Determinants of undernutrition among children under 2 years of age in Bangladesh: insights from nationally representative data

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Bangladesh

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A thesis submitted in partial fulfillment of the requirement for the degree of Master of Public Health

By

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Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirements. The thesis "Determinants of undernutrition among children under 2 years of age in Bangladesh: insights from nationally representative data" is my own work.

Signature Iftia Jerin

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Dedication

I would like to dedicate this thesis

To my beloved son Ahnaf Insaf (Kabbo)

Acknowledgement

First of all I would like to express my gratitude to the almighty Allah as I was able to finish the thesis with his enormous blessings.

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List of abbreviations

A&T	Alive and Thrive
ANC	Antenatal Care
ARI	Acute Respiratory Infection
BBS	Bangladesh Bureau of Statistics
BDHS	Bangladesh Demographic Health Survey
BMI	Body Mass Index
BRAC	Programme Bangladesh Rural Advancement Committee
CI	Confidence Interval
DALYs	Disability-Adjusted Life Years
EAs	Enumeration Areas
FFWs	Food for Works
EPI	Expanded Programme of Immunization
FWAs	Family Welfare Assistants
GDP	Gross Domestic Product
Has	Health Assistants
HAZ	Height-for-Age Z-score
HKI	Helen Keller International
HNPSP	Health, Nutrition and Population Sector Programme
HPNSDP	Health, Population and Nutrition Sector Development Programme
HPSP	Health and Population Sector Programme
IDD	Iodine Deficiency Disorder
IMCI	Integrated Management of Childhood Illness
IMR	Infant Mortality Rate
IYCF	Infant and Young Child Feeding
LMICs	Low and Middle Income Countries
MAD	Minimum Acceptable Diet
MAs	Medical Assistants
MDD	Minimum Dietary Diversity
MDGs	Millennium Development Goals
MMF	Minimum Meal Frequency
MMR	Maternal Mortality Ratio
MoHFW	Ministry of Health and Family Welfare
LGRD&Co	Local Government, Rural Development and Cooperatives
NGOs	Non Governmental Organizations
NMR	Neonatal Mortality Rate
NNP	National nutrition programme
NNS	National Nutrition Services
NSP	Nutrition Surveillance Project
OR	Odds Ratio
PHC	Primary Health Care
SAM	Severe Acute Malnutrition
SWAp	Sector-Wide Approach
TBAs	Traditional Birth Attendants
UHC	Upazila Health Complex
UNHFWC	Union Health and Family Welfare Centre
UNICEF	United Nations International Children's Emergency Fund

VGF	Vulnerable Group Feeding
WAZ	Weight-for-Age Z-score
WFP	World Food Programme
WHO	World Health Organization
WHZ	Weight-for-Height Z-score

Abstract

Introduction

Undernutrition among children under 2 years of age is a major public health problem in Bangladesh. The aim of this study was to understand the determinants which are contributing to the development of undernutrition among children under 2 years in context of Bangladesh.

Methods

Utilizing data from 2936 children aged 0-23 months included in the 2011 Bangladesh Demographic and Health Survey (BDHS), this study assessed the association between undernutrition and different determinants. Three anthropometric indices (stunting, underweight and wasting) were used to assess child's nutritional status. Both univariate and multivariate logistic regression analyses were done to find out the factors associated with child's nutritional status. A literature review was also done to guide the analysis.

Results

Study findings revealed that the prevalence of stunting, underweight and wasting was 34.5%, 27.9% and 15.4% respectively among children under 2 years of age. The multivariate results showed that children with low BMI mothers had 1.4 (95% CI [1.15-1.73], p=0.001) and 1.4 (95% CI [1.11-1.81], p=0.004) times more likely to be underweight and wasted than children with normal BMI mothers. Minimum dietary diversity, minimum meal frequency, minimum acceptable diet, prelacteal feeding, fever, diarrhoea, ARI, household food security, mother's antenatal care, region, age of the child, access to media, father's education, mother's education and wealth quintile were also important determinants associated with child's undernutrition.

Conclusion and Recommendation

This study concludes that undernutrition among children under 2 years of age is influenced by multiple factors and a multi-sectoral approach is required to improve the nutritional status of children in Bangladesh. Not only nutrition specific intervention but also nutrition sensitive approaches i.e. women empowerment, agriculture, education, social protection and safety net are required to reduce the burden of child undernutrition.

Keywords: Undernutrition, determinants, children under 2, interventions, and Bangladesh.

Word count: 12,372

Introduction

Undernutrition is a serious public health problem in Bangladesh. The levels of child undernutrition in Bangladesh are among the highest in the world. According to BDHS 2011, the prevalence of stunting, underweight, and wasting among under 5 children are 41%, 36% and 16% respectively. Among the under 5 children, those under 2 years of age are more vulnerable to undernutrition. First two years of life is a crucial time for health and cognitive development of a child. Poor nutrition during this period can lead to serious physical and cognitive retardation which is irreversible. It may cause long term consequences such as adult short stature, lower educational achievement, and reduced productivity. In addition, the consequences of undernutrition is intergeneration that means it passed across generations as low BMI mothers (undernourished) give birth to low birthweight babies. The problem of undernutrition can be tackled effectively if evidence based intervention are delivered before age of 2.

My education background is from nutrition field. I completed my Master degree in nutrition and food science in 2007. Thereafter I started my work in Centre for Woman and Child Health (CWCH) and got an opportunity to be involved in management of malnourished children. My working place is located in the middle of the garments industry area of Bangladesh. Poor female garment workers came to my hospital with malnourished children everyday. I was involved to counsel those mothers about breastfeeding, complementary feeding practices etc. From this experience I came to realize that not only poverty but also other factors like education, culture, and lack of knowledge are contributing to the development of malnutrition. I was interested to recognize the contextual factors that are contributing to the development of undernutrition among children under 2 years of age in Bangladesh. Therefore I chose the thesis regarding determinants of undernutition of under 2 children in context of Bangladesh.

Addressing undernutrition is very important as it can lead to achieve Millennium Development Goal (MDG) 1 in developing countries which will in turn increase the chance of achieving goals 4 and 5. Thus, Low and Middle Income Countries (LMICs) like Bangladesh it is an urgent need to find out the determinants of undernutrition and take effective action to eradicate it.

This thesis is organized in 6 chapters. Chapter 1 and 2 describes the country background, problem statement, justification, objectives and methodology. Chapter 3 presents the literature on determinants of undernutrition in Bangladesh. Chapter 4 analyzes the determinants of undernutrition among under 2 children. Chapter 5 gives a clear discussion and intervention activities to mitigate malnutrition. Chapter 6 concludes the thesis through providing recommendation to improve the nutrition situation for children under 2 years of age.

Chapter 1: Background information about Bangladesh

1.1 Geography and population:

Bangladesh is a densely populated South Asian country, surrounded by India and Myanmar. It has 147,570 square kilometers of area.[1] Population is almost 150 million and approximately 1,015 persons live in per square kilometer.[2] The country is divided into 7 divisions, 64 districts and 483 upazilas for administrative purpose.[3] Almost 72% of people live in rural areas.[4] Islam is the most dominated religion and 90% people are muslim which is followed by hindu (9%) and other religions (1%).[5]

Figure 1: Map of Bangladesh

Source: Worldatlas, 2013.

1.2 Socio-economic situation:

1.2.1 Housing characteristics

Average family member in a household is 4.6. Around 89% of household is headed by the men and only 11% are headed by the women. Almost 99% of households have access to an improved source of drinking water. In addition, one-third of the households use (34%) improved not shared toilet facility. More households in rural area (6%) have no toilet facility compared to urban area (1%). Access to electricity is increased from 47% in 2007 to 60% in 2011.[1] There is a disparity between urban (90%) and rural area (49%) in regard to access of electricity. Currently mobile phone user is 78%. Moreover, every 4 out of 10 households have television and most of the urban households have television.[1]

1.2.2 Economic context

Gross Domestic Product (GDP) growth rate is 6.32% in 2011-2012. Per capita income has increased from US$599 in 2007-08 to US$848 in 2011-2012.[6,7] Country has Gross national income is per capita $1940.[8] Though service sector contributes to more than half of the GDP but nearly two third of population are employed in the agriculture sector. 45% of labour forces are engaged in agricultural sector, 30% in industrial sector and 25% in service sector. Service sector contributes to 54.1% of the GDP which is then followed by industrial sector (28.6%) and agricultural sector (17.3%) respectively.[9] Textile industry is an emerging sector in Bangladesh and it employs nearly 3.2 million workers.[10] Despite recent high growth rates, 31.5% population people live under poverty line.[4] Sharp disparities exist between urban and rural area in regard to wealth quintile and urban people have better economic condition than rural people.[1]

1.2.3 Food production

Rice is the most dominating crop and more than 80% land is used for rice production. Very limited land is used for production of micronutrient rich crops such as vegetables, fruits, pulses and oilseeds. Production of non-agricultural crops such as meat, fish, milk, and egg are far below than the actual requirement of the people.[11]

1.2.4 Education

In 1990, Bangladesh government adopted a primary education policy to achieve universal primary enrolment by 2005. Government is providing free and equal primary education for all children.[12] Public expenditure on education as % of total government expenditure is 14.1% of GDP.[4] Almost 95% of people have attended school. In primary level, there is no gender difference according to school enrolment. But more men usually complete secondary or higher education than women. Overall, percentage of completion of secondary or higher education increased among both men and women since 2007. For men it increased from 12% to 15% in 2011 and for women it increased from 7% to 10% in 2011. Completion of secondary or higher education and levels of educational attainment is higher in urban than in rural area.[1]

1.3 Health and health care system

The health care system is basically centralized in nature and both public and private sector are providing health services. Both curative and promotive health services of the country are planned and managed by the Ministry of Health and Family Welfare (MoHFW). But delivery of health services including Primary Health Care (PHC) services in the urban area are managed by the Ministry of Local Government, Rural Development and Cooperatives (LGRD&Co). Since 1998, government has been pursuing a sector-wide approach (SWAp) to improve the effectiveness of the service and to provide the demand responsive service for country's population. With inclusion of nutrition the initial Health and Population Sector Programme (HPSP) of the period 1998 – 2003 was reformed by Health, Nutrition and Population Sector Programme (HNPSP) in 2003- 2010.[13] In Bangladesh total health expenditure is 3.7% of GDP. Majority of health expenditure is from private sector and almost 97% of health expenditure is from out of pocket (OOP).[14]

PHC services are delivered by three layers: community (ward), union and upazila. To revitalize the PHC services government has taken initiative to make the community clinics operational. These community clinics, serve 6000 rural people, are the unique example of community participation. As local community leaders and representatives, called Community Clinic Management Group, are responsible to manage these clinics.[13] Health Assistants (HAs) and Family Welfare Assistants (FWAs), namely domiciliary health staff, are providing services in community clinic each for 3 days a week alternatively. The Union Health and Family Welfare Centre (UNHFWC) provides outpatient care services and supervise the field activities at the community level and are staffed by Medical Assistants (MAs) and Family Welfare Visitors (midwife). The Upazila Health Complex (UHC), staffed by qualified medical practitioner, provides outpatient and inpatient health care services at sub district level and serves as the first level referral facility.[15] The district hospitals (100-250 beds) and medical colleges (650 beds) are providing curative care at secondary and tertiary levels respectively.[13,15]

The private sector facilities are mostly providing for-profit curative services and are gradually taking a big share of services at all levels.[15] In the private sector, there is a wide range of providers—private health practitioners, traditional healers, homeopathic practitioners, village doctors, and pharmacists. They vary by qualification, skill, experience, and type of health care practiced.[16]

1.4 Maternal and child health:

During pregnancy, around 68% of pregnant women received antenatal care (ANC) at least once from any kind of provider in Bangladesh and majority of them (55%) received care from a medically trained personnel. ANC service uptake from a medically trained provider is decreased with increasing age and birth order. In Bangladesh, still 71% of deliveries are home delivery and more than half of the deliveries (53%) are assisted by untrained Traditional Birth Attendants (TBAs). Only 29% of births are delivered at health facility and among them 12% in a public facility, 15% in a private facility, and 2% in an NGO facility. Use of facilities for delivery care is common among mothers who are educated, live in better wealth quintile and in urban area.[1] Bangladesh is on the way to achieve Millennium Development Goal (MDG) 5 and maternal mortality ratio (MMR) decreased from 322 in 2001 to 194/ 100,000 live births in 2010.[17]

In Bangladesh, approximately above 90% of children are fully vaccinated against vaccine preventable diseases.[18,19] The coverage of BCG is 93% or higher but coverage of measles vaccine is slightly lower (88%) than other vaccines.[1] Diarrhoea and pneumonia[1] are most common diseases among under 5 and they are within top ten causes of disability-adjusted life years (DALYs) in Bangladesh.[20] Bangladesh ranked 60 among the world list of under 5 mortality and under 5 mortality rate is 46/1000 live births. Among under 5 mortality, a major proportion of children died during infant and neonatal period. Infant mortality rate (IMR) is 37/ 1000 live births and neonatal mortality rate (NMR) is 26/1000 live births in Bangladesh.[18]

1.5 Nutrition situation in Bangladesh

1.5.1 Maternal and child nutrition:

In Bangladesh, 22% children are born with low birth weight (<2500gm). The prevalence of stunting, underweight and wasting among under 5 children is 41%, 36% and 16% respectively. Around 51% of children aged 6-59 months are anemic. Exclusive breastfeeding rate under 6 months of age is 64% and introduction of semisolid, solid food at 6-8 months of age is 71%.[18] Breastfeeding is universal and 90% of children breastfeed until age 2. Among age 6-23 months, only 21% are fed appropriately based on recommended infant and young child feeding (IYCF) practices. The prevalence of undernutrition (BMI <18.5) and obesity (BMI ≥25) is 24% and 17% respectively among women age 15-49 years. Over forty percent (42%) women age 15-49 years are anemic.[1]

1.5.2 National food and nutrition policy

The policy stipulates the need to incorporate nutritional objectives, component and consideration into development policies and programme. The strength of this policy implementation is that it is a consensus document emphasizing human rights, it will complement with other policies of the government and it has achievable broad goals and objectives with wide coverage.[21] But the major gap in the implementation of policy is the lack of implementation guidelines, an overly ambitious target, lack of monitoring and evaluation guidelines, lack of strong commitment, lack of earmarking of funds, inadequate leadership of the policy coordinator's authority and lack of attention to the lessons learned.[22]

1.5.3 National response to nutrition

National nutrition programme (NNP) under the HNPSP was the single provider of comprehensive nutrition intervention administered by the government and implemented by local NGOs.[23] Core component was to increase awareness and treatment of malnutrition, micronutrient supplementation for mother and child, growth monitoring, women empowerment etc. Although this programme was designed based on local needs but it only covered 30% of the country's population.[24] The efficacy of the programme has been questioned and in 2011 government stopped that programme. Under the Health, Population and Nutrition Sector Development Programme (HPNSDP, 2011-2016),[25] government replaced NNP with National Nutrition Services (NNS) to mainstream nutrition within the health system. NNS has targeted many different types of intervention like promotion of breastfeeding and complementary feeding, micronutrient supplementation, growth monitoring and promotion, promotion of Severe Acute Malnutrition (SAM). [26] All these activities will be guided by NNS operation plan. In Bangladesh vitamin A supplementation programme is scheduled with measles vaccination and now coverage is 60% among under 5 children.[1] To reduce iodine deficiency disorders (IDD) government has taken different initiatives. A variety of other stakeholders such as Alive and Thrive (A&T), Bangladesh Rural Advancement Committee (BRAC), World Food Programme (WFP), and Helen Keller International (HKI) are implementing different small scale interventions in some targeted areas.

Chapter 2: Problem statement, justification, objectives and methodology

2.1 Problem statement

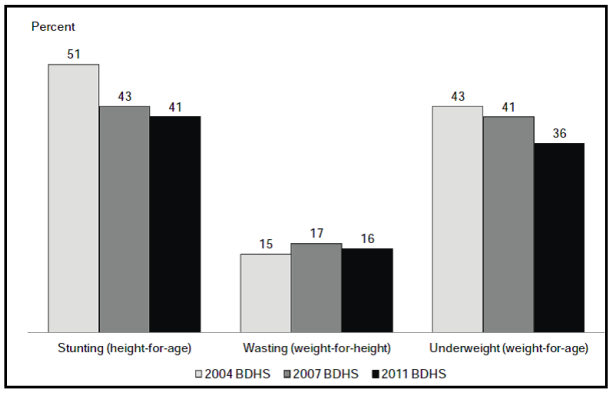
Undernutrition is the serious health problem and the single largest contributor to child mortality.[27] Globally, undernutrition is responsible for 3.1 million deaths of children under 5 annually which constitute 45% of all child deaths in 2011.[28] Around 11% of total global DALYs are lost because of child undernutrition.[29] Globally, it is estimated that the prevalence of stunting among under 5 has decreased from 40% in 1990 to 26% in 2011 and more than 90% of stunted children live in Africa and Asia. Prevalence of underweight also declined from 25% in 1990 to 16% in 2011. Though prevalence of both stunting and underweight has decreased but it is not satisfactory level and still millions of children remain at risk. In addition, prevalence of wasting is 8% among under 5 children and around 70% of wasted children live in Asia. These children have increased risk of SAM and death.[27] Most of the Asian countries are now going through rapid economic growth but still undernutrition remains a big challenge for them especially for South Asian countries.[30] The prevalence of stunting, underweight and wasting in South Asia is 39%, 33% and 16% respectively which is much higher than the global figure. Moreover, the prevalence of undernutrition in India, Bangladesh, Afghanistan, and Pakistan is 38-51% which is even much higher than the sub-Saharan Africa (26%).[31]

First two years of life is a crucial time for health and cognitive development of a child. Poor nutrition during this period can lead to serious physical and cognitive retardation which is irreversible. It may cause long term consequences such as adult short stature, lower educational achievement, reduced productivity and chronological malnutrition that means it passed across generations as low BMI mothers (undernourished) give birth to low birthweight babies.[32] In addition, undernutrition during this time also has short term consequences such as mortality, morbidity and disability. Undernourished children are at high risk of developing chronic diseases in later life if they gain rapid weight after infancy. According to Lancet child survival series 2008, undernutrition accounts for the cause of one third of under 5 child deaths and disease burden and effective interventions targeted at under 2 child can mitigate this problems.[33,29]

Undernutrition remains a serious public health problem in Bangladesh.[24,34] Like South Asian countries, the levels of child undernutrition in Bangladesh are among the highest in the world. The prevalence of stunting among under 5 children was 51% in 2004. Although it decreased to 43% in 2007 but after that there was little change since 2011 (41%). (See figure 2). Among all stunted children in 2011, 15% are severely stunted. Stunting is more prevalent among 18-23 months age group and is slightly higher among female children (42%). In addition, over the 7 years periods underweight decreased from 43% in 2004 to 36% in 2011 and among them 10% children are severely underweight. Underweight is mostly common among children age 36-47 months. Female children are slightly more underweight (39%) than male (34%) children. In between 2004 to 2011, there is little change for the percentage of wasted children. Level of wasting increased from 15% in 2004 to 17% in 2007 and again declined to 16% in 2011. Male children are slightly more likely to be wasted (16%) than female children (15%) and wasting is

more common among children 18-23 months. A study analyzed nationally representative data showed that prevalence of stunting, underweight and wasting among children under 2 years of age is 33.6%, 34.7% and 21.4% respectively.[35]

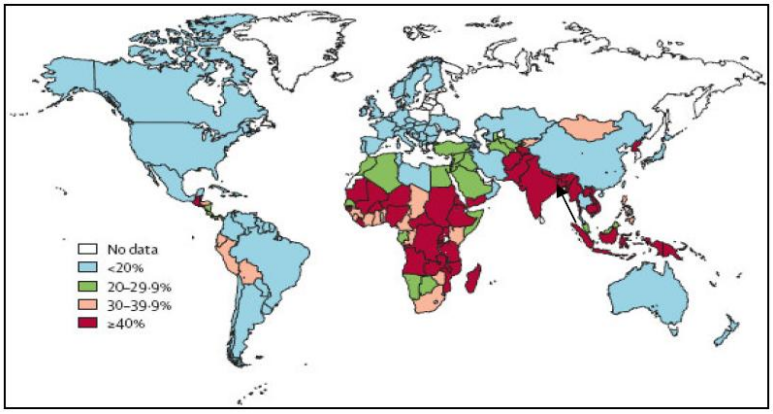
Figure 2: Trends in nutritional status of children under 5 years of age, 2004, 2007, and 2011



Source: BDHS, 2011.

Since 2004, the nutritional status of children has improved but Bangladesh still remains in the list of high prevalence country. (See figure 3).

Figure 3: Global prevalence of stunting among <5 years



Source: Lancet, 2008.

Bangladesh has made significant improvement in achieving some of the health indicators such as MMR decreased from 322 in 2001 to 194/ 100,000 live births in 2010 and IMR fell from 87 in 1993 to 43/1000 live births in 2011,[36,1] as well as under 5 mortality dropped from 148 in 1990 to 53/ 1000 live births deaths in 2011.[37,1] In spite of considerable progress in some health indicators but still maternal and child nutrition remains the neglected agenda. Only since 2003 nutrition issues started to receive attention from government.

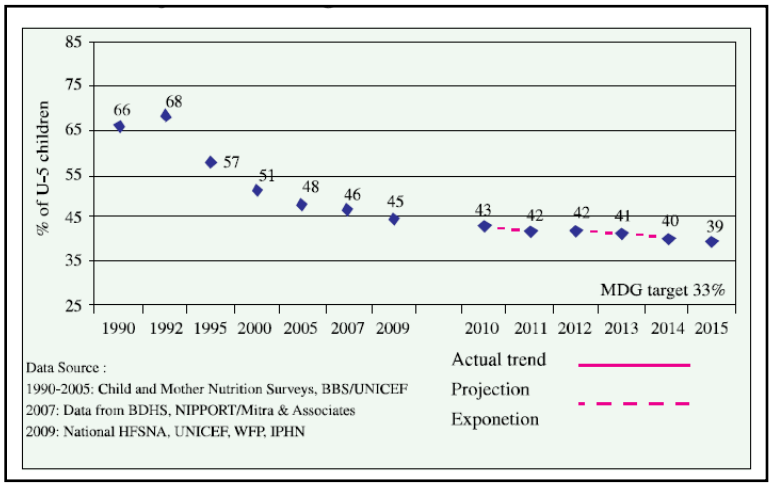
2.2 Justification

For a child, first two years of life is a crucial time for health and cognitive development. Undernutrition has long term, irreversible, and intergenerational consequences for children under 2 which may result in

increased morbidity and mortality, high disease burden, short adult size, low school performance, and low productivity. All these factors are negatively linked with economic development of a country.[31] So, it is important to prevent undernutrition of under 2 children which will in turn improve the overall nutritional situation and will increase the productivity of the country.

Improvement of maternal and child nutrition is the precondition for the economic development of the country. There is strong correlation between undernutrition and poverty and for that reasons the 2nd target of MGD 1 is to halve the under 5 underweight rate by 2015 from its 1990 level. Presence of undernutrition is not only contributing to the failure of achievement of MDG 1 but also is contributing to the failure of other MDGs such as MDG 4 (reducing under 5 mortality) and MDG 5 (improving maternal health). Actually it is interlinked with all other MDGs.[31] In between 2000 and 2005, Bangladesh has made significant progress to achieve the high rates of economic growth and in reducing poverty rates by 9% (from 49% to 40%), but still this country is far from being on track for achieving the 2nd target of MDG 1. Though Bangladesh government made promise to achieve MDGs 1, 4 and 5 by 2015 but Bangladesh's MDGs progress report 2011[38] mentioned that it is not possible to the reach the MDG target of 33% prevalence rate of underweight by 2015. (See figure 4). Recent data of UNICEF[39] also noticed that Bangladesh's progress towards achieving the MDG 1 is insufficient.

Figure 4: Actual and projected underweight rates for children under 5 years



Source: Bangladesh MGDs progress report 2011.

Interaction of multiple factors is accountable for the occurrence of undernutrition.[29] A framework developed by UNICEF[40] (See figure 5) showed that social, political, economic and environmental causes are interplayed for the development of undernutrition. In Bangladesh, there are limited studies regarding the determinants of under nutrition among children under 2 years of age. Several studies[41,42,43,44,45,46] have been done by analyzing nationally representative data to find out the determinants of undernutrition among under 5 children but from those studies very little is known about determinants of undernutrition for under 2 children. Three studies[47,48,35] have reported the determinants of undernutrition for under 2 children in context of Bangladesh. But two of them are not representative of whole country and one study only examined the association of IYCF indicators and

undernutrition. Bangladesh, like many other LMICs, is going through demographic and nutrition transition and lifestyle and dietary pattern of the people is changing frequently. So, these study findings are not enough to take concerned decision about the intervention to reduce undernutrition for under 2 children.

Intense nutrition intervention in developing countries can lead to achieve MDG 1 which will in turn increase the chance of achieving MDG 4 and 5. The new NNS under the government nutrition operation plan (HPNSDP) for 2011-2016[49] will be implemented with different nutrition interventions all over the country. According to lancet 2013, if only ten evidence-based interventions with 90% coverage can reach to people then it can reduce 15% of total death among under 5 children.[50] From the above scenario it is evident that this is the right time now to find out the determinants of undernutrition of under 2 children in Bangladesh. Therefore, this study will find out the determinants of undernutrition of under 2 children in order to guide the policy maker and stakeholders to take concerned decision about implementation of feasible and evidence based interventions and resource allocation which will improve the survival and nutritional status of under 2 children in the country.

2.3 Objectives:

2.3.1 General objective:

This paper aims to identify the determinants of undernutrition among children under 2 years of age in order to provide recommendations to policymakers and stakeholders to improve the nutritional status of under 2 children in Bangladesh.

2.3.2 Specific objectives:

- To explore the determinants of undernutrition among children under 2 years of age in Bangladesh using a literature review.
- To analyze the key determinants of undernutrition (stunting, underweight and wasting) among children under 2 years of age using Bangladesh Demographic Health Survey (BDHS) datasets.
- To provide recommendations based on the study findings to policymakers and stakeholders for the improvement of nutritional status of under 2 children in Bangladesh.

2.4 Methodology:

2.4.1 Target population of the study:

Children under 2 years of age.

2.4.2 Source of data:

Bangladesh DHS 2011 datasets which are available in MEASURE DHS website has been accessed and downloaded for further analysis to determine the determinants of undernutrition among children under 2 years of age. The data has been used after taking required approval by the author from the MEASURE DHS archive.

2.4.3 Methodology of the DHS and sample size of the thesis:

Data analyzed for the thesis was Bangladesh DHS 2011 which used a two stage stratified sample of household. 600 EAs (enumeration areas) were selected at first stage of sampling with 393 clusters in rural areas and 207 clusters in urban areas. All household under each EA were listed which were then used as sampling frame for the second-stage selection of household. By using an equal probability systematic sampling technique, on average 30 households were selected from per EA. The survey was expected to get complete interview of 18,072 ever-married women aged 15–49 years. Finally, 17,842 ever married women were interviewed, yielding a response rate of 98%. Among 17,842 interviewed women, 6,196 and 11,646 were interviewed from urban and rural area respectively. The present analysis was included all the youngest living children under 2 years who were alive and living with respondent (ever-married women age 15–49 years). A total of 3202 eligible children under 2 years of age met the inclusion criteria. Due to missing anthropometric data we excluded 278 children. So after excluding those children, sample size was 2924 and the total weighted sample size was 2936.

2.4.4 Independent variables

Variables focused in this thesis are age of the child, sex of the child, region, types of residence, father's education, father's occupation, access to media, source of drinking water, toilet facility, morbidity history such as fever, diarrhoea and Acute Respiratory infection (ARI), mother's education, mother's age during child birth, antenatal care visit (ANC), mother's body mass index (BMI), birth order, place of delivery, prelacteal feeding, household food security and wealth quintile. Three variables namely household food security, wealth quintile and access to media are composite variables. The wealth index which reflects the socioeconomic condition of the household is an assets based index. This index is mostly used in developing countries to measure the inequalities and to control the confounding effect of socioeconomic variables. This variable includes ownership of some assets (e.g. refrigerator, television), housing characteristics (e.g. materials of wall, floor, and roof) and access to services (e.g. electricity). Access to media, is also a composite indicator which developed based on three variables whether they listen radio, watch television and read newspaper or magazine. It was divided into two categories where 'yes' means household had access to at least one of these media and 'no' means no access to media. Food insecurity questions were included in BDHS 2011 questionnaire and the reference period for the food insecurity assessment was 12 months preceding the survey to allow the seasonal variation. All IYCF indicators were calculated by using WHO indicators for IYCF practice.[51] The indicators are early initiation of breastfeeding; exclusive breastfeeding <6 months; introduction of solid, semi-solid or soft foods at 6-8 months; continued breastfeeding at 1 year; minimum dietary diversity (MDD); minimum meal frequency (MMF); and minimum acceptable diet (MAD). In this study, MDD was defined as proportion of children aged 6-23 months who received four or more food groups out of seven. MMF was defined as proportion of all 6-23 months children (both breastfeed and non breastfeed) who received solid, semi-solid or soft foods the minimum number of times or more. Minimum was defined according to WHO guideline (see **annex 2**). MAD, a composite indicator, was calculated from two fractions; breastfeed children who received at least the MDD and MMF; and non breastfeed who had received at least the MDD and MMF including two milk feedings during previous day.

2.4.5 Dependent variables

Height-for-age Z-score (HAZ), weight-for-age Z-score (WAZ) and weight-for-height Z-score (WHZ)-these three anthropometric indices were calculated based on the WHO growth standards and used to measure the nutritional status of children. Stunting, underweight and wasting were defined as being less than 2 SD below the median of the WHO reference population in terms for HAZ, WAZ and WHZ respectively.

2.4.6 Statistical analysis

Stunting, underweight and wasting were examined against a set of independent variables to determine the prevalence and factors associated with undernutrition among children under 2 years of age. Analysis was performed by using SPSS version 11.5 programme. A chi-squared test was used to estimate the undernutrition among exposed and non-exposed group. The logistic regression was run to calculate the both unadjusted and adjusted odds ratio for the different independent variables. After univariate analysis, we constructed a multivariate regression model by the following procedure: only variables which showed significant ($p<0.05$) result with the outcome variable in the univariate analysis was entered into the final model; the potential confounders were included in the analysis; and we also considered multi-colinearity. We ran separate regression model for each outcome variable and the model included all significant variables from univariate analysis and potential confounders. The final results of multivariate regression analysis were presented by odds ratios (ORs) with 95% confidence interval.

2.4.7 Search strategy

A literature review was conducted in order to collect evidence to support the conceptual framework for data analysis. Databases such as PubMed, Google, Google Scholar and Hinari were used to search the relevant information. My keywords were determinants of undernutrition, under 2 children, Bangladesh, socio-demographic determinants, morbidity, feeding practices, environmental factors, interventions, strategies, programme, IYCF promotion intervention, micronutrient supplementation, and poverty alleviation.

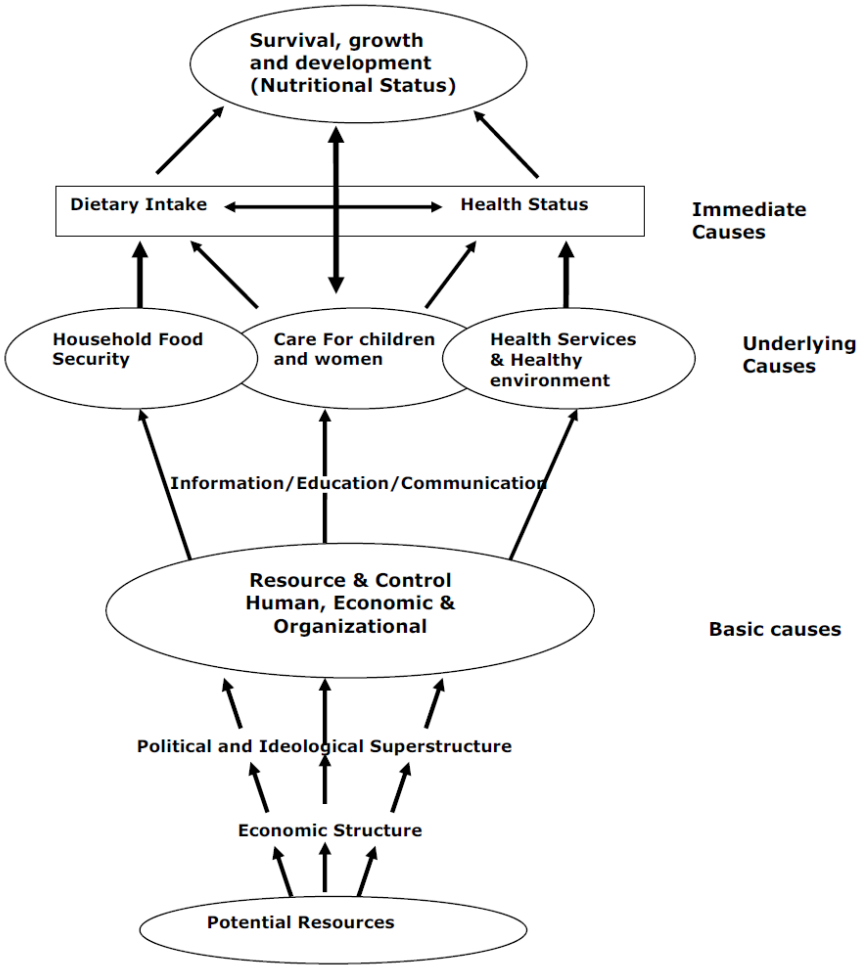
2.4.8 Limitations of the study

- The data is cross sectional in nature so selection and recall bias could affect the results.
- Some limited proxy indicators have been used for analysis.
- Important determinants like mother's knowledge on nutrition, hygiene practices have not been analyzed. As these data were not available in DHS datasets, analysis of these indicators could be considered for future.
- For literature review, this study broadened the age group up to under 5 as study for under 2 children is very limited in context of Bangladesh.

2.4.9 Conceptual framework

Interaction of multiple determinants such as individual, community, and societal level factors are responsible for child undernutrition. The conceptual frame work develop by UNICEF[40] will be used to analyze the determinants of undernutrition of under 2 children in context of Bangladesh.

Figure 5: Conceptual framework for immediate, underlying, and basic determinants of child undernutrition



Adapted from UNICEF 1990

Chapter 3: Literature review

There are limited studies on determinants of undernutrition among children under 2 years of age in context of Bangladesh. Very little is known about the determinants of undernutrition among children under 2 years of age. In order to analyze the determinants of undernutrition, this thesis reviewed literature to understand the immediate, underlying and basic causes which influence the development of undernutrition of under 2 children in Bangladesh. Because of scarcity of literature, the age group was broadened up to under 5 years with extrapolations made to children under 2 where possible.

3.1 Immediate causes:

3.1.1 Dietary intake:

The literature suggests that there is strong association between dietary intake and undernutrition of children of under 2 years. A study was done to find out the relation of IYCF indicators and undernutrition of under 2 children by using 2007 Bangladesh DHS data and it showed that dietary factors such as exclusive breastfeeding under 6 months of age, MDD and MAD were important factors related with undernutrition of under 2 children. Exclusive breastfeeding acted as a protective factor against wasting among children of <6 months. Children who achieved MDD and a MAD had lower level of stunting and underweight than children who did not achieve MDD and a MAD.[35]

Another study conducted in Bangladesh showed that frequency of complementary feeding was significantly associated with stunting. Children who received frequent complementary feeding were less likely to be stunted compared to children who did not receive frequent complementary feeding.[44]

3.1.2 Health Status or morbidity history:

Research showed poor health status or morbidity is closely linked with nutritional status of children. A study investigated the determinants of child malnutrition of Bangladesh using BDHS 2004 data and it showed that incidence of some diseases such as fever, ARI and diarrhoea were the significant predictors of child malnutrition. Children who suffered from ARI, fever and diarrhoea within last 2 weeks of the survey had 1.2, 1.3 and 1.2 times higher risk of being underweight respectively in comparison to children with no such health problems.[52] Another study showed that presence of ARI was the risk factor associated with wasting.[53]

A study in rural Bangladesh showed that presence of diarrhoea within previous 2 weeks of survey was a risk factor associated with stunting. Children with Diarrhoea in the previous two weeks were 1.2 and 1.1 times more likely to be moderately and severely stunted than children without diarrhoea. The study also noted that highest rate of diarrhoea occurred among undernourished children which actually reflect the vicious cycle of the malnutrition–infection interaction.[47]

3.2 Underlying causes:

3.2.1 Household food security:

HKI Bangladesh has done a study by using nationally representative Nutrition Surveillance Project (NSP)'s data and showed that household food insecurity was an important determinant of

undernutrition. Children from food insecure household were more stunted than children from food secure households.[54] Another study showed that children from food insecure households had 1.2 times higher risk to be stunted and underweight than children from food secure households.[55]

3.2.2 Caring for women and children

Siddiqi et al. analyzed Bangladesh's DHS 2007 data and showed that mother's age during child birth was associated with undernutrition of children. Study result demonstrated that children with mother's age less than 20 years were 1.2 and 1.3 times more likely to be stunted and underweight than children with mother's age 20 years or more.[42] Another study also showed that mother's age during child birth was the determinant for stunting.[56]

Rayhan et al. investigated the determinants of undernutrition among children in Bangladesh and showed that maternal nutritional status has a significant effect on the nutritional status of their children. Children whose mothers had normal BMI were 30% less likely to be underweight compared to children whose mother had low BMI.[46] Other studies in context of Bangladesh showed that maternal BMI was a risk factors for stunting[41,42,45, 47, 56,57,58], underweight[42,47,52] and wasting[42,46,47,53].

Research conducted in Bangladesh showed that birth order of the child was significantly associated with chronic undernutrition of children. Results of three studies illustrated that the risk of being severely stunted was lower for first, third and fourth order births than fifth or higher order births.[41,45,59]

Evidence showed that following recommended feeding practices had positive effects on nutritional status of children. A cohort study has been done in Bangladesh to see the causal relation between infant feeding practices (e.g. 1st hour initiation of breastfeeding, complementary feeding and prelacteal feeding practices) and child growth. The study results revealed that children who practiced recommended feeding had lower risk to be stunted, underweight, and wasted than children who did not practice recommended feeding.[60]

3.2.3 Environmental factors and utilization of health services:

Research conducted in Bangladesh to examine the predictors of undernutrition by using 2007 BDHS data showed that source of drinking water was a predictor for undernutrition among children. Study result revealed that children who drank piped water and tubewell water were 21% and 29% less likely to be wasted than the children who drank other sources of water.[43]

A study conducted in rural Bangladesh to find out the determinants of undernutrition among under 2 children by using NNP baseline survey data and showed that use of unhygienic toilet was significantly associated with undernutrition of children. Children whose families used un-hygienic toilet had higher level of moderate stunting and underweight than children whose families used hygienic toilet.[47] Other studies[41,43,59] also showed that toilet facility was the significant predictor for stunting and wasting.

Evidence showed that place of delivery has a significant effect on the chronic malnutrition of children in context of Bangladesh.[56,45] A study conducted in Bangladesh demonstrated that children delivered at

home with traditional delivery systems had 1·4 and 1·5 times higher risk of moderate and severe stunting than children born in hospital.[45]

Research showed that uptake of antenatal service was positively associated with better nutritional status of their children. Studies conducted in Bangladesh showed that children whose mothers had no ANC visits were 1.2 and 1.5 times more likely to be stunted[42] and underweight[57] than children whose mothers had ANC visits.

3.3 Basic causes

3.3.1 Socio-demographic factors:

A study investigated the effect of some socio-demographic, community and health factors on the chronic malnutrition in Bangladeshi children and showed that geographical region was significantly associated with stunting. The prevalence of stunting was highest among the children of Sylhet division compared to other divisions in Bangladesh.[45] Other studies also showed that geographical location had a strong association with chronic malnutrition.[41,56,57,59]

Research conducted in Bangladesh showed that risk of being undernourished increased with increasing age. The study noted that the risk of having underweight was 6.5 times higher among the children belonging to the age group 12-23 months compared to the infants.[52] Age of the child is a determinant for stunting[56, 41,45,57,59], underweight[52,59] and wasting[53,59] as described by many studies .

A study conducted in Bangladesh showed that sex of the child had a strong significant effect on the undernutrition and male child had a higher risk of being stunted, underweight and wasted. Study result marked that female children had 30% and 20% less risk to be moderately stunted and underweight than males.[47]

Research conducted in Bangladesh showed that father's education was significantly related to the nutritional status of their children. Study results revealed that children whose father had no formal education and primary education were 2.3 and 1.9 times more likely to be severely stunted than children whose fathers had higher education.[41] Other studies also demonstrated that father's education is a strong determinant for stunting[42,44,45,59], underweight[42,46,59] and wasting[42,43] in context of Bangladesh.

Alom et al. has done a study and showed that father's occupation has a significant effect on the nutrition outcomes of their children. The study results illustrated that children were more likely to be stunted and wasted if their fathers were involved in agriculture compared to business and service.[59]

Rahman et al. conducted a study in Bangladesh and showed that exposure of media to mother was significantly associated with undernutrition of children. Study findings demonstrated that the risk of being severely wasted was 2.5 times higher among the children whose mothers had no media exposure compared to children whose mother had media exposure.[53] Another study showed that media exposure to mother was significantly associated with stunting.[45]

Research in Bangladesh showed that the prevalence of stunting was 35% and 36% times higher among children whose mothers had no education and primary education compared to children whose mothers had higher education.[42] Other studies in context of Bangladesh showed that maternal education has a strong significant effect on stunting[46, 47,45,57] , underweight[47,42,52] and wasting[42,43,47,59] .

Research has been done in Bangladesh to identify the relationship between wealth inequality and chronic childhood undernutrition and showed that wealth quintile had the strong significant effect on chronic undernutrition. Study result showed that children from the lowest wealth quintile were 3 times more likely to suffer from chronic malnutrition than children from richest wealth quintile.[56] Several studies showed that household economic condition is the most strongest determinants of stunting,[47, 42,41,45,57,59] underweight[47,42,52,59] and wasting[43,47,42].

To analyze the basic, underlying and immediate causes of malnutrition, this study selected some proxy indicators under each cause which will guide to interpret the results. These proxy indicators are described in the **table 1**.

Table 1: Proxy indicators for immediate, underlying and basic causes of undernutrition

Causes	Proxy indicators
Immediate causes	
Dietary intake	• Exclusive breastfeeding <6 months • MDD • MMF • MAD
Health status or morbidity	• Diarrhoea • ARI • Fever
Underlying causes	
Household food security	• Household food security
Care for women and children	• Mother's age at child birth • Mother's BMI • Birth order • Prelacteal feeding • Initiation of breastfeeding • Introduction of soft, semisolid or solid food at 6-8 months • Continued breastfeeding at 1 year
Environmental factors and utilization of health services	• Toilet facilities • Sources of drinking water • Place of delivery • Mother's ANC visits
Basic causes	
Socio-demographic factors	• Region • Type of residence • Age of the child • Sex • Father's education • Father's occupation • Access to media • Mother's education • Wealth index

Chapter 4: Study results

4.1 Sample characteristics

Child's age was distributed into 4 different categories: 0-5 months (23.4%), 6-11 months (27.6%), 12-17 months (26.5%), and 18-23 months (22.5%). Among all children, 50.8% of children were male and 49.2% were female. More than three fourth of children (77.5%) lived in rural areas whereas only 22.7% lived in urban areas. The majority of mothers of under 2 children (53.6%) had secondary and higher education, 30.1% had primary education and 16.3% of mothers had no education. In addition, 21.8% children were in the poorest wealth quintile and 19.8% in the middle and 17.8% were in the richest wealth quintile. 76% of households had tubewell for source of drinking water and 9.7% had piped water. Moreover, 54.3% used hygienic toilet and 45.7% used non-hygienic toilet. One third of children (34.5%) were stunted, 27.9% children were underweight, and 15.4% were wasted. Over sixty percent of children (62.7%) under 6 months were exclusively breastfeed. Some of the sample characteristics of the child and other IYCF indicators are showed in **annex 3** and **annex 4**.

Below is a graphical presentation of some of the sample characteristics of under 2 children.

Figure 6: Sex distribution (%) of children

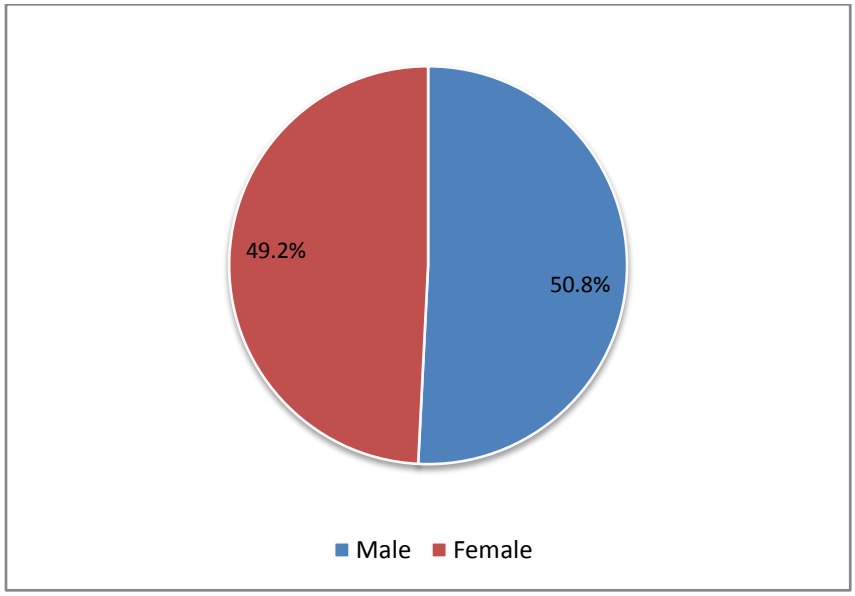


Figure 7: Distribution of mother's (%) educational level

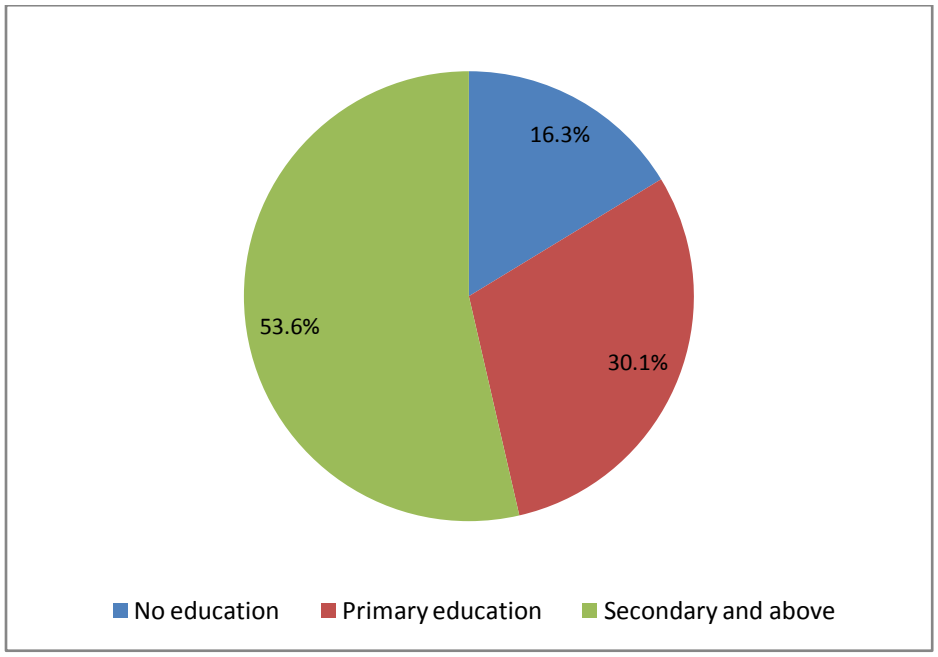


Figure 8: Percentage of children with different types of undernutrition

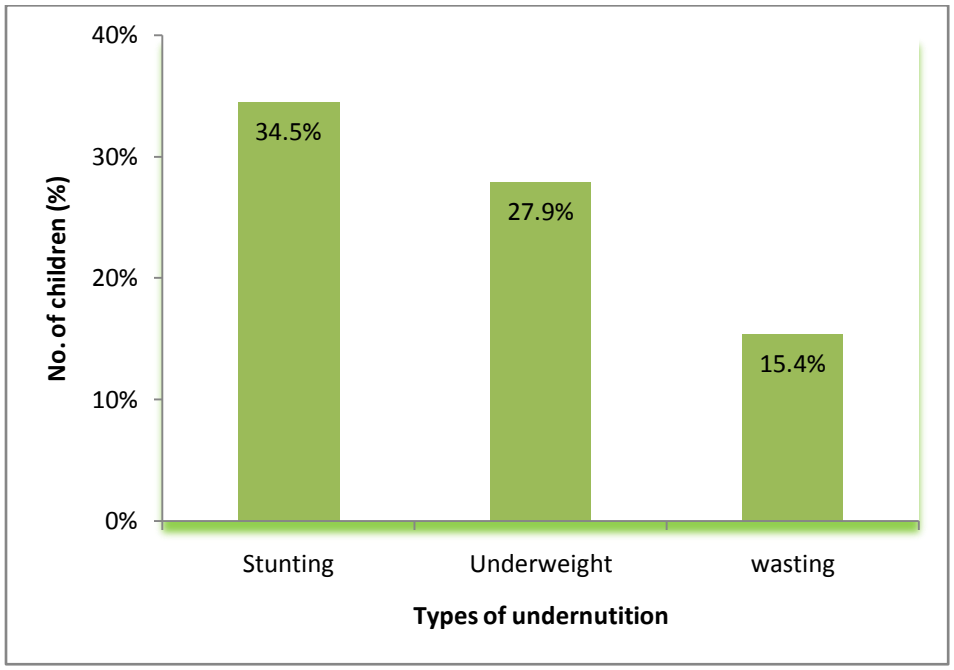


Figure 9: Age distribution (%) of children

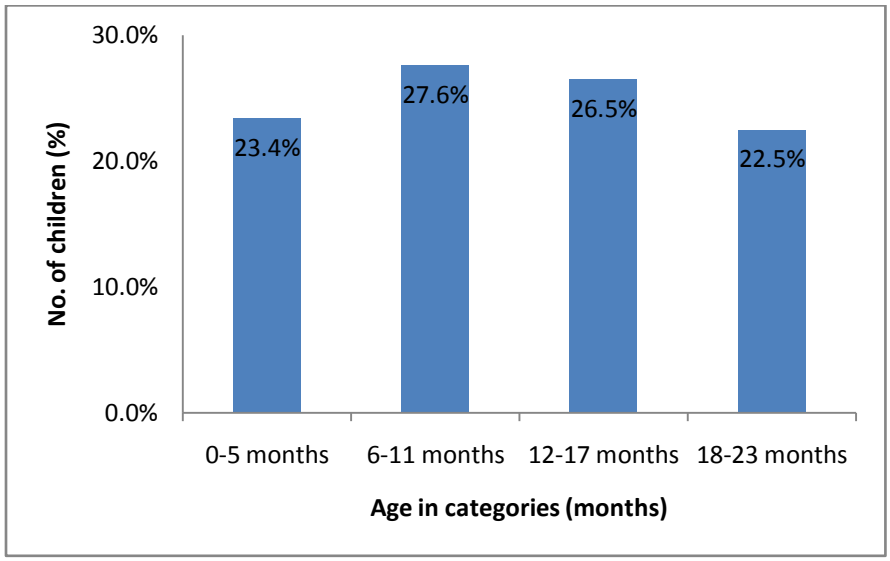
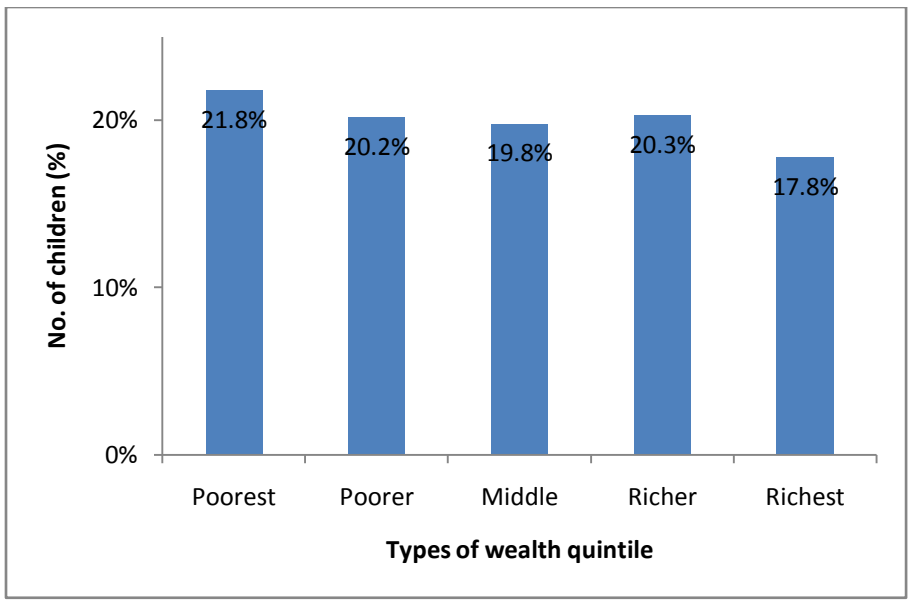


Figure 10: Distribution of children (%) by wealth quintile



4.2 Results of univariate and multivariate analysis

4.2.1 Immediate causes:

4.2.1.1 Dietary intake

Exclusive breastfeeding showed insignificant association in univariate analysis so it was not included in multivariate analysis. The prevalence of stunting, underweight and wasting was 38.4%, 23.5% and 12.6% respectively among children who ate minimum 4 groups of food.

Table 2: Association between dietary intake and undernutrition of under 2 children

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Minimum dietary diversity for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	555	38.4% (213)	555	23.5% (130)	555	12.6% (70)
No	1687	40.1% (677)	1687	34.2% (577)	1687	16.2% (274)
Minimum meal frequency for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	1399	40.5% (566)	1399	28.7% (401)	1399	14.0% (196)
No	801	38.3% (307)	801	35.8% (287)	801	17.6% (141)
Minimum acceptable diet for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	451	40.9% (184)	451	23.5% (106)	451	12.5% (56)
No	1704	39.2% (668)	1704	33.1% (564)	1704	15.9% (271)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
Minimum dietary diversity for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	1		1		1	
No	1.5 (1.30-1.81)	0.000	1.9 (1.59-2.29)	0.000	1.1 (0.09-1.40)	0.274
Minimum meal frequency for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	1		1		1	
No	0.9 (0.81-1.12)	0.589	1.3 (1.13-1.57)	0.001	1.1 (0.91-1.38)	0.283
Minimum acceptable diet for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	1		1		1	
No	1.5 (1.27-1.80)	0.000	1.9 (1.59-2.34)	0.000	1.0 (0.87-1.36)	0.441
Multivariate analysis						
Variable	**Adjusted OR (95% CI) for stunting**	**P-value**	**Adjusted OR (95% CI) for underweight**	**P-value**	**Adjusted OR (95% CI) for wasting**	**P-value**
Minimum dietary diversity for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	1		1			
No	1.2 (0.98-1.44)	0.020	1.3 (1.06-1.62)	0.012		
Minimum meal frequency for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes			1			
No			1.3 (1.05-1.51)	0.013		
Minimum acceptable diet for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes			1			
No			1.3 (1.06-1.67)	0.012		

Initially, the result of univariate analysis showed that MDD and MAD had significant association with stunting and underweight but MMF had significant association only with underweight. Detailed description of univariate analysis can be found in **annex 5.** After running multivariate analysis with all significant variables from univariate analysis, MDD showed significant association with stunting and

underweight. Those children who did not eat minimum 4 groups of food were 1.2 (95% CI [0.98-1.44], p=0.020) and 1.3 (95% CI [1.06-1.62], p=0.012) times likely to be stunted and underweight than those who ate minimum 4 groups of food. In addition, MMF and a MAD showed significant association with underweight. Children who did not have MMF were 1.3 (95% CI [1.05-1.51], p=0.013) times likely to be underweight compared to children who had MMF. Moreover, the chance of being underweight was 1.3 (95% CI [1.06-1.67], p=0.012) times higher among children who did not achieve a MAD compared to children who achieved a MAD.

4.2.1.2 Health status or morbidity history of children

The prevalence of stunting and underweight were 45.1% and 33.2% among children with ARI. Children with diarrhoea had 42.4%, 37.2% and 22.6% of stunting, underweight and wasting respectively.

Table 3: Association between morbidity history and undernutrition of children under 2 years of age

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
ARI						
Yes	200	45.1% (90)	200	33.2% (66)	200	11.6% (23)
No	2728	33.9% (924)	2728	27.5% (750)	2728	15.6% (425)
Fever						
Yes	1275	36.8% (469)	1275	32.7% (404)	1275	16.8% (214)
No	1661	32.8% (545)	1661	25.0% (415)	1661	14.2% (237)
Diarrhoea						
Yes	196	42.4% (83)	196	37.2% (73)	196	22.6% (44)
No	2741	34.0% (932)	2741	27.2% (746)	2741	14.8% (407)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
ARI						
Yes	1.6 (1.23-2.19)	0.001	1.3 (1.09-1.85)	0.037	0.7 (0.47-1.13)	0.166
No	1		1		1	
Fever						
Yes	1.2 (1.03-1.40)	0.016	1.4 (1.19-1.65)	0.000	1.1 (0.96-1.45)	0.099
No	1		1		1	
Diarrhoea						
Yes	1.2 (0.93-1.69)	0.123	1.6 (1.20-2.19)	0.001	1.6 (1.19-2.41)	0.003
No	1		1		1	
Multivariate analysis						
Variable	**Adjusted OR (95% CI) for stunting**	**P-value**	**Adjusted OR (95% CI) for underweight**	**P-value**	**Adjusted OR (95% CI) for wasting**	**P-value**
ARI						
Yes	1.6 (1.13-2.17)	0.006				
No	1					
Fever						
Yes			1.2 (1.01-1.46)	0.035		
No			1			
Diarrhoea						
Yes					1.5 (1.06-2.22)	0.022
No					1	

ARI and fever were significantly associated with stunting and underweight in univariate analysis. Diarrhoea showed significant association with underweight and wasting. (See **annex 5**). After controlling the potential confounders by using multivariate analysis, ARI only remained the significant risk factor for stunting. Children with ARI during last 2 weeks were 1.6 (95% CI [1.13-2.17], p=0.006) times likely to be stunted compared to the children who had no ARI. Fever showed significant association with underweight. Children with fever were 1.2 (95% CI [1.01-1.46], p=0.035) times more likely to be underweight than those children who had no fever. Children with diarrhoea were 1.5 (95% CI [1.06-2.22], p=0.022) times more likely to be wasted compared to their healthy counterpart.

4.2.2 Underlying causes:

4.2.2.1 Household food security

The prevalence of stunting, underweight and wasting was 47.7%, 46.7% and 21.8% among the moderate food insecure household.

Table 4: Association of household food security and undernutrition of children under 2 years of age

Variables	Total number (N)	% Stunted (n)	Total Number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Food security						
Food secure	1919	31.2% (598)	1919	23.0% (441)	1919	14.1% (270)
Mild food insecure	761	39.3% (299)	761	34.6% (263)	761	16.5% (125)
Moderate food insecure	213	47.7% (101)	213	46.7% (99)	213	21.8% (46)
Severe food insecure	35	40.1% (14)	35	36.1% (13)	35	24.3% (8)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
Household food security						
Food secure	1		1		1	
Mild food insecure	1.4 (1.23-1.76)	0.000	1.8 (1.53-2.27)	0.000	1.1 (0.88-1.43)	0.331
moderate food insecure	2.3 (1.76-3.12)	0.000	2.8 (2.15-3.84)	0.000	1.5 (1.07-2.19)	0.019
Severe food insecure	1.1 (0.60-2.22)	0.654	1.5 (0.80-3.05)	0.185	1.4 (0.67-3.22)	0.332
	P=0.000		P=0.000		P=0.091	
Multivariate analysis						
Variable	**Adjusted OR (95% CI) for stunting**	**P-value**	**Adjusted OR (95% CI) for underweight**	**P-value**	**Adjusted OR (95% CI) for wasting**	**P-value**
Food security						
Food secure	1		1			
Mild food insecure	1.1 (0.94-1.42)	0.164	1.3 (1.06-1.62)	0.011		
moderate food insecure	1.4 (1.07-2.07)	0.018	1.4 (1.05-2.01)	0.024		
Severe food insecure	0.7 (0.3-1.4)	0.341	0.7 (0.36-1.55)	0.441		
	P=0.049		P=0.014			

In univariate analysis, household food security showed significant association stunting and underweight. (See **annex 5**). After running multivariate regression with all confounders, household food security showed significant association with stunting and underweight. The risk of being stunted was 1.4 (95% CI [1.07-2.07], p=0.018) times higher among the children whose household had moderate food insecurity compared to children whose household had food security. Children from mild and moderate insecure household were 1.3 (95% CI [1.06-1.62], p=0.011) and 1.4 (95% CI [1.05-2.01], p=0.024) times likely to be underweight compared to the children from food secure household.

4.2.2.2 Care for women and children

Though we included the variables regarding feeding practices of child such as 1st hour initiation of breastfeeding after birth, continued breastfeeding at 1 year, introduction of complementary food at 6-8 months but in univariate analysis they showed the insignificant results.

Table 5: Association of care practices for women and children with undernutrition of children under 2 years of age

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Mother's age during child birth						
<20 years	884	38.0% (336)	884	29.9% (264)	884	15.9% (141)
20 to 34 years	1949	32.6% (636)	1949	26.3% (512)	1949	14.6% (285)
35 or above	103	41.1% (42)	103	41.1% (42)	103	24.6% (25)
Birth order						
1st child	1061	33.1% (351)	1061	24.6% (261)	1061	14.7%(156)
2nd to 4th child	1637	33.7% (551)	1637	27.6% (452)	1637	15.2%(249)
5th or above	238	47.2% (112)	238	44.2% (105)	238	19.3%(46)
Mothers' BMI						
<18	665	41.9% (278)	665	40.6%(270)	665	22.0%(146)
18 to 25	1986	34.4% (683)	1986	25.5%(507)	1986	13.8%(274)
Above 25	275	18.5% (51)	275	13.2%(36)	275	9.3%(26)
Prelacteal feeding						
Yes	1039	37.6%(391)	1039	29.4% (305)	1039	15.6%(162)
No	1831	32.9% (603)	1831	26.5% (486)	1831	14.5% (265)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
Mother's age during child birth						
<20 years	1		1		1	
20 to 34 years	0.7 (0.64-0.89)	0.001	0.8 (0.71-1.01)	0.079	0.9 (0.77-1.20)	0.748
35 or above	1.1 (0.74-1.67)	0.587	1.8 (1.22-2.74)	0.004	1.5 (0.91-2.46)	0.107
	P=0.002		P=0.000		P=0.188	
Birth order						
1st child	1		1		1	
2nd to 4th child	1.0 (0.85-1.18)	0.903	1.1 (0.95-1.35)	0.158	0.9 (0.76-1.18)	0.648
5th or above	1.5 (1.14-2.03)	0.004	2.1 (1.61-2.90)	0.000	1.2 (0.86-1.81)	0.234
	P=0.009		P=0.000		P=0.188	
Mothers' BMI						
<18	1.3 (1.16-1.66)	0.000	1.9 (1.58-2.29)	0.000	1.5 (1.23-1.94)	0.000
18 to 25	1		1		1	
Above 25	0.4 (0.31-0.58)	0.000	0.4 (0.31-0.63)	0.000	0.6 (0.39-0.91)	0.018

	P=0.000		P=0.000		P=0.000	
Prelacteal feeding						
Yes	1.2 (1.04-1.44)	0.011	1.1 (0.97-1.36)	0.105	1.0 (0.88-1.35)	0.418
No	1		1		1	
Multivariate analysis						
Variable	**Adjusted OR (95% CI) for stunting**	**P-value**	**Adjusted OR (95% CI) for underweight**	**P-value**	**Adjusted OR (95% CI) for wasting**	**P-value**
Mother's BMI						
<18	1.1 (0.83-1.25)	0.806	1.4 (1.15-1.73)	0.001	1.4 (1.11-1.81)	0.004
18 to 25	1		1		1	
Above 25	0.5 (0.37-0.75)	0.000	0.6 (0.42-0.93)	0.021	0.6 (0.42-1.06)	0.092
	P=0.002		P=0.000		P=0.002	
Prelacteal feeding						
Yes	1.2 (1.03-1.47)	0.021				
No	1					

In univariate analysis, mother's age at child birth and birth order were significantly associated with stunting and underweight. Mother's BMI showed significant association with all three types of undernutrition. Prelacteal feeding was associated only with stunting. (See **annex 5**). But after controlling all confounders, only mother's BMI showed significant association with all types of undernutrition. For stunting, mother's high BMI showed as a protective factor. Children whose mothers had high BMI were 50% less likely to be stunted than children whose mothers had normal BMI. In addition, children whose mother had low BMI were 1.4 (95% CI [1.15-1.73], p=0.001) times higher risk of being underweight compared to children whose mother had normal BMI. Moreover, the risk of children being wasted was 1.4 (95% CI [1.11-1.81], p=0.004) times higher among the children whose mothers had low BMI compared to children whose mother had normal BMI. Prelacteal feed showed significant association with stunting. Children who were fed prelacteal feed were 1.2 (95% CI [1.03-1.47], p=0.021) times more likely to be stunted compared to children who were not fed prelacteal feed.

4.2.2.3 Environmental factors and utilization of health services

The prevalence of stunting, underweight and wasting were 35.7%, 32.5% and 16.8% respectively among children with no toilet facilities.

Table 6: Association of environmental factors and utilization of health services with undernutrition of under 2 years children

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Toilet facility						
Flush latrine	393	29.0% (114)	393	16.5% (65)	393	10.9% (43)
Pit latrine	1870	35.3% (660)	1870	28.3% (530)	1870	15.2% (285)
No facility/others	661	35.7% (236)	661	32.5% (215)	661	16.8% (111)
Source of drinking water						
Pipe water	270	29.6% (80)	270	17.8% (48)	270	13.3% (36)
Tube well water	2234	36.2% (809)	2234	29.5% (685)	2234	15.2% (339)
Others	420	18.8% (121)	420	24.8% (104)	420	15.2% (64)
Place of delivery						
Home	2048	37.7% (773)	2048	32.2%(659)	2048	17.1%(350)

Hospital	889	27.2% (242)	889	18.0%(160)	889	11.4%(101)
Mother's ANC visits						
No visit	919	40.7% (374)	919	38.2%(351)		18.9% (174)
1 to3	1192	30.9% (368)	1192	24.7%(295)		15.1%(180)
4 to 6	518	34.2% (177)	518	21.1%(109)		13.5%(70)
7 or above	264	29.0% (77)	264	16.7%(44)		7.7%(20)
Univariate analysis						
Variable	**P-value**	**Unadjusted OR (95% CI)**	**P-value**	**Unadjusted OR (95% CI)**	**P-value**	**Unadjusted OR (95% CI)**
Toilet facility						
Flush latrine	1		1		1	
Pit latrine	1.3 (1.05-1.69)	0.017	1.9 (1.50-2.65)	0.000	1.4 (1.04-2.05)	0.029
No facility/others	1.3 (1.03-1.78)	0.026	2.4 (1.78-3.32)	0.000	1.6 (1.12-2.39)	0.010
	P=0.046		P=0.000		P=0.034	
Source of drinking water						
Pipe water	1		1		1	
Tube well water	1.3 (1.02-1.77)	0.033	1.9 (1.39-2.67)	0.000	1.1 (0.80-1.68)	0.424
Others	0.9 (0.68-1.34)	0.817	1.5 (1.03-2.23)	0.031	1.5 (1.03-2.23)	0.488
	P=0.003		P=0.000		P=0.720	
Place of delivery						
Home	1.7 (1.44-2.03)	0.000	2.0 (1.69-2.45)	0.000	0.4 (1.17-1.84)	0.001
Hospital	1		1		1	
Mother's ANC visits						
No visit	1		1		1	
1 to3	0.6 (0.53-0.76)	0.000	0.5 (0.42-0.61)	0.000	0.6 (0.52-0.83)	0.001
4 to 6	0.7 (0.58-0.90)	0.005	0.4 (0.33-0.54)	0.000	0.6 (0.48-0.86)	0.004
7 or above	0.5 (0.38-0.69)	0.000	0.3 (0.22-0.44)	0.000	0.4 (0.26-0.62)	0.000
	P=0.000		P=0.000		P=0.000	
Multivariate analysis						
Variable	**Adjusted OR (95% CI) for stunting**	**P-value**	**Adjusted OR (95% CI) for underweight**	**P-value**	**Adjusted OR (95% CI) for wasting**	**P-value**
Mother's ANC visits						
No visit	1		1			
1 to3 visits	0.8 (0.66-1.02)	0.078	0.7 (0.58-0.91)	0.005		
4 to 6 visits	0.8 (0.90-1.57)	0.220	0.8 (0.62-1.12)	0.230		
7 and above	0.8 (0.59-1.22)	0.400	0.6 (0.45-0.99)	0.047		
	P=0.015		P=0.029			

In univariate analysis, toilet facilities, place delivery and mother's ANC visits were the significant determinants for stunting, underweight and wasting. Source of drinking water showed significant association with stunting and underweight. (See **annex 5**). But after running multivariate analysis, only mother's ANC visits showed significant association with stunting and underweight. For stunting, overall ANC visits appear to leave a significant protective effect but results are difficult to interpret as individual p-values are not significant. The likelihood of being underweight was 0.7 (95% CI [0.58-0.91], p=0.005) and 0.6 (95% CI [0.45-0.99], p=0.047) times lower among children whose mother had 1 to 3 ANC visits and 7 and above ANC visits compared to children whose mothers had no visit.

4.2.3 Basic causes

4.2.3.1 Socio-demographic factors

In univariate regression sex of the child showed insignificant association. Highest percentages of stunted, underweight and wasted children were lived in Sylhet district.

Table 7: Association of socio-demographic factors and undernutrition of children under 2 years of age

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Region						
Chittagong	711	28.8% (205)	711	27.8% (197)	711	15.9% (113)
Barisal	154	38.7 % (60)	154	31.3% (48)	154	15.4% (24)
Chittagong	711	28.8% (205)	711	27.8% (197)	711	15.9% (113)
Dhaka	890	37.0% (330)	890	28.1% (250)	890	17.5% (155)
Khulna	286	31.4% (90)	286	18.2% (52)	286	10.0 % (29)
Rajshahi	386	31.8% (123)	386	27.3% (105)	386	14.6% (56)
Rangpur	299	41.0% (123)	299	28.1% (84)	299	10.5 % (31)
Sylhet	211	40.4% (85)	211	38.9% (82)	211	20.1% (42)
Type of place of residence						
Urban	660	31.1% (205)	660	18.3% (121)	660	12.3% (81)
Rural	2277	35.6% (809)	2277	30.7%(698)	2277	16.2 %(370)
Age of child in months						
0-5 months	687	17.7% (121)	687	15.9%(109)	687	15.4% (107)
6-11 months	810	22.4% (181)	810	23.7%(192)	810	14.4%(117)
12-17 months	779	46.8% (364)	779	33.3% (259)	779	14.8% (115)
18-23 months	661	52.6% (347)	661	39.1%(109)	661	16.9%(112)
Father's education						
No education	777	40.0% (311)	777	37.7% (293)	777	19.6%(152)
Primary	886	40.6% (360)	886	32.9% (291)	886	16.3%(144)
Secondary and above	1272	27.0% (344)	1272	18.5% (235)	1272	12.2%(155)
Father's occupation						
Agricultural	841	43.3% (364)	841	38.3% (322)	841	18.5% (156)
Non-agricultural	2021	31.4% (634)	2021	23.9%(483)	2021	13.9% (280)
Others	59	24.6% (15)	59	22.8%(14)	59	25.1% (15)
Access to media						
Yes	1907	30.7%(586)	1907	22.3% (425)	1907	12.7% (242)
No	1017	41.7%(424)	1017	37.9% (385)	1017	19.4% (197)
Mother's education						
None	480	44.2% (212)	480	41.7% (200)	480	19.9% (96)
Primary	883	37.4% (330)	883	34.7% (306)	883	19.1% (169)
Secondary or above	1574	30.0 %(472)	1574	19.8% (312)	1574	11.9% (187)
Wealth quintile						
Poorest	641	45.5% (292)	641	45.2%(290)	641	20.0% (128)
Poorer	594	38.2% (227)	594	33.0% (196)	594	15.6% (93)
Middle	582	32.8% (191)	582	27.3%(159)	582	17.8%(103)
Richer	597	30.9%(185)	597	16.8% (100)	597	11.0%(66)
Richest	522	23.0% (120)	522	14.1% (73)	522	11.6%(61)

Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
Region						
Chittagong	1		1		1	
Barisal	1.3 (1.03-1.83)	0.030	1.1 (0.86-1.58)	0.298	0.9 (0.65-1.39)	0.797
Dhaka	1.3 (1.07-1.78)	0.012	1.0 (0.765-1.31)	0.994	1.1 (0.81-1.55)	0.469
Khulna	1.1 (0.84-1.48)	0.424	0.5 (0.43-0.81)	0.001	0.5 (0.39-0.89)	0.013
Rajshahi	1.0 (0.75-1.33)	0.968	0.8 (0.64-1.16)	0.345	0.9 (0.67-1.37)	0.839
Rangpur	1.6 (1.27-2.19)	0.000	0.9 (0.74-1.32)	0.950	0.5 (0.39-0.89)	0.014
Sylhet	1.4 (1.09-1.84)	0.008	1.5 (1.20-2.03)	0.001	1.3 (0.96-1.83)	0.081
	P=0.001		P=0.000		P=0.001	
Place of residence						
Urban	1		1		1	
Rural	1.2 (1.07-1.50)	0.005	1.6 (1.40-2.02)	0.000	1.2 (1.01-1.59)	0.038
Age of child						
0-5 months	1		1		1	
6-11 months	1.4 (1.09-1.83)	0.007	1.7 (1.34-2.27)	0.000	0.9 (0.71-1.29)	0.799
12-17 months	4.1 (3.23-5.27)	0.000	2.5 (1.95-3.27)	0.000	1.0 (0.74-1.34)	0.983
18-23 months	4.9 (3.85-6.35)	0.000	3.4 (2.66-4.47)	0.000	1.2 (0.94-1.69)	0.119
	P=0.000		P=0.000		P=0.219	
Father's education						
None	1.8 (1.55-2.27)	0.000	2.5 (2.08-3.13)	0.000	1.6 (1.28-2.11)	0.000
Primary	1.8 (1.56-2.24)	0.000	2.0 (1.70-2.52)	0.000	1.3 (1.04-1.69)	0.023
Secondary and above	1		1		1	
	P=0.000		P=0.000		P=0.000	
Father's occupation						
Agricultural	1		1		1	
Non-agricultural	0.6 (0.52-0.74)	0.000	0.5 (0.47-0.67)	0.000	0.7 (0.60-0.94)	0.014
Others	0.4 (0.27-0.87)	0.017	0.5 (0.28-0.96)	0.039	1.1 (0.60-2.24)	0.652
	P=0.000		P=0.000		P=0.029	
Access to any type of media						
Yes	1		1		1	
No	1.6 (1.37-1.88)	0.000	2.1 (1.79-2.50)	0.000	1.6 (1.34-2.03)	0.000
Mother's education						
None	1.9 (1.58-2.42)	0.000	2.7 (2.20-3.44)	0.000	1.7 (1.28-2.24)	0.000
Primary	1.4 (1.21-1.72)	0.000	2.1 (1.78-2.58)	0.000	1.6 (1.31-2.07)	0.000
Secondary or above	1		1		1	
	P=0.000		P=0.000		P=0.000	
Wealth quintile						
Poorest	3.0 (2.38-3.93)	0.000	4.5 (3.43-5.99)	0.000	1.7 (1.20-2.29)	0.002
Poorer	2.2 (1.71-2.86)	0.000	2.9 (2.18-3.87)	0.000	1.4 (0.96-1.90)	0.077
Middle	1.7 (1.31-2.21)	0.000	2.2 (1.64-2.94)	0.000	1.5 (1.09-2.11)	0.013
Richer	1.5 (1.18-1.99)	0.001	1.2 (0.92-1.71)	0.145	0.9 (0.69-1.39)	0.932
Richest	1		1		1	
	P=0.000		P=0.000		P=0.002	

Multivariate analysis						
Variable	**Adjusted OR (95% CI) for stunting**	**P-value**	**Adjusted OR (95% CI) for underweight**	**P-value**	**Adjusted OR (95% CI) for wasting**	**P-value**
Region						
Chittagong	1		1		1	
Barisal	1.2 (0.91-1.72	0.156	0.9 (0.72-1.37)	0.982	0.8 (0.60-1.32)	0.592
Dhaka	1.4 (1.07-1.87)	0.012	0.9 (0.67-1.20)	0.477	1.0 (0.78-1.52)	0.579
Khulna	1.2 (0.90-1.66)	0.195	0.6 (0.44-0.87)	0.007	0.6 (0.41-0.95)	0.029
Rajshahi	0.8 (0.65-1.21)	0.455	0.7 (0.51-0.98)	0.039	0.9 (0.63-1.32)	0.642
Rangpur	1.4 (1.09-1.99)	0.011	0.7 (0.52-0.985)	0.040	0.5 (0.35-0.83)	0.005
Sylhet	1.4 (1.07-1.91)	0.014	1.3 (1.00-1.79)	0.049	1.1 (0.78-1.53)	0.590
	P=0.001		P=0.000		P=0.010	
Age of the child						
0-5 months	1		1			
6-11 months	1.3 (1.03-1.76)	0.027	1.6 (1.24-2.17)	0.000		
12-17 months	4.3 (3.39-5.65)	0.000	2.6 (2.04-3.53)	0.000		
18-23 months	5.0 (3.91-6.57)	0.000	3.5 (2.69-4.67)	0.000		
	P=0.007		P=0.000			
Father's education						
None	1.1 (0.85-1.44)	0.415				
Primary	1.3 (1.10-1.70)	0.004				
Secondary and above	1					
	P=0.011					
Access to media						
Yes					1	
No					1.3 (1.02-1.69)	0.030
Mother's education						
None			1.3 (1.00-1.84)	0.044		
Primary			1.3 (1.09-1.70)	0.006		
Secondary and above			1			
			P=0.018			
Wealth quintile						
Poorest	2.4 (1.59-3.63)	0.001	2.3 (1.57-3.46)	0.000		
Poorer	1.9 (1.33-2.88)	0.000	1.7 (1.19-2.51)	0.004		
Middle	1.7 (1.19-2.44)	0.001	1.5 (1.12-2.23)	0.009		
Richer	1.6 (1.20-2.28)	0.003	1.0 (0.73-1.42)	0.903		
Richest	1		1			
	P=0.001		P=0.000			

Region, types of area, father's education, father's occupation, access to media, mother's education, and wealth quintile showed significant risk factors for stunting, underweight and wasting in univariate analysis. But age of child showed insignificant association with wasting. (See **annex 5**). After running multivariate regression, region showed significant association with stunting, underweight and wasting. Dhaka, Rangpur and Sylhet division's children had the 40% higher risk to be stunted than Chittagong division's children. The risk of being underweight was 40% and 30% lower among the children from Khulna and Rajshahi divisions compared to children from Chittagong division. In addition, children from Sylhet divisions were 1.3 (95% CI [1.00-1.79], p=0.049) times more likely to be underweight compared to

children from Chittagong division. Moreover, children from Rangpur and Dhaka division were 50% and 40% less likely to be wasted than children from Chittagong division.

Multivariate result showed that the risk of being undernourished increases with increase of age. Age of child showed significant risk factor for stunting and underweight. Children in age categories of 18-23 months, 12-17 months and 6-11 months had 5.0 (95% CI [3.91-6.57], p=0.000), 4.3 (95% CI [3.39-5.65], p=0.000), and 1.3 (95% CI [1.03-1.76], p=0.027) times higher risk to be stunted compared to the children of under 6 months. In addition, the likelihood of being underweight was 3.5 (95% CI [2.69-4.67], p=0.000), 2.6 (95% CI [2.04-3.53], p=0.000) and 1.6 (95% CI [1.24-2.17], p=0.000) times higher among the children whose age were 18-23 months, 12-17 months and 6-11 months respectively compared to children whose age was <6 months. But it did not show any significant association with wasting.

Father's education had a significant effect on the chronic malnutrition of the child. Children whose fathers had primary educated were 1.3 (95% CI [1.10-1.70], p=0.004) times higher risk to be stunted compared to children whose father had secondary or higher level of education. It had no significant association with underweight and wasting.

Children whose mothers had no media exposures were 1.3 (95% CI [1.02-1.69], p=0.030) times more likely to be wasted compared to children whose mothers had media exposure. Exposure to media was not a risk factor for stunting and underweight.

In multivariate analysis, mother's education was a significant determinant for underweight. Children whose mother had no education and primary educated both were 1.3 (95% CI [1.00-1.84], p=0.044 & 95% CI [1.00-1.84], p=0.006) times more likely to be underweight than children whose mother had secondary or higher education. It showed insignificant association with stunting and wasting.

After running multivariate analysis and controlling confounders, wealth quintile showed significant result with stunting and underweight. Compare to wealthiest household, children from poorest, poorer and middle household had 2.4 (95% CI [1.59-3.63], p=0.001), 1.9 (95% CI [1.33-2.88], p=0.000), and 1.7 (95% CI [1.19-2.44], p=0.001) times higher risk of stunting. In addition, children who lived in poorest, poorer and middle wealth quintile had 2.3 (95% CI [1.57-3.46], p=0.000), 1.7 (95% CI [1.19-2.51], p=0.004) and 1.5 (95% CI [1.12-2.23], p=0.009) times more risk to be underweight compared to children who lived in richest wealth quintile.

Chapter 5: Discussion

This chapter is going to discuss the key determinants for undernutrition in context of Bangladesh based on the analysis and how government can address those determinants for improving the nutrition status of under 2 children.

5.1 Key determinants for undernutrition

5.1.1 Immediate cause

5.1.1.1 Dietary intake

MDD

Evidence showed that 6-23 months of age is the most vulnerable period for child growth and development.[61] During this time only breast milk is not enough to fulfill the nutrient requirements and a child must be effectively shifted from only breast milk to a combination of nutritious complementary food or family food and breast milk. So, this period is vulnerable for IYCF practices also. Multivariate results showed that children who did not eat minimum 4 groups of food were 1.2 and 1.3 times more likely to be stunted and underweight than children who ate minimum 4 groups of food. It indicates that eating diversified diet during 6-23 months is positively associated with the growth of the child. Diversified diet provides the required nutrient for growth and development of a child and helps to build up the immunity. So, children who eat diversified diet have less risk to be stunted and underweight than children who do not eat diversified diet. The same thing also reflected in this study. A Bangladeshi study analyzed nationally representative data also found the similar result.[35] Other studies also mentioned that diversified diet act as a protective factor against stunting[62,63,64] and underweight[52,65].

Surprisingly in our study exclusive breastfeeding under 6 months of age did not show any association with undernutrition in context of Bangladesh. Possible explanation could be in Bangladesh exclusive breastfeeding rate among children under 6 months of age has increased to sufficiently high levels that it no longer plays a significant role in determining whether a child becomes malnourished or not.

MMF

Evidence showed that frequent feeding in a day improves the nutritional status of a child.[66] After 6 months of age breast milk is not enough for the infant so they need nutrient dense frequent meal to fulfill their nutritional requirement. After controlling all confounders, this study result found that the prevalence of underweight was 1.3 times higher among the children (aged 6 to 23 months) who did not achieve MMF compared to children who achieved MMF. Children need extra calorie but their stomach is small so they need frequent meal for their proper growth and development. If they do not get age appropriate frequent meal then undernutrition starts to develop. As expected this study also indicated the same fact. Study finding suggests that age appropriate frequent meal can prevent underweight. Different studies also found the similar result.[52,65]

MAD

MAD, a composite indicator derived from both MDD and MMF, was associated with underweight of the children. The risk of being underweight was 1.3 times higher among the children who did not achieve a

MAD compared to children who achieved a MAD. Inadequate intake of MAD may be made them susceptible for growth faltering so they became underweight. The study results indicate that not only diversified diet but also age appropriate frequent meal is necessary for the proper growth and development of a child. This study yielded consistent results with a study conducted in India.[65]

5.1.1.2 Health status or morbidity history

ARI

This study suggested that ARI had significant association with stunting. After running multivariate analysis, children who suffered from ARI showed 1.6 times higher risk of developing stunting than children without ARI. This study result corresponds to other studies.[52,53] Children who suffer from respiratory infection have a tendency to avoid food intakes or have a lower frequency and quantity of food intakes. There is a possibility that those children who affected by ARI were already immuno-compromised due to inadequate food intake. So, in presence of ARI along with low food intakes they became susceptible to stunting. Poor treatment seeking behabiour of the parents could be another reason which helped to the development of stunting as only 35% of the children with ARI received treatment from a medically trained provider in Bangladesh.[1]

Fever

After adjusting the effect of confounders, children who had fever were 1.2 times more likely to be underweight compared to the children who had no fever. This result indicates that children with disease are more vulnerable to development of underweight than their healthy counterparts. Our study found consistent result with other studies.[52,67] Children usually avoid food intakes or take less amount of foods during fever. Avoid or reduce food intakes, inadequate supply of nutrient rich diet, inadequate care from parents and lack of treatment during disease condition may be the factors interplayed in the development of underweight among our study population.

Diarrhoea

In this study, the highest rate of diarrhoea was present among malnourished children which indicate the vicious cycle of malnutrition-infection interaction. After controlling cofounders, diarrhoea showed significant association only with wasting. Study findings illustrated that children with diarrhoea had 1.5 times more risk to be wasted than healthy children. This study result is consistent with the other studies.[47,67,68] It indicates that acute malnutrition (wasting) can be developed quickly by presence of diarrhoea or other infections. Diarrhoea may be reduced food intake or lost the body weight which helped to develop wasting among children. Lack of treatment during diarrhoea could be another reason as only 25% of the children with diarrhoea received treatment[1] in Bangladesh from a medically trained provider.

5.1.2 Underlying causes

5.1.2.1 Household food security

Household food insecurity which is closely related with poverty was significantly associated with stunting and underweight. In this present study, children from moderate food insecure household were 1.4 times more likely to be stunted and underweight than children from food secure household. Severe household food insecurity showed lower odds than food secure household for both types of

malnutrition. Small number of sample size in that group or information bias may be the possible explanation of that. This study suggests that children from food insecure household have higher chance to be undernourished than food secure household. Food insecure household usually have food which is low in quantity and quality. Food insecurity can reduce adequate food consumption, intake of diversified diet and nutrient intake which may have a negative impact on the growth and development of children. This study reflected the same thing. This study result corresponds to other studies which also showed that food insecurity is closely related with undernutrition.[55,69,70]

5.1.2.2 Care for women and children

Mother's BMI

Mother's BMI showed significant association with stunting, underweight and wasting. Children whose mothers had low BMI were 1.4 times higher risk of being underweight and wasted than children whose mother had normal BMI. Among all underlying causes maternal undernutrition is a complex one. Maternal undernutrition is rooted with poverty, social deprivation and gender norms of the society. Early marriage, frequent child birth, low access to health care, intra-household food distribution in a male dominated family, all these factors together contributes to the development of maternal malnutrition. Undernourished mothers usually give birth to low weight babies and probably cannot provide adequate breast milk and care to their babies, which can have an effect on the undernutrition of their child. This study finding is similar to other studies which also showed that maternal malnutrition is a risk factor for stunting[41,42, 45, 47,56,57,58,71], underweight[46,42,47,52] and wasting[42,46,47,53].

Prelacteal feeding

In this study, prelacteal feeding which is a social norm in Bangladesh showed significant association with chronic undernutrition. Study result revealed that children who received other liquid within 1st three days after birth had 1.2 times more likely to be stunted than children who did not receive other liquid. Similar findings also found in other studies.[60,55] Actually, giving prelacteal foods immediately after birth limits the frequency of suckling by the infant, the release of prolactin and the production of mother's milk. In addition, prelacteal feeding exposes infants to different kinds of gastrointestinal infection. In a long run these children have shorter duration of breastfeeding and they are early exposed to semisolid or solid food. Shorter duration of breastfeeding, early introduction of semisolid or solid food, and exposure to different kinds of infection makes them susceptible for undernutrition. The same thing may be happened with our study population. This study suggests that prelacteal feeding is a significant risk factor for undernutrition.

5.1.2.3 Environmental factors and utilization of health services

Mother's ANC visits

Mother's ANC visit is an important determinant and showed significant association with stunting and underweight. After controlling confounders, children whose mothers had 1 to 3 ANC visits and 7 and above ANC visits were 30% and 40% less risk to be underweight than children whose mothers had no ANC visits. It indicates that proper care of mother has a positive impact on the nutritional status of their children. Growth and development of a child starts to develop from pregnancy. Proper ANC services of mothers like dietary advice, micronutrient supplementation and treatment for preexisting medical

conditions during pregnancy can influence the birth outcomes of their child. Mothers who get ANC services gather different knowledge on complication, breastfeeding practices, child and maternal nutrition, and child care which may have positive effects on nutritional status of their child. This study also reflected the same thing. Like this study, other studies also found that children were less likely to be stunted[42,57,55] and underweight[42,52,55] if their mother had ANC visits.

Water and sanitation facilities

Surprisingly, toilet facilities and source of drinking water did not show any association with any types of undernutrition. This could probably mean that these factors were influenced by others factors such as wealth, parents education; diminishing the effect of these factors on undernutrition. These may also be indicators which are not sufficiently representative of true environmental hygiene, as source of water does not reflect the amount available and whether hand washing is done or not.

5.1.3 Basic causes

5.1.3.1 Socio-demographic factors

Region

A significant regional difference was observed in the level of undernutrition. The likelihood of a child being chronically stunting was highest in Sylhet, Rangpur and Dhaka division while it was lowest in Rajshahi division. Other studies in Bangladesh found the similar result.[41,45,56] In addition, prevalence of underweight was highest in Sylhet division whereas it was lowest in Khulna division. Both stunting and underweight were more prevalent in Sylhet division. Regional variations in the nutritional status of children can be influenced by the differences in socio-economic status, social security, poor accessibility of education and health services for mother and child. This study also reflected the same thing.[1] Because IYCF practices, immunization coverage, education status of women, utilization of health care services-all conditions are poor in Sylhet division compared to other divisions.[1]

Age of child

This study result indicated that the risk of being undernourished increased significantly with increase age. Children aged 18 to 23 months were 5 and 3.5 times more likely to be stunted and underweight than children <6 months of age. Prevalence of malnutrition among children <6 months is usually less due to the protective effect of breastfeeding. But after 6 months malnutrition gradually increase because of inappropriate feeding practices. If children do not get proper complementary feeding then they become nutrient deficient. In addition, contaminated food or inadequate hygiene practice during this time makes them more susceptible to diarrhoea or other infections. All these factors might be interplayed in the development of undernutrition among our study population. As like this study, other studies in Bangladesh and other developing countries also found that risk of being stunted[41,45,72,73] and underweight[47,52,72,74] increased with age.

Father's education

Although many studies all over the world showed mother's education is an important predictor for chronic undernutrition but our study showed that in context of Bangladesh father's education even

more important determinant for chronic malnutrition than mother's education. Children whose fathers had primary education were 1.3 times more likely to be stunted than children whose father had higher education. Several studies in Bangladesh found the similar findings.[42,44,41,45] This study results suggest that the risk of being stunted decreases with increasing fathers education. The growth of infants and young child related with their socio-economic condition. In Bangladesh father's education is closely related with household economic condition because father is the predominant earner in a family. This study indicates the fact that fathers who are more educated their children have more access to nutritious food, better access to essential health care, better living standard and lesser chance to be undernourished.

Access to media

Access to media showed significant association with acute undernutrition. Children whose mother had no exposure to any type of media were 1.3 times more likely to be wasted than children whose mother had exposure to media. This is similar to the findings of the study done analyzing the 1999 to 2000 DHS data, which found that children were 2.5 times more likely to be severely wasted if their mother had no exposure to media.[53] This could be due to the fact that economically better off and educated women have exposure to the media and they can thereby gather information about child feeding, immunization, and child care etc.

Mother's education

Underweight is a composite index of stunting and wasting. Thus, it is difficult to distinguish whether it is acute malnutrition or chronic malnutrition. This study showed that mother's education is an important predictor for underweight. Children whose mothers had no education and primary education were 1.3 times more likely to be underweight than children whose mothers had higher education. Previously many studies showed the same findings.[42,52,47,75,76] Mother's education is more important for child health because educated mothers are knowledgeable and they can make better choices regarding their child's health and nutrition. They can choose proper feeding practices, make better use of health services, provide better care, and have better hygiene practices for their child. This may be the case in our study.

Wealth index

After controlling the potential confounders, wealth quintile showed significant association with stunting and underweight. This study findings showed that chronic undernutrition is a critical problem in Bangladesh and children in poorest household were at more than twice (2.4) and children in the poorer household almost twice (1.9) the risk of being stunted than children from the richest household. This study result corresponds to the other studies.[42,41,45,47,77,78] On the other hand, the risk of being underweight was also highest in children of poorest (2.3) and poorer (1.7) household compared to children of the richest household. Studies in Bangladesh and other developing countries found the similar results.[42,52,47,73] The rich families can allocate more resources for their children and allocation of more resources bring better health outcomes for their children. This study indicates that children who live in poor household have less access to nutritious food, greater exposure to infection, lack of access to basic health care services and higher risk to be undernourished.

5.2 The way forward

From the above discussion, we see that inadequate dietary intake, morbidity of children, household food insecurity, inadequate care for women and children, low utilization of health services and socio-demographic conditions like region, age of the child, father's education, access to media, mother's education, and poverty were significantly contributing to the development of undernutrition among children under 2 years of age in Bangladesh. It is now essential to implement effective intervention on the priority basis to tackle these determinants in order to improve the nutrition situation of under 2 children in the country. This section attempts to find out solution in regard to mitigate those determinants. Some cross cutting issues will be discussed together.

Inadequate dietary intake due to improper feeding practices (also called IYCF practices) was associated with undernutrition of children in Bangladesh. Though the country has a good national IYCF policy in place and but the implementation is not satisfactory. WHO showed through a scoring system that in Bangladesh large scale intervention activities are needed for the implementation of national IYCF strategy[79] (see **annex 6**). Though exclusive breastfeeding is in rising trend but we need to maintain and upgrade that trend otherwise situation will be worsen again. Evidence showed that training of the health care provider[80], breastfeeding counseling and support by the community health worker[81], and peer counseling in the community[82,83,84] is highly effective to improve the exclusive breastfeeding status. So, government can implement these interventions to further improvement of exclusive breastfeeding. A systematic review[85] reported that maternal counseling and community based health education programme can improve child growth through improving complementary feeding practices and this intervention can significantly reduce the undernutrition in developing countries. In Bangladesh HAs who are already involved for domiciliary visit and different media can be used for health education session, cooking demonstration, and counseling for mothers. A&T in collaboration with BRAC is implementing intensive community based interventions and national media campaign for promotion of IYCF practices.[86] Government can collaborate with them for national level promotion of IYCF practices. Evidence showed that micronutrient like vitamin A and iron (micronutrient) supplementation is highly effective in reducing mortality and anemia among under 2 children.[87,88] Government can integrate micronutrient supplementation with expanded programme of immunization (EPI).

Morbidity of children was strongly correlated with the development of undernutrition of under 2 children. Possible solution can be Integrated Management of Childhood Illnesses (IMCI) strategy developed by WHO as it encompasses a range of interventions that combines prevention and better management of childhood illness. IMCI evaluation in different countries showed that it can reduces mortality, improve health service quality and health care cost saving.[89, 90] Bangladesh government adopted integrated management of Childhood Illness (IMCI) strategy since 1998. But facility based IMCI and community based IMCI is now running only in 395 and 63 upazilas respectively out of 482 upazilas which is inadequate to cover the whole population.[91] Government can expand this programme all over the country to prevent and manage common childhood diseases. Evidence showed that Facility based management of SAM according to WHO protocol is highly effective and high rate of survival can be achieved by improving staff training and quality in resource poor setting.[92] Integrated management of SAM child is already under the IMCI. Training can be given all health workers on integrated management

of SAM child by using WHO guidelines. Evidence showed that community based management of SAM is highly effective in resource poor setting. [93] Government can adopt this strategy in context of Bangladesh.

Diarrhoea, an immediate cause, was associated with acute malnutrition. Though Bangladesh government has adopted a water and sanitation policy and strategic plan since 1998 (approved by LGRD&Co ministry) but the implementation of this policy is very weak in the field level.[94,95] Evidence showed that in developing countries including Bangladesh different interventions like education on hygiene, sanitation and hand washing promotion with soap or without soap can significantly reduces the incidence of diarrhoea.[96,97,98,] All these interventions could be integrated with the LGRD&Co's existing interventions.

Poverty and household food insecurity were the two important factors were associated with child undernutrition in Bangladesh. Though government has placed elimination of poverty and inequality as one of the prime strategy but still one third of people live under poverty line. For eradication of poverty government along with donor and NGOs is already running some social safety net intervention such as Food for Works (FFW) Programme, Vulnerable Group Feeding (VGF) programme to eradicate poverty and household food insecurity. Evidence showed this programme has positive effect on eradication of poverty and food insecurity.[99] Recently Bangladesh bureau of statistics (BBS) with help of WFP and World Bank updated poverty map of Bangladesh.[100] Government can expand these poverty elimination programmes in the area where poverty and food insecurity are most prevalent by using the poverty map. Ministry of LGRD&Co and agriculture in collaboration with WFP can reach those vulnerable areas. Weather based[101] insurance scheme can be other options to address poverty for poor farmers. Because affordable index based drought insurance for the poor farmers worked well in Malawi and it greatly increased the productivity of agricultural product. Rice is the main crop in Bangladesh and excessive rice production is hindering the production of diversified crop.[11,102] Farmers can be encouraged to produce micronutrient rich foods by providing subside. In China, a multi-sectoral approach where agriculture sector worked with rural development and other sectors, helped to reduce poverty, hunger and malnutrition.[33] Bangladesh government can take this example and adopt a multi-sectoral approach to solve the undernutrition problem.

Evidence showed that balanced energy protein supplementation during pregnancy can help to improve the pregnancy weight gain of mother and better health outcome of their babies.[103] Bangladesh NNP which ran a balanced energy protein supplementation programme for pregnant women in targeted poor area is now stopped since 2011. Government can reintroduce that supplementation programme under NNS by targeting the poor region where prevalence of malnutrition is high among mothers.[104] Evidence showed folic acid[105], iron[106]and multiple micronutrients[107] supplementation during pregnancy can improve the birth outcomes of the baby and help to reduce maternal anemia. In addition, calcium supplementation[108] during pregnancy can reduce the incidence of preeclampsia by 52%. Micronutrient supplementation programme can be implemented by focusing the worst affected geographic areas where most of the undernourished women live in. Evidence showed microcredit programme can alleviate poverty and ensure the empowerment of women[109,110] as well as can improve maternal BMI.[111]

In Bangladesh microcredit programme is running in some parts of the country. This programme can be scaled up in the targeted poor area.

Evidence from different countries showed that mobilize communities to send their girls to school, targeted financial support, and increase number of female teacher- all these factors can influence to retain girls in school.[112,113] In Bangladesh there is a primary education policy and government has already given free education opportunity for girls up to class 10. But there is an implementation problem because of low awareness campaign about that issue. The proper implementation of that policy needs more campaign and advocacy. For community mobilization mass media such as television, radio, newspapers and religious leaders can be involved to communicate parents and community members about the importance and benefits of education. As maternal education is vital for child nutrition, there need a collaboration of nutrition sector with education sector. Implementation of nutrition policy which focused on the mainstream nutrition with other sectors showed magnificent result for reduction of stunting in many countries of Latin America.[33] In this regard, the existing food and nutrition policy of Bangladesh requires to reanalyze the possible range of mainstreaming nutrition with other sectors and where is the implementation gap of the existing policy's.

Lack of ANC visits is one of the determinants for undernutrition of children. Not only lack of health care providers but also lack of awareness of mothers and community is responsible for low coverage. In Bangladesh, most of the mother's (70%) perception about ANC visit is that it is not necessary and 25% think it is expensive (BDHS).[34] WHO recommended that those countries with shortage of trained delivery attendants, should invest their resources effectively for capacity building to produce diverse health care providers and train traditional birth attendant for supportive care during the antenatal and postnatal period.[114] Government can adopt same strategy in context of Bangladesh. Community involvement is another important strategy[115] to remove cultural and social barriers as well as build up awareness about the importance of ANC visit. The use of mass media, collaboration with women's association and with community leader can be effective in context of this country. Evidence showed that removing user fees improves the utilization of ANC among pregnant mothers.[116] Government can implement this strategy in Bangladesh. In Bangladesh government introduced a pilot maternal health voucher scheme (demand side financing) since 2006 to increase utilization of care among pregnant mother and their newborn of the poorer household from designated provider.[117] Government can scale up this programme in the national level to provide services for selected poor or vulnerable groups.

Chapter 6: Conclusions and recommendations

6.1 Conclusions

From the above discussion and analysis, we see determinants of undernutrition in the context of Bangladesh are very complex. This study demonstrates that all three causes namely immediate, underlying and basic causes are interacting with each other and together they are contributing to the development of undernutrition among children under 2 years of age. According to this study, inadequate dietary intake like MDD, MMF, MAD and history of diseases like ARI, fever, diarrhoea are the major immediate causes responsible for occurrence for undernutrition. Household food insecurity, mother's low BMI, prelacteal feeding, and inadequate utilization of ANC services are the underlying causes related with undernutrition. Basic causes like region, age of the child, father's education, access to media, mother's education, and poverty are contributing to the development of undernutrition.

Multiple strategies and interventions with multi-sectoral collaboration are required to deal with undernutrition as many factors are beyond the scope of the health ministry. Government is already addressing many of the key determinants. However, some gaps remain that need to be covered to optimize the impact of nutrition programmes. The following strategies or interventions are found to be feasible and promising to improve the nutritional situation for under 2 children. Inadequate dietary intake and inappropriate feeding practices need to be addressed through strengthening of IYCF practices. Micronutrient supplementation can be provided for both mother and child as currently government is doing only in a small scale. Infectious disease control remains weak in Bangladesh and it needs to be strengthened through the continued improvement of sanitation and hygiene practices to reduce diarrhoea and the prevention and management of common childhood diseases by expanding the IMCI programme nationally. For improvement of maternal nutritional status, balanced protein energy supplementation can be provided which in turn will improve the birth outcomes of the babies. Different types of social safety net programme need to be expanded in the poor geographical area by using the poverty map. It will help to reduce poverty, increase household food security, women empowerment and better nutritional status for both mother and child. Different national and international organizations are running small scale nutrition interventions in different parts of the country. Sometimes these programmes are overlapping the same geographical area. There is need for collaboration among them to improve coverage within limited resources.

Essential policies are already in place that support the achievement of improved females' education and women's rights, but their implementation needs to be reinforced. Continued advocacy is needed for promotion of female education and the continued expansion of health services will improve access to ANC services and other preventive activities such as vaccination and health education. Uptake of ANC service can be promoted by community mobilization, demand side financing, and withdrawal of user fees.

For implementation of nutritional programme there is a need for strengthening of existing human resource working at different levels. Increase government's budget allocation and continual international financial support for nutritional programme are also crucial for the reduction of

undernutrition among children under 2 years of age. Commitment from ministry of health, agriculture, education, rural development and other stakeholders is required for implementing the nutritional programme.

6.2 Recommendations

At policy level

- Promote a multi-sectoral approach: The ministry of health should involve relevant stakeholders and other ministries like agriculture, water and sanitation, LGRD&Co, and education ministry including community in the planning and implementation of nutrition programme.
- Support poverty reduction: Ministry of finance in collaboration with agriculture, LGRD&Co and relevant stakeholders should implement nutrition sensitive social safety net programme such as FFW, VGF, microcredit and other income generating programmes to alleviate poverty, improve household food security and increase women empowerment. Priority should be given to poor geographical area where undernutrition is most prevalent.
- Involve multiple stakeholders to improve service provision: Government should collaborate with other national and international NGOs who are already running some nutrition interventions for better coordinate service provision.

At programme level

- IYCF practices should be strengthened through mass media campaign at all level of community and engaging HAs to conduct counseling, health education and cooking demonstration to improve the knowledge of people regarding IYCF practices.
- Balanced energy protein supplementation (macronutrient) for pregnant undernourished mother should be started under NNS. Micronutrient supplementation for mother and child and should be provided through EPI and ANC services.
- For prevention and management of common childhood diseases both facility and community based IMCI should be expanded all over the country. Necessary training, equipment and supplies should be provided to effectively run this programme.
- ANC visits should be promoted through different strategies like expansion of health services, community mobilization, mass media campaign, collaboration with women's association and community leaders, demand side financing, and withdrawal of user fees.
- National level mass media and community based awareness campaign of hygiene and sanitation should be implemented for prevention of diarrhoea under the water and sanitation programme of LGRD&Co ministry.
- Government should promote female education in the community level through advocacy and mass media campaign.

Research

- The ministry of health in collaboration with BRAC should conduct a qualitative research involving mothers, fathers, caregivers and key informants to understand how the determinants are contributing to the development of undernutrition among children of under 2 years of age.

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Glossary

Undernutrition – An insufficient intake and/or inadequate absorption of energy, protein or micronutrients that in turn leads to nutritional deficiency.

Stunting– Stunting means low height for age. A child who is below two standard deviations from the median (-2 SD) of the WHO reference population in terms of height-for-age is considered stunted. Stunting reflects chronic malnutrition, which means failure to receive adequate nutrition for a long period of time.

Underweight– Underweight means low weight for age. Weight-for-age is a composite index of weight-for-height and height-for-age. A child who is below two standard deviations (-2 SD) from the median of the WHO reference in terms of weight-for-age is considered underweight. It does not distinguish between acute malnutrition (wasting) and chronic malnutrition (stunting).

Wasting– Wasting means low weight for height. A child who is below two standard deviations (-2 SD) from the median of the WHO reference in terms of weight-for-height is considered wasting. It reflects acute malnutrition.

Prelacteal feeding– Children have given something other than breast milk during the first three days of life.

Infant and young child feeding (IYCF) – Term used to describe the feeding of infants (less than 12 months old) and young children (12–23 months old). IYCF programmes focus on the protection, promotion and support of exclusive breastfeeding for the first six months, on timely introduction of complementary feeding and on continued breastfeeding for two years or beyond. Issues of policy and legislation around the regulation of the marketing of infant formula and other breast milk substitutes are also addressed by these programmes.

Body mass index (BMI) – Defined as an individual's body mass (in kilograms) divided by height (in metres squared): BMI units = kg/m2. Acute malnutrition in adults is measured by using BMI.

Annex 2: Definition of indicators for assessing infant and young child feeding practices

CORE INDICATORS

Breastfeeding initiation

1. **Early initiation of breastfeeding:** Proportion of children born in the last 24 months who were put to the breast within one hour of birth

$$\frac{\text{Children born in the last 24 months who were put to the breast within one hour of birth}}{\text{Children born in the last 24 months}}$$

Notes:

- This indicator is based on historic recall. The denominator and numerator include living children and deceased children who were born within the past 24 months.
- It is recommended that the indicator be further disaggregated and reported for (i) live births occurring in the last 12 months; and (ii) live births occurring between the last 12 and 24 months.

Exclusive breastfeeding

2. **Exclusive breastfeeding under 6 months:** Proportion of infants 0–5 months of age who are fed exclusively with breast milk

$$\frac{\text{Infants 0–5 months of age who received only breast milk during the previous day}}{\text{Infants 0–5 months of age}}$$

Notes:

- This indicator includes breastfeeding by a wet nurse and feeding expressed breast milk. It was, however, thought simpler to retain the term "exclusive breastfeeding" rather than the more precise but cumbersome term "fed exclusively on breast milk". (For the definition of "exclusive breastfeeding" see Table 1.)
- This is the first in the series of current status indicators based on recall of the previous day and includes living infants. All indicators that follow, except "children ever breastfed", are also based on recall of the previous day.
- Using the previous day recall period will cause the proportion of exclusively breastfed infants to be overestimated, as some infants who are given other liquids irregularly may not have received them in the day before the survey.
- As with other indicators that are based on current status, exclusive breastfeeding is based on a cross section of children in a given age range, in this case children from birth to just

under 6 months of age. It therefore does not represent the proportion of infants who are exclusively breastfed *until just under* 6 months of age and *should not* be interpreted as such. It is generally accepted that the proportion of children who are exclusively breastfed *until just under* 6 months of age is lower than the number derived from the indicator of current status. For example, if there is a linear rate of decline in the proportion exclusively breastfed from 100% at birth to 20% at 6 months, the indicator value for exclusive breastfeeding under 6 months would be 60% (as compared to 20% still exclusively breastfed at 6 months). However, the indicator recommended in this document represents the best option for estimating exclusive breastfeeding and is more sensitive to capturing changes. If there is interest in identifying differences in proportions of infants exclusively breastfed over smaller age ranges, creation of figures such as shown in Annex 3, and disaggregation as suggested in the bullet below may provide such information.

- It is recommended that the indicator be further disaggregated and reported for the following age-groups: 0–1 months, 2–3 months, 4–5 months and 0–3 months.

Continued breastfeeding

3. **Continued breastfeeding at 1 year:** Proportion of children 12–15 months of age who are fed breast milk

$$\frac{\text{Children 12–15 months of age who received breast milk during the previous day}}{\text{Children 12–15 months of age}}$$

Notes:

- This indicator includes breastfeeding by a wet nurse and feeding expressed breast milk.
- The title of this indicator on continued breastfeeding reflects an approximation of the age range covered. Because of the age interval, the indicator underestimates the proportion of children breastfed at one year.
- Because the indicator has a relatively narrow age range of 4 months, estimates from surveys with small sample sizes are likely to have wide confidence intervals.

Introduction of complementary foods

4. **Introduction of solid, semi-solid or soft foods:** Proportion of infants 6–8 months of age who receive solid, semi-solid or soft foods

$$\frac{\text{Infants 6–8 months of age who received solid, semi-solid or soft foods during the previous day}}{\text{Infants 6–8 months of age}}$$

Notes:

- This indicator is one of the two parts of the previous composite indicator for timely complementary feeding, which also included continued breastfeeding (*1*).
- The previous indicator included living infants 6–9 months in the numerator and denominator. A narrower age range has been chosen so as not to include infants first receiving foods as late as 9 months in the numerator.
- Because the indicator has a very narrow age range of 3 months, estimates from surveys with small sample sizes are likely to have wide confidence intervals.

Dietary diversity

5. **Minimum dietary diversity:** Proportion of children 6–23 months of age who receive foods from 4 or more food groups

$$\frac{\text{Children 6–23 months of age who received foods from} \geq 4 \text{ food groups during the previous day}}{\text{Children 6–23 months of age}}$$

Notes:

- The 7 foods groups used for tabulation of this indicator are:
  - grains, roots and tubers
  - legumes and nuts
  - dairy products (milk, yogurt, cheese)
  - flesh foods (meat, fish, poultry and liver/organ meats)
  - eggs
  - vitamin-A rich fruits and vegetables
  - other fruits and vegetables
- Consumption of any amount of food from each food group is sufficient to "count", i.e., there is no minimum quantity, except if an item is only used as a condiment.[1]
- The cut-off of at least 4 of the above 7 food groups above was selected because it is associated with better quality diets for both breastfed and non-breastfed children (*10*). Consumption of foods from at least 4 food groups on the previous day would mean that in most populations the child had a high likelihood of consuming at least one animal-source food and at least one fruit or vegetable that day, in addition to a staple food (grain, root or tuber).
- Results may be reported separately for breastfed and non-breastfed children. However, diversity scores for breastfed and non-breastfed children should not be directly compared, because breast milk is not 'counted' in any of the above food groups. Breast milk is not counted because the indicator is meant to reflect the quality of the complementary food diet. As a consequence, this indicator may show 'better' results for children who are not breastfed than those who are breastfed in populations where formula and/or milk are commonly given to non-breastfed children.
- For the same reason, this indicator should not be used to compare populations that differ in prevalence of continued breastfeeding. This caution applies both to comparisons between different sub-populations at one point in time (e.g. urban versus rural comparisons) and the same population at different points in time (e.g. if continued breastfeeding has declined). The composite indicator (# 7 below) captures several different dimensions of feeding and can be used for comparisons across time and between populations with different rates in continued breastfeeding.
- It is recommended that the indicator be further disaggregated and reported for the following age groups: 6–11 months, 12–17 months and 18–23 months.

Meal frequency

6. **Minimum meal frequency:** Proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more.

   The indicator is calculated from the following two fractions:

$$\frac{\text{Breastfed children 6–23 months of age who received solid, semi-solid or soft foods the minimum number of times or more during the previous day}}{\text{Breastfed children 6–23 months of age}}$$

   and

$$\frac{\text{Non-breastfed children 6–23 months of age who received solid, semi-solid or soft foods or milk feeds the minimum number of times or more during the previous day}}{\text{Non-breastfed children 6–23 months of age}}$$

   Notes:

   - Minimum is defined as:
     - — 2 times for breastfed infants 6–8 months
     - — 3 times for breastfed children 9–23 months
     - — 4 times for non-breastfed children 6–23 months
     - — "Meals" include both meals and snacks (other than trivial amounts[1]), and frequency is based on caregiver report.
   - This indicator is intended as a proxy for energy intake from foods other than breast milk.[2] Feeding frequency for breastfed children includes only non-liquid feeds and reflects the Guiding Principles[3] (*5*). Feeding frequency for non-breastfed children includes both milk feeds and solid/semi-solid feeds, and also reflects the Guiding Principles for these children (*7*).
   - It is recommended that the indicator be further disaggregated and reported for the following age groups: 6–11 months, 12–17 months and 18–23 months of age. Results may also be reported separately for breastfed and non-breastfed children.

Summary infant and young child feeding indicator

7. **Minimum acceptable diet:** Proportion of children 6–23 months of age who receive a minimum acceptable diet (apart from breast milk).

   This composite indicator will be calculated from the following two fractions:

$$\frac{\text{Breastfed children 6–23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day}}{\text{Breastfed children 6–23 months of age}}$$

   and

$$\frac{\text{Non-breastfed children 6–23 months of age who received at least 2 milk feedings and had at least the minimum dietary diversity not including milk feeds and the minimum meal frequency during the previous day}}{\text{Non-breastfed children 6–23 months of age}}$$

Notes:

- For breastfed children, see indicators 5 and 6 above for "Minimum dietary diversity" and "Minimum meal frequency" definitions.
- For non-breastfed children, see indicator 6 above for definition of "Minimum meal frequency". The definition of "Minimum dietary diversity" is similar to the definition for indicator 5, but milk feeds are excluded from the diversity score for non-breastfed children when calculating "Minimum acceptable diet". This is because milk feeds are considered as a separate and required element for non-breastfed children in this multi-dimensional indicator. Exclusion of milk feeds from the diversity score here avoids "double-counting" of this food group and allows use of this indicator in comparisons – across space and time – between populations with different rates of continued breastfeeding.
- See indicator 15 below for the rationale for at least 2 milk feedings for non-breastfed children.
- It is recommended that the indicator be further disaggregated and reported for the following age groups: 6–11 months, 12–17 months and 18–23 months of age.

Annex 3: Background characteristics of the child

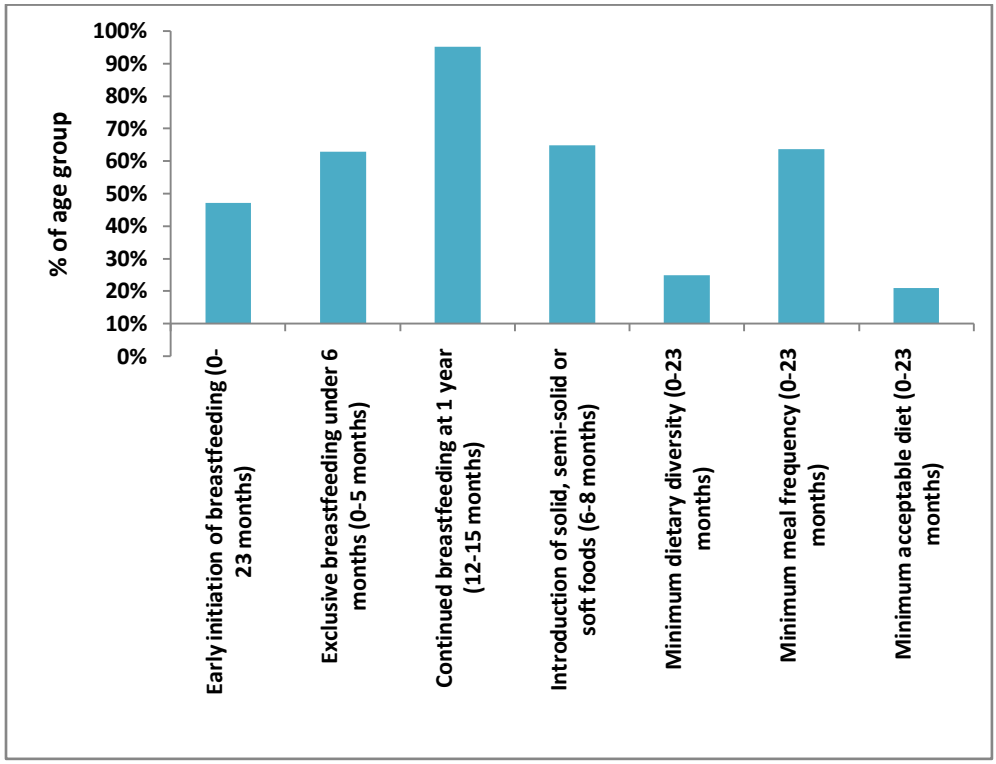
Variables		Total number (N)	Percent (%)
Region			
	Barisal	154	5.2
	Chittagong	711	24.2
	Dhaka	890	30.3
	Khulna	286	9.7
	Rajshahi	386	13.2
	Rangpur	299	10.2
	Sylhet	211	7.2
Father's education			
	No education	777	26.5
	Primary	886	30.2
	Secondary and above	1272	43.4
Father's occupation			
	Agricultural	841	28.8
	Non-agricultural	2021	69.2
	Others	59	2.0
Birth order			
	1st child	1061	36.1
	2nd to 4th	1637	55.7
	5th and above	238	8.1
Age of mother during last child birth			
	less than 20 years	884	30.1
	20 to 34 years	1949	66.4
	35 and above	103	3.5
ANC visits			
	No visit	919	31.8
	1 to 3 visit	1192	41.2
	4 to 6 visit	518	17.9
	7 and above	264	9.1
BMI of mother			
	<18	665	22.7
	18 to 25	1986	67.9
	Above 25	275	9.4
Place of delivery			
	Home	2048	69.7
	health facility	889	30.3
Food insecurity			
	Food secure	1919	65.5

	Mild food insecure	761	26.0
	Moderate food insecure	213	7.3
	Severe food insecure	35	1.2
Access to media			
	Yes	1907	65.2
	No	1017	34.8
Had fever in last two weeks			
	Yes	1275	43.4
	No	1661	56.6
Had symptoms of ARI in last two weeks			
	Yes	200	6.8
	No	2728	93.2
Had diarrhea in last two weeks			
	Yes	196	6.7
	No	2741	93.3
Prelacteal feeding			
	Yes	1039	36.2
	No	1831	63.8

Annex 4: Infant and Young Child Feeding (IYCF) Indicators

Among 2936 children, almost half of the children (47%) initiated breastfeeding within one hour after birth. 64.8% of children aged between 6 to 8 months had been introduced to solid semi-solid or soft foods. In addition, continued breastfeeding among children 12-15 months was 95.1%. Only one fourth of children (24.8%) 6-23 months achieved the minimum dietary diversity. Almost two third of children (63.6%) 6-23 months had minimum dietary diversity. When these two indicators were combined, less than one fourth of children (20.9%) had a minimum acceptable diet.

Figure 1: IYCF practices among children aged 0-23 months



Annex 5: Results of univariate analysis

5.1 Immediate causes

5.1.1 Dietary intake

Table 1: Association between dietary intake and undernutrition of under 2 children

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
Minimum dietary diversity for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	1		1		1	
No	1.5 (1.30-1.81)	0.000	1.9 (1.59-2.29)	0.000	1.1 (0.09-1.40)	0.274
Minimum meal frequency for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	1		1		1	
No	0.9 (0.81-1.12)	0.589	1.3 (1.13-1.57)	0.001	1.1 (0.91-1.38)	0.283
Minimum acceptable diet for all 6 to 23 months children (both breastfeed & non-breastfeed)						
Yes	1		1		1	
No	1.5 (1.27-1.80)	0.000	1.9 (1.59-2.34)	0.000	1.0 (0.87-1.36)	0.441

In univariate analysis Children who did not eat minimum 4 groups of food were 1.5 (95% CI [1.30-1.81], p=0.000) and 1.9 (95% CI [1.59-2.29], p=0.000) times likely to being stunted and underweight than those who ate minimum 4 groups of food. It did not show significant association with wasting. In addition, Children who did not receive minimum meal frequency were 1.3 (95% CI [1.13-1.57], p=0.001) times higher risk to be underweighted compared to children who had minimum meal frequency. Minimum meal frequency was insignificantly associated with stunting and wasting. Moreover, Children who did not achieve a minimum acceptable diet were 1.5 (95% CI [1.27-1.80], p=0.000) and 1.9 (95% CI [1.59-2.34], p=0.000) times higher odds to being stunted and underweight compared to children who achieved a minimum acceptable diet.

5.1.2 Health status or morbidity history of children

Table 2: Association between morbidity history and undernutrition of children under 2 years of age

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
ARI						
Yes	1.6 (1.23-2.19)	0.001	1.3 (1.09-1.85)	0.037	0.7 (0.47-1.13)	0.166
No	1		1		1	
Fever						
Yes	1.2 (1.03-1.40)	0.016	1.4 (1.19-1.65)	0.000	1.1 (0.96-1.45)	0.099
No	1		1		1	
Diarrhoea						

Yes	1.2 (0.93-1.69)	0.123	1.6 (1.20-2.19)	0.001	1.6 (1.19-2.41)	0.003
No	1		1		1	

Univariate analysis showed that children who had ARI during the last 15 days had 1.6 (95% CI [1.23-2.19], p=0.001) and 1.3 times (95% CI [1.09-1.85], p=0.037) higher risk to be stunted and underweight compared to the children who had no ARI. ARI was insignificantly associated with wasting. In addition, children with diarrhoea during last 2 weeks were both 1.6 (95% CI [1.20-2.19], p=0.001 & 95% CI [1.19-2.41] p=0.003) times as likely to be underweight and wasted compared to the children without diarrhoea. Moreover, children with fever in previous 2 weeks had 1.4 (95%CI [0.93-1.69], p=0.000) times more likely to be underweight compared to those children who had no fever. Fever had no significant association with stunting.

5.2 Underlying causes

5.2.1 Household food security

Table 3: Association of household food security and undernutrition of children under 2 years of age

Variables	Total number (N)	% Stunted (n)	Total Number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
Household food security						
Food secure	1		1		1	
Mild food insecure	1.4 (1.23-1.76)	0.000	1.8 (1.53-2.27)	0.000	1.1 (0.88-1.43)	0.331
moderate food insecure	2.3 (1.76-3.12)	0.000	2.8 (2.15-3.84)	0.000	1.5 (1.07-2.19)	0.019
Severe food insecure	1.1 (0.60-2.22)	0.654	1.5 (0.80-3.05)	0.185	1.4 (0.67-3.22)	0.332
	P=0.000		P=0.000		P=0.091	

In univariate analysis, moderate food insecure household's children were 2.3 (95% CI [1.76-3.12], p=0.000) times more likely to be stunted compared to children from food secure household. In contrast to food secure household, moderate food insecure household had 2.8 (95% CI [2.15-3.84], p=0.000) times more underweight children. It did not show significant result with wasting.

5.2.2 Care for women and children

Table 4: Association of care practices for women and children with undernutrition of children under 2 years of age

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
Mother's age during child birth						
<20 years	1		1		1	
20 to 34 years	0.7 (0.64-0.89)	0.001	0.8 (0.71-1.01)	0.079	0.9 (0.77-1.20)	0.748

35 or above	1.1 (0.74-1.67)	0.587	1.8 (1.22-2.74)	0.004	1.5 (0.91-2.46)	0.107
	P=0.002		P=0.000		P=0.188	
Birth order						
1st child	1		1		1	
2nd to 4th child	1.0 (0.85-1.18)	0.903	1.1 (0.95-1.35)	0.158	0.9 (0.76-1.18)	0.648
5th or above	1.5 (1.14-2.03)	0.004	2.1 (1.61-2.90)	0.000	1.2 (0.86-1.81)	0.234
	P=0.009		P=0.000		P=0.188	
Mothers' BMI						
<18	1.3 (1.16-1.66)	0.000	1.9 (1.58-2.29)	0.000	1.5 (1.23-1.94)	0.000
18 to 25	1		1		1	
Above 25	0.4 (0.31-0.58)	0.000	0.4 (0.31-0.63)	0.000	0.6 (0.39-0.91)	0.018
	P=0.000		P=0.000		P=0.000	
Prelacteal feeding						
Yes	1.2 (1.04-1.44)	0.011	1.1 (0.97-1.36)	0.105	1.0 (0.88-1.35)	0.418
No	1		1		1	

In univariate analysis, children with mother of 35 years or above at the time of birth 1.8 (95% CI [0.74-1.67], p=0.004) times more likely to be underweighted compared to children whose mother's age less than 20 years at the time of birth. The results were insignificant for wasting. Children with 5th or more birth were 1.5 (95% CI [1.14-2.03], p=0.004) and 2.1 (95% CI [1.61-2.90], p=0.000) times more likely to be stunted and underweighted compared to the children with 1st birth. In addition, children whose had low BMI (<18) were 1.3 (95% CI [1.16-1.66], p=0.000), 1.9 (95% CI [1.58-2.29], p=0.000) and 1.5 (95% CI [1.23-1.94], p=0.000) times more likely to be stunted, underweighted and wasted compared to children whose mothers had normal BMI.

Moreover, children who were fed prelacteal feed were 1.2 (95% CI [1.04-1.44], p=0.011) times more likely to be stunted compared to children who were not fed prelacteal feed. But the result did not show significant association with underweight and wasting.

5.2.3 Environmental factors and utilization health services

Table 5: Association of environmental factors and health services with undernutrition of under 2 years children

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Univariate analysis						
Variable	**P-value**	**Unadjusted OR (95% CI)**	**P-value**	**Unadjusted OR (95% CI)**	**P-value**	**Unadjusted OR (95% CI)**
Toilet facility						
Flush latrine	1		1		1	
Pit latrine	1.3 (1.05-1.69)	0.017	1.9 (1.50-2.65)	0.000	1.4 (1.04-2.05)	0.029
No facility/others	1.3 (1.03-1.78)	0.026	2.4 (1.78-3.32)	0.000	1.6 (1.12-2.39)	0.010
	P=0.046		P=0.000		P=0.034	
Source of drinking water						
Pipe water	1		1		1	
Tube well water	1.3 (1.02-1.77)	0.033	1.9 (1.39-2.67)	0.000	1.1 (0.80-1.68)	0.424
Others	0.9 (0.68-1.34)	0.817	1.5 (1.03-2.23)	0.031	1.5 (1.03-2.23)	0.488
	P=0.003		P=0.000		P=0.720	
Place of delivery						
Home	1.7 (1.44-2.03)	0.000	2.0 (1.69-2.45)	0.000	0.4 (1.17-1.84)	0.001
Hospital	1		1		1	

Mother's ANC visits						
No visit	1		1		1	
1 to3	0.6 (0.53-0.76)	0.000	0.5 (0.42-0.61)	0.000	0.6 (0.52-0.83)	0.001
4 to 6	0.7 (0.58-0.90)	0.005	0.4 (0.33-0.54)	0.000	0.6 (0.48-0.86)	0.004
7 or above	0.5 (0.38-0.69)	0.000	0.3 (0.22-0.44)	0.000	0.4 (0.26-0.62)	0.000
	P=0.000		P=0.000		P=0.000	

In univariate analysis, children who had no facilities and pit latrine were both 1.3 (95% CI [1.05-1.69], p=0.026 & 95% CI [1.05-1.69], p=0.017) times more likely to be stunted compared to children with flush latrine. In addition, the likelihood of being underweight was 2.4 (95% CI [1.78-3.32], p=0.000) and 1.9 (95% CI [1.50-2.65], p=0.000) times higher among children with no toilet facilities and pit latrines. Moreover, Children whose household had no facilities and pit latrine were 1.6 (95% CI [1.12-2.39], p=0.010) and 1.4 (95% CI [1.04-2.05], p=0.029) times likely to be wasted compared to children with flush latrine.

Children who drank tube well water were 1.3 (95% CI [1.02-1.77], p=0.033) times odds to be stunted compared to children who drank pipe water. In addition, the likelihood of being underweight were 1.9 (95% CI [1.39-2.67], p=0.000) and 1.5 (95% CI [1.03-2.23], p=0.031) times higher among children with tube well and other sources of water compared to children with pipe water. Source of drinking water did not show any association with wasting.

Children who were born in home were 1.7 (95% CI [1.44-2.03], p=0.000) and 2.0 (95% CI [1.69-2.45] p=0.000) times higher odds to be stunted and underweighted compared to children who were born in hospital. But in case of wasted children who were born in home were 0.4 (95% CI [1.17-1.84], p=0.001) times lower odds to be wasted than children who were born in hospital.

The prevalence of stunting, underweight and wasting was 30%, 60%, and 40% less among the children whose mothers had 4 to 6 ANC visits compared to children whose mothers had no ANC visits.

5.3 Basic causes

5.3.1 Socio-demographic factors

Table 6: Association of socio-demographic factors and undernutrition of children under 2 years of age

Variables	Total number (N)	% Stunted (n)	Total number (N)	% Underweight (n)	Total number (N)	% Wasted (n)
Univariate analysis						
Variable	**Unadjusted OR (95% CI) for stunting**	**P-value**	**Unadjusted OR (95% CI) for underweight**	**P-value**	**Unadjusted OR (95% CI) for wasting**	**P-value**
Region						
Chittagong	1		1		1	
Barisal	1.3 (1.03-1.83)	0.030	1.1 (0.86-1.58)	0.298	0.9 (0.65-1.39)	0.797
Dhaka	1.3 (1.07-1.78)	0.012	1.0 (0.765-1.31)	0.994	1.1 (0.81-1.55)	0.469
Khulna	1.1 (0.84-1.48)	0.424	0.5 (0.43-0.81)	0.001	0.5 (0.39-0.89)	0.013
Rajshahi	1.0 (0.75-1.33)	0.968	0.8 (0.64-1.16)	0.345	0.9 (0.67-1.37)	0.839
Rangpur	1.6 (1.27-2.19)	0.000	0.9 (0.74-1.32)	0.950	0.5 (0.39-0.89)	0.014

Sylhet	1.4 (1.09-1.84)	0.008	1.5 (1.20-2.03)	0.001	1.3 (0.96-1.83)	0.081
	P=0.001		P=0.000		P=0.001	
Place of residence						
Urban	1		1		1	
Rural	1.2 (1.07-1.50)	0.005	1.6 (1.40-2.02)	0.000	1.2 (1.01-1.59)	0.038
Age of child						
0-5 months	1		1		1	
6-11 months	1.4 (1.09-1.83)	0.007	1.7 (1.34-2.27)	0.000	0.9 (0.71-1.29)	0.799
12-17 months	4.1 (3.23-5.27)	0.000	2.5 (1.95-3.27)	0.000	1.0 (0.74-1.34)	0.983
18-23 months	4.9 (3.85-6.35)	0.000	3.4 (2.66-4.47)	0.000	1.2 (0.94-1.69)	0.119
	P=0.000		P=0.000		P=0.219	
Father's education						
None	1.8 (1.55-2.27)	0.000	2.5 (2.08-3.13)	0.000	1.6 (1.28-2.11)	0.000
Primary	1.8 (1.56-2.24)	0.000	2.0 (1.70-2.52)	0.000	1.3 (1.04-1.69)	0.023
Secondary and above	1		1		1	
	P=0.000		P=0.000		P=0.000	
Father's occupation						
Agricultural	1		1		1	
Non-agricultural	0.6 (0.52-0.74)	0.000	0.5 (0.47-0.67)	0.000	0.7 (0.60-0.94)	0.014
Others	0.4 (0.27-0.87)	0.017	0.5 (0.28-0.96)	0.039	1.1 (0.60-2.24)	0.652
	P=0.000		P=0.000		P=0.029	
Access to any type of media						
Yes	1		1		1	
No	1.6 (1.37-1.88)	0.000	2.1 (1.79-2.50)	0.000	1.6 (1.34-2.03)	0.000
Mother's education						
None	1.9 (1.58-2.42)	0.000	2.7 (2.20-3.44)	0.000	1.7 (1.28-2.24)	0.000
Primary	1.4 (1.21-1.72)	0.000	2.1 (1.78-2.58)	0.000	1.6 (1.31-2.07)	0.000
Secondary or above	1		1		1	
	P=0.000		P=0.000		P=0.000	
Wealth quintile						
Poorest	3.0 (2.38-3.93)	0.000	4.5 (3.43-5.99)	0.000	1.7 (1.20-2.29)	0.002
Poorer	2.2 (1.71-2.86)	0.000	2.9 (2.18-3.87)	0.000	1.4 (0.96-1.90)	0.077
Middle	1.7 (1.31-2.21)	0.000	2.2 (1.64-2.94)	0.000	1.5 (1.09-2.11)	0.013
Richer	1.5 (1.18-1.99)	0.001	1.2 (0.92-1.71)	0.145	0.9 (0.69-1.39)	0.932
Richest	1		1		1	
	P=0.000		P=0.000		P=0.002	

In univariate analysis, children born in Rangpur and Sylhet divisions had 1.6 (95% CI [1.27-2.19], p=0.000) and 1.4 (95% CI [1.09-1.84], p=0.008) times higher risk to be stunted compared to the children born in Chittagong division. In addition, children from Sylhet division were 1.5 (95% CI [1.20-2.03], p=0.001) times more likely to be underweighted compared to children from Chittagong division. Moreover, Khulna and Rangpur division's children were 50% less likely to be wasted than the Chittagong division.

Compared to urban children, rural children had 1.2 (95% CI [1.07-1.50], p=0.005), 1.6 (95% CI [1.40-2.02], p=0.000) and 1.2 (95% CI [1.01-1.59], p=0.038) times more odds of stunting, underweight and wasting.

The risk of being malnourished is increased with increase of age. Children in age category of 12-17 months and 18-23 months had 4.1 (95% CI [3.23-5.27], p=0.000) and 4.9 (95% CI [3.85-6.35], p=0.000) times higher risk to be stunted compared to the children of under 6 months. In addition, the risk of being underweight was high among children of children 12-17 months and of 18-23 months which were 2.5 (95% CI [1.95-3.27], p=0.000) and 3.4 (95% CI [2.66-4.47], p=0.000), and times compared to children of under 6 months of age. In case of wasted children it did not show any significant result.

Children whose fathers had no formal education were 1.8 (95% CI [1.55-2.27], p=0.000), 2.5 (95% CI [2.08-3.13], p=0.000) and 1.6 (95% CI [1.28-2.11], p=0.000) times higher risk to be stunted, underweighted and wasted compared to the children whose fathers had secondary or higher education.

Children whose fathers worked in non-agricultural sector had 0.6 (95% CI [0.52-0.74], p=0.000) and 0.5 (95% CI [0.47-0.67], p=0.000) times lower odds of stunting and underweight than children whose fathers worked in agricultural sector.

Children whose mothers had no media exposures were 1.6 (95% CI [1.37-1.88], p=0.000), 2.1(95% CI [1.79-2.50], p=0.000) and 1.6 (95% CI [1.34-2.03], p=0.000) times more likely to be stunted, underweighted and wasted compared to children whose mothers had media exposure.

Children whose mothers had no education and primary educated were 1.9 (95% CI [1.58-2.42], p=0.000) and 1.4 (95% CI [1.21-1.72], p=0.000) times likely to stunted than children whose mother had secondary or higher education. In addition, the likelihood of being underweighted and wasted were 2.7 (95% CI [2.20-3.44], p=0.000) and 1.7 (95% CI [1.28-2.24], p=0.000) times higher among children whose mothers had no education compared to children whose mother had secondary or higher education.

In univariate analysis, compared to richest wealth quintile, poorest and poorer wealth quintile's children were 3.0 (95% CI [2.38-3.93], p=0.000) and 2.2 (95% CI [1.71-2.86], p=0.000) times more likely to be stunted. In addition, children from poorest and poorer wealth quintile had 4.5 (95% CI [3.43-5.99], p=0.000) and 2.9 (95% CI [2.18-3.87], p=0.000) p=0.000) times higher risk to be underweight than children of richest wealth quintile. Moreover, children who lived in poorest and poorer households were 1.7 and 1.4 times more likely to be wasted.

Annex 6: WHO scoring on IYCF intervention activities in Bangladesh

Criteria of Indicator 6	Scoring	Results ✓ *Check any one*
6.1) A national Infant and Young Child Feeding/Breastfeeding policy has been officially adopted/approved by the government	2	✓
6.2) The policy promotes exclusive breastfeeding for the first six months, complementary feeding to be started after six months and continued breastfeeding up to 2 years and beyond.	2	✓
6.3) A National Plan of Action has been developed with the policy	2	✓
6.4) The plan is adequately funded	1	
6.5) There is a National Breastfeeding Committee	1	
6.6) The National Breastfeeding (Infant and Young Child Feeding) Committee meets and reviews on a regular basis	1	
6.7) The National Breastfeeding (Infant and Young Child Feeding) Committee links with all other sectors like health, nutrition, information etc., effectively	0.5	
6.8) Breastfeeding Committee is headed by a coordinator with clear terms of reference	0.5	
Total Score	**6/ 10**	**6**