2SLS)	(Model- 3) IV (2SLS) clustered within unions	(Model- 4) IV Probit 2SLS	(Model- 5) IV (2SLS) Non-robust SE
Anderson canon. corr. LM statistic					32.23***
(p-value)					(0.000)
Cragg-Donald Wald F statistic		16.20	16.20		16.20
		(10-15%)	(10-15%)		(10-15%)
Kleibergen-Paap Wald rk F statistic		11.29	12.63		
		(15-20%)	(10-15%)		
Sargan-Hansen J statistic		2.549	0.377		2.842
(P-value)		(0.110)	(0.539)		(0.09)
Endogeneity test of regressors ($\chi 2$)		10.689***	2.701*		9.821**
		(0.001)	(0.10)		(0.002)

Notes: 1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. Hence, IV specification for both Column 2 and Column 5 are similar; however, in column 2 we have used robust standard error, and in column 5 we used normal standard error. 3) Over identification test of all instruments (Sargan-Hansen J-stat being 0.000) shows that equation is exactly identified since only one instrument is used.

Table 5.8 reports that the WAZ anthropometry measures the children of the households living with an international migrant compared to children living in non-migrant households. In this case also, international migration has resulted in an increase in z score of WAZ by 3.2 SD for Model 2 and 5, 2.9 SD for Model 3 and 3.1 SD for model 5. The OLS estimate is not significant, but the IV estimates are significant, varying from 1% level of significance to 10 per cent level of significance based on the Models.

Across the two sets of results presented in Tables 5.7 and 5.8, children's age, weight of the mother, mother's age at marriage, and female headed household are positively and significantly associated with WAZ as well as HAZ, and these results are consistent. On the other hand, living in a household with poor housing reduces the WAZ score by 0.3 SD. On the contrary, this result is different from table 5.5 as the gender of the child and the height of the mother, size of the household, and household access to sanitary latrine was not found significant in table 5.8.

Sex Ratio and Percentage of International Migrants in districts were used as instruments in the 2SLS models. The F-tests resulting from Table 5.7 and Table 5.8 are higher than 10, suggesting that our models are correctly specified.

In addition, both the F-tests of excluding IVs and the F statistics for weak identification being higher than 10 show that both the instruments, 'sex ratio' and 'percentage of international migrants in districts in 2011', are not weak. To test that the (excluded) instruments 'sex ratio' and 'percentage of international migrants in districts in 2011' are not correlated with the endogenous regressor 'international migration', we performed under identification tests. The assumption of the null hypothesis was that there is no correlation and we used Kleibergen-Paap rk LM statistic (with robust option) on Model 2 and Model 3 and Anderson canon. corr. LM statistic (without robust option) for Model 5 to test this hypothesis. The test results reported at the end of the tables showed that these statistics are significant, suggesting that the endogenous regressor is not under-identified.

Moreover, two additional tests are performed to test whether the instruments are correlated with the regressors (null is weak correlation), using Cragg-Donald Wald F statistic (without robust option) and Kleibergen-Paap Wald rk F statistic (with robust option) for Model 2, 3, and 5. The Cragg-Donald Wald F statistic for three Models is 16.20 which lies between 15 to 20 per cent of the maximal IV size. The Kleibergen-Paap Wald rk F statistic being 11.29 for Model 2 lies between 15 to 20 per cent maximal IV size, and 12.63 model 3 that lies between 10 to 15 per cent maximal IV size. In case of one or two instrument(s), the Staiger–Stock rule of thumb (1997) conforming to a 5 per cent level states that the maximum size of the Kleibergen-Paap Wald rk F statistic should be no more than 15 per cent (Stock & Yogo, 2005). Thus, the instruments used in this study are not weak.

The Sargan-Hansen J statistic is used to test for the over-identification restriction of the model. Tables 5.1 to 5.6 has reported results for a single instrument, sex ratio at district level in 2011, for migration; as a consequence, the problem of over identification does not arise at all. However, when two instrumental variables, 'sex ratio at district level' and 'share of international migrant households at district level in 2011' were used (Table 5.7 and 5.8) to instrument for international migration. This situation requires examining the over identification assumption. The values of Sargan- Hansen J statistic are insignificant (Table 5.7 and Table 5.8), which implies that these models do not suffer from over identification problems.

Endogeneity test of endogenous regressor 'international migration' passes the test as the p-values of Chi-square ($\chi 2$) is less than α, level of significance varying in different significant levels for different models (see at the end of Table 5.7 and 5.8).

Table 5.9 reports the first stage IV regression estimates, and it is seen that both the instruments, District wise Sex Ratio in 2011 (share male/female) and Percentage of international migrant households by district 2011 are significant (at 1% level) and positively correlated with international migration.

Table 5.9: First-stage Regression Estimates for IV 2SLS Models and Probit Model for International Migration

[Instruments: Sex Ratio in Districts & International Migrant Household's in Districts in 2011]

Instruments	IV 2SLS Regression Models			Probit 2SLS Regression Model
	Model-2	Model-3	Model-5	Model-4
District wise Sex Ratio	0.007***	0.007***	0.007***	0.102***
in 2011(share male/female)	(0.002)	(0.002)	(0.001)	(0.023)
Percentage of international migrant	0.004***	0.004***	0.004***	
households by districts 2011	(0.001)	(0.001)	(0.001)	0.066***
				(0.014)
Variables				
Gender of child: male 0; female1	0.002	0.002	0.002	0.030
	(0.008)	(0.009)	(0.008)	(0.133)
Child age in months	0.001	0.001	0.001	0.013
	(0.001)	(0.001)	(0.001)	(0.016)
Child age in months (squared)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Age of the mother	0.000	0.000	0.000	-0.011
	(0.008)	(0.009)	(0.008)	(0.129)
Age of the mother (squared)	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.002)
Height of the mother (cm)	0.001	0.001	0.001	0.013
	(0.001)	(0.001)	(0.001)	(0.013)
Weight of the mother (kg)	0.000	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.008)
Mother's age at marriage	-0.002	-0.002	-0.002	-0.037
	(0.002)	(0.002)	(0.001)	(0.027)
Years of education	0.000	0.000	0.000	0.005
of the mother	(0.001)	(0.002)	(0.001)	(0.022)
Size of the Household	0.002	0.002	0.002	0.026
	(0.001)	(0.002)	(0.002)	(0.026)
Household has sanitary latrine	-0.009	-0.009	-0.009	-0.166
	(0.008)	(0.011)	(0.008)	(0.143)
Percentage of elderly persons	0.011**	0.011	0.011**	0.182**
in districts population 2011	(0.006)	(0.008)	(0.005)	(0.082)
Percentage of poverty rate	0.000	0.000	0.000	-0.008
by districts in 2011	(0.000)	(0.000)	(0.000)	(0.007)
Household's source	0.044***	0.044***	0.044***	
of drinking water	(0.008)	(0.011)	(0.017)	
Log of total income of household	-0.002	-0.002	-0.002	-0.041
	(0.004)	(0.003)	(0.004)	(0.069)
Household's access to electricity	0.006	0.006	0.006	0.155
	(0.008)	(0.007)	(0.009)	(0.153)
Cashpor-index				
2.poor housing	0.022**	0.022	0.022	
	(0.01)	(0.015)	(0.024)	
3.average housing	0.027***	0.027*	0.027	
	(0.006)	(0.01)	(0.023)	
4.good housing	0.027*	0.027	0.027	
	(0.016)	(0.017)	(0.026)	
District wise bank branches in 2011	0.000***	0.000***	0.000***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.001)
Constant	-0.888***	-0.888***	-0.888***	-14.599***
	(0.294)	(0.306)	(0.237)	(3.854)

Notes: 1) Figures in parentheses are robust standard errors. *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively. 2) Robust standard errors in parentheses except column 5. Hence, IV specification for both Column 2 and Column 5 are similar; however, in column 2 we have used robust standard error, and in column 5 we used normal standard error.

The variables that are significant determinants of international migration include district wise bank branches in 2011, percentage of elderly persons in districts population 2011, household's source of drinking water, and cashpor index reflecting the housing condition of the rural households.

5.3 Discussion

In the previous sections, we have established that migration, particularly international migration, is indeed associated with better nutritional outcomes for both the HAZ (stunting) and WAZ (underweight) indicators in Bangladesh. Now, the interesting part is to gain a better understanding of the channels through which this relationship may be at play for rural Bangladesh. The BIHS 2015 data allowed us to explore some of the possible channels among those identified in our conceptual framework in section 3.2. These are i) income effect through remittance that increases households disposable income and ii) effect of improved knowledge on health and care practices of young children because of international migration (Azzarri & Zezza, 2011; Anton, 2010; de Brauw, 2011; Thow et al., 2016).

To describe the income effect, it should be acknowledged that migrants, internal or international both, bring an additional amount of money to households, which helps raise household income, reducing poverty and enabling the recipient households to move up the asset ladder (Osmani, 2016) and thus ensuring food security of the household, which results in improving the children's nutrition level (Anton, 2010; Azzarri & Zezza, 2011) as well as the overall nutrition status of the households. Thus, asset accumulation or economic development at the household level where remittances from labour migration play an important role and also contribute to improving the nutritional status of children, as explained in the studies by Headey et al., 2015; Nisbett et al., 2017, and Islam, Khan, and Mondal, 2018, assessing the condition and journey of nutrition improvement in Bangladesh. Hence, we can argue that 'income effect' through remittance has contributed to poverty reduction (Adams & Page, 2005; Osmani, 2016) and consequently contributed to improving the nutritional status of children in rural Bangladesh (Headey et al., 2015; Nisbett et al., 2017; Islam, Khan & Mondal, 2018).

Surprisingly, the other channels, like female headship resulting in better allocation of household resources towards food, were actually negatively associated with nutritional outcome of children in results reported in Table 5.1, 5.2, 5.4, and 5.5. However, they have a positive impact when the instrument changes in Tables 5.7 and 5.8. This ambivalent result occurred because female headship without increases in the number of years of education of the female and the power of decision making in the household may not result in a positive impact. Our study findings are corroborated by the findings of Islam et al. (2018), which in the Bangladeshi context concluded that, "*household economic condition and maternal*

educational status are significant factors determining the nutritional development of children <5 years of age" (p.101), which directly supports our findings in Table 5.1, 5.2., 5.4, and 5.6. Besides, Headey et al. (2015) also did not find any significant association between women empowerment and improvement of nutrition at the household level in south Asian countries, including Bangladesh. Moreover, recent literature by Holland and Rammohan (2019), using Women's Empowerment in Agriculture Index (WEAI)[3], found women's empowerment in Bangladesh, especially "*autonomy in making productive decisions and confidence to speak up in public being significantly associated with improvements in children's haz*" (p.124). They described that 'women's empowerment is closely related to "autonomy" or the ability to make decisions based on personal values rather than outside pressures. That is a stronger indicator of actual empowerment that positively correlates with improving stunting outcomes in children. Hence, female headship alone cannot contribute to improving the nutritional status of children without proper education and empowerment of women.

5.4 Policy Implications

The study established the direct and positive relationship between children living in international migrant households in rural areas and their higher Weight-for-age (WAZ) and Height-for-age (HAZ) z-scores compared to children living in non-migrant households from a national representative dataset. It can be directly used to achieve objectives 3 and 5[4] of the National Food and Nutrition Security Policy of Bangladesh (NFNSP) 2020, specifically in designing nutrition behaviour change communications (NBCC) and nutrition education strategies for the prevention and control of malnutrition in international migrant households. Moreover, as international migrant households have access to additional income and resources through remittances, interlinking these households in the water, health and sanitation (WASH) programme would incur better results in terms of sustaining the current nutrition status.

A report by Bangladesh National Nutrition Council (BNNC) (2020) mentioned that although the government scaled up the current direct nutrition interventions (proven cost-effective nutrition-specific interventions) by up to 90 per cent, the coverage rate would only

[3] Five keys of Women's Empowerment in Agriculture Index (WEAI): women's input in productive decisions, autonomy in productive decisions, control over use of income, group membership and speaking in public, discussed in Holland, and Rammohan (2019).

[4] Objectives:
The following five objectives have been identified for NFNSP.
1. To ensure the availability of safe and nutritious food for healthy diets
2. To improve access to safe and nutritious food at an affordable price
3. To enhance the consumption and utilisation of healthy and diversified diets for achieving nutrition improvements
4. To increase access to nutrition-sensitive social protection and safety nets across the life cycle with a focus on vulnerable groups and regions
5. To strengthen cross-sectoral food and nutrition security governance, coordination, capacity building and partnership for effective policy implementation (NFNSP, Draft report, 2020)

be able to reduce stunting prevalence by 20 per cent and severe acute malnutrition by 60 per cent (Lancet Series, 2013 cited in BNNC, 2020). Hence, nutrition-sensitive interventions were suggested to be implemented in a way where poor people with the highest malnutrition could access social protection and safety nets, such as the public food distribution system (PFDS), and be linked with the National Security Strategy (NSSS) in order to re-establish food productive capacities in the case of disasters. Therefore, having the information at this national portal of households categorised in i) internal migrants, ii) international migrants, and iii) non-migrant members would be able to assist the government in effectively implementing the National Nutrition Policy in an effective way. The policy would address direct assistance, provide safety nets to the poor in non-migrant households, provide consumer support to poor internal migrant households, especially those living in the slum areas, through subsidised food selling, and awareness generating about food safety and supply of hygiene and micronutrient enrich food among the international migrant households. Such targeted interventions would ensure the efficient use of government revenue and successfully increase the nutritional outcome.

In addition, this study finds that households with female headship did not have a significant positive impact on children's nutrition; this finding may be surprising but not uncommon in the context of Bangladesh (Headey et al., 2015). It implies that female headship alone cannot improve the nutritional status of children in those households without women's empowerment in resources and decision making of the households (Holland & Rammohan, 2019). Therefore, this study calls for policymakers and development stakeholders concerned with the issue of migration to take up policies directed at increasing females' years of education and knowledge on the nutrition of children in migrant families and enabling them to make decisions on productive choices, to spend the households' resources prudently and independently and to encourage them for public exposure. These issues need to be addressed properly in the 'National Nutrition Policy' of Bangladesh so that females in migrant families can improve the nutritional outcomes of the households.

There is concern about the left-behind caregivers who substitute for absent migrants in childcare and domestic work. These caregivers also minimise the economic stress faced by international migrant families stemming from the cycle of debts resulting from borrowing from informal sources and mishandling the remittances sent by the migrants (Lam, Ee, Anh, & Yeoh, 2013). In addition, returned international migrants face a massive decline in their income (about 66 per cent reported in Siddiqui et al.'s panel study in 2018) even if they were to engage in earning activities after returning home. This could pose negative effects on the nutrition condition of the children living in those households. Thus, returnee migrants' families and left-behind vulnerable family members (especially old, disabled people, and women) need to be mindful of when nutrition-sensitives policies are implemented.

Moreover, the study shows that improvements in nutritional outcomes are greater for children who live in international migrant households. Hence, improved nutrition outcomes of children in rural Bangladesh significantly depend on the international issues that may affect international migration. Thus, this study appeals to policymakers to keep international crises like recessions, international political instability, and global pandemics in mind while implementing national nutritional policies. These events have the potential to worsen the children's nutritional status in international migrant households and spoil the remarkable success the government achieved in improving the nutritional status of children in the past decades. Besides, a major portion of international migration expenses is usually borne by borrowing from relatives and lenders, resulting in debt formation. Moreover, if returnees from overseas increase due to global crises, then the income and economic situation of these migrant households will certainly deteriorate (Chowdhury & Chakraborty, 2021), thereby affecting the households' overall nutrition situation. Thus, policymakers need to keep the international migration situation in mind when planning interventions for expanding social safety net programmes in rural areas of Bangladesh.

5.5 Limitations

This study rigorously established the relationship between migration (internal and international combined), international migration, and the nutritional status of children in rural households in Bangladesh. Yet a set of channels through which this relationship flourishes need to be addressed and studied in detail. The income effect of migration through the consumption of food and investment in education and sanitary systems could be observed in the data. However, there are still three channels through which migration affects the nutrition condition of children: how the bargaining power on resource allocation shifts to females in the absence of a male migrant member, how the spillover of knowledge on nutritious food and hygiene behaviour absorbed by the migrant households; and how the time allocation of child-rearing and household chores distributed among the left behind members. These issues are not discussed in this report, and the authors hope to elaborate on these issues in future research.

Another possible channel is to explore how the presence of a migrant member or remittance acts as insurance to smooth the consumption of households by ensuring food security during seasonality, natural calamity and crisis, which we could not address in this study because of the data availability. It is one of the study limitations that could not be captured with the available dataset.

Future research on 'migration and nutrition' directions can focus on how remittances through migration have contributed to agricultural development, ensuring food security in rural communities and how it influenced the nutrition and health knowledge of households with migrant members.

CHAPTER 6
CONCLUSIONS

This study provides sound empirical evidence between migration, specifically international migration, and the nutritional outcome of children below five years of age in rural Bangladesh. The results of this study establish the positive impact of migration (both internal and international) and international migration in improving the nutritional status of children. Migration, specifically international migration, can increase both the Height-for-age (HAZ) z-score and Weight-for-age (WAZ) z-score of children living in those households compared to non-migrant households. However, the magnitude of the nutritional indicators was higher for international migrant households compared to non-migrant households than the migrant households (both internal and international) relative to the non-migrant scenario. However, the magnitude of the increase differs across the models and instruments used in this study. The variants of the IV regression results validate the robustness of the study findings.

This study reports that mothers' height, mothers' weight, and mothers' years of education are significant and positively related to improving their children's nutrition conditions. However, female children have a lower WAZ (weight) than male children, strengthening the prevalence of the biasness toward male children in Bangladesh. Like other studies, this study also finds that households' access to sanitary latrines is positively associated with the nutritional status of children, and households with female headship did not have a significant positive impact on the nutrition status of children. This latter finding may be surprising but not uncommon in the context of Bangladesh (Headey et al., 2015). Without bargaining and decision-making power in the household's resources, female headship alone cannot improve the nutritional status of children in those households (Headey et al., 2015; Holland & Rammohan, 2019). Hence, this study expects strategies devising women empowerment in migrant households to be accelerated and dealt with properly in the 'National Food and Nutrition Security Policy of Bangladesh (NFNSP)' so that females in migrant families can contribute appropriately to the positive nutritional outcomes of the households.

This study reveals that significant improvement has been achieved in reducing the overall underweight and stunting of children in rural Bangladesh, where migration, specifically international migration, played a major role. However, wasting (indicated by weight for height (WHZ) z score) or acute malnutrition persists at a 10 per cent level; therefore, the income and consumption soothing effect through remittance earning could not positively influence this nutrition indicator. Also, the study mentioned five channels through which migration affects nutrition in children; however, it could not delve into depth about how those channels have impacted improving the WAZ and HAZ scores in children of migrant households. The findings of this study are valuable in implementing the Second National Plan of Action for Nutrition (NPAN2) 2016-25 and the National Food and Nutrition Security Policy of Bangladesh (NFNSP) 2020 to target nutrition-sensitive interventions at appropriate community levels.

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Appendix

Table A.1: Mean Values of Main Variables for Children under 5 Years Old by Households' Migration Status

Variables	Households with no migrant members	Households with at least one international migrant member	Difference in mean values	p-values	t-statistics	Combined mean
Weight for age z score (WAZ)	-1.50	-1.362122	-0.140	.3736413	(-0.89)	-1.498181
Weight for height z score (WHZ)	-0.99	-1.118041	-0.401	.4853456	(0.70)	-.9924481
Height for age z score (HAZ)	-1.44	-1.037388	-0.401	.0539389	(-1.93)	-1.426786
Gender of child: male 0, female1	0.47	.4897959	-0.0253	.7266822	(-0.35)	.4652223
Child age in months	29.52	29	0.519	.8348683	(0.21)	29.50456
Child age in months square	1166.90	1113.49	53.41	.7224166	(0.36)	1165.41
Age of the mother	26.69	26.42857	0.258	.7108989	(0.37)	26.67902
Height of the mother (cm)	150.96	152.0354	-1.072	.1906037	(-1.31)	150.9924
Weight of the mother (kg)	48.16	49.60208	-1.442	.2709829	(-1.10)	48.19921
Mother's age at marriage	17.61	17.12245	0.490	.2096271	(1.26)	17.5992
Years of education of the mother	5.31	5.77551	-0.470	.3507349	(-0.93)	5.3187
Household Head is female	0.13	.7083333	-0.576***	2.44e-29	(-11.45)	.1486797
Birth Order of the child	2.34	2.44898	-0.108	.5815442	(-0.55)	2.344356
Number of children below 15 years of age in household	2.44	2.530612	-0.0884	.5972891	(-0.53)	2.444698
Number of adults above 15 years of age in household	2.88	2.469388	0.406	.0572727	(1.90)	2.86374
Household has sanitary latrine	0.44	.3877551	0.0492	.4937809	(0.68)	.4355758
Household disposes garbage in a systematic way	0.30	.2653061	0.0338	.6101918	(0.51)	.2981756
Distance of household to nearest town	8.97	8.867347	0.0978	.9354005	(0.08)	8.962308
Age of Household Head	39.84	38.77083	1.067	.5754721	(0.56)	39.80884
Age of Household Head square	1753.51	1775.021	-21.51	.9053016	(-0.12)	1754.099
Household Head has Primary education	0.43	.5510204	-0.123	.0854319	(-1.72)	.4310148
Household Head has Secondary education	0.09	.0612245	0.0297	.4745305	(0.72)	.0900798
District wise Sex Ratio in 2011(share male/female)	98.57	99.14286	-0.569	.3837236	(-0.87)	98.59008

(Contd. Table A.1)

Variables	Households with no migrant members	Households with at least one international migrant member	Difference in mean values	p-values	t-statistics	Combined mean
Percentage of international migrant households by district 2011	8.61	11.93143	-3.318**	.0015767	(-3.17)	8.706249
Percentage of elderly persons in district population 2011	7.64	7.711429	-0.0690	.6715552	(-0.42)	7.644379
Household's Total Yearly Income	178013.80	148416.6	29597.2	.3659065	(0.90)	177187
Land amount owned by household in 2011 (decimal)	92.87	104.9082	-12.04	.5943157	(-0.53)	93.20606
Log of total income of household	11.69	11.60098	0.0880	.5075857	(0.66)	11.68651
Log of total land owned by household	3.30	3.768002	-0.468	.0745675	(-1.78)	3.313231
District wise bank branches in 2011	209.35	200.3673	8.980	.6949491	(0.39)	209.0964

Notes: *, ** and *** represent statistical significance at the 10% level, 5% level (or better), and 1% level (or better), respectively.
Source: Author's calculation from BIHS Second Round Survey 2015.