Chapter 1: Introduction

The health status of the people is the wealth of a nation and nutrition is one of the most important pre-requisites for good health. The most neglected form of human deprivation is malnutrition; particularly among preschool children (Vipin Chandran, 2009). Malnutrition refers to inadequate dietary intake, infectious disease, or a combination of both (Olack et al., 2011; Mengistu et al., 2013; UNICEF, 2015).Three common indices of malnutrition for children are stunting (low height-for-age), wasting (low weight-for-height), and underweight (low weight-for-age) (Zere and McIntyre, 2003; De Onis et al., 2006; Islam et al., 2013). Malnutrition can exacerbate the impact of disease and nearly one-half of all child deaths globally are attributable to this cause (Mengistu et al., 2013).Children suffering malnutrition are more likely to die from common childhood illnesses such as diarrhea, pneumonia, malaria, measles, and AIDS (UNICEF, 2010).The primary causes of malnutrition include a lack of quality food, poor infant and child feeding and care practices such as suboptimal breastfeeding, deficiencies of micronutrients such as vitamin A or zinc, and recurrent attack of infections, often intensified by intestinal parasites (Franz, 2012; SCI, 2012).
Malnutrition is the greatest single threats to the world's public health, it is still widely believed that malnutrition is restricted to the third world population. Over population and poverty are pervasive in Bangladesh and causing population hazards like malnutrition among pre-school children who are naturally innocent, vulnerable, dependent often suffering from malnutrition (Rayhan and Khan, 2006).The prevalence of malnutrition in Bangladesh remains among the highest in the world (UNICEF, 2015).The nutrition of infants and young children are causing great concern among social scientists and planners these days, since child is the chief victim of interplay of nutritional, socio-economic and health factors that cause malnutrition. Undernutrition is a serious public health problem in Bangladesh. According to NIPORT et al., 2014, the prevalence of stunting, underweight, and wasting among under 5 children are 36%, 33% and 14% respectively. Rural children are more likely to be underweight (35 percent) than urban children (26 percent).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 birth-weight babies. The problem of undernutrition can be tackled effectively if evidence based intervention are delivered. Mother's education, family income, sex and birth order of the children are important determinant of malnutrition (Bairagi and Chowdhury, 1994). In Bangladesh this is further aggressive and critical because of unbalanced diet and poverty stress.

But, Bangladesh has made significant progress in the health and human development sectors since its independence in 1971 (Chowdhury, 2007; Khan et al., 2011).In Bangladesh, the child mortality per 1000 live births declined from 144 in 1990 to 41 in 2012, with an annual rate of reduction of 5.5%. Bangladesh has already achieved the Millennium Development Goal 4 and proven its achievement to be more impressive than other South Asian countries, particularly, India, Pakistan, and Afghanistan (de Onis et al., 2012).Unfortunately, the prevalence malnutrition in childrenless than 5 years of age in Bangladesh is high. Nutritional status is a sensitive indicator of community health and nutrition among preschool children, especially the prevalence of under nutrition that affects all dimensions of human development and leads to growth faltering in early life. Hence, a comprehensive study to determine the relationship between health-related factors and various malnutrition status is in demand. Nutritional assessment by anthropometric measurement is an important technique for identifying individuals, groups or communities whose growth is not keeping up with the expected pattern (NIPORT et al 2016). Therefore, the assessment of the nutritional status of a community is one of the first steps for the formulation of any public health strategy to combat malnutrition.

1.1 General Objective:

This research aim to identify the determinants of undernutrition among under five years of aged children in order to provide recommendations to policymakers and stakeholders to improve the nutritional status of them at two Islands of Bangladesh.

1.2 Specific Objectives:

- To explore the determinants of undernutrition among children under 5 years of age in Bangladesh using literature review.

- To analyze the key determinants of undernutrition (stunting, underweight and wasting) among children under 5 years of age.
- To provide recommendations based on the study findings to policymakers and stakeholders for the improvement of nutritional status of under 5 years of aged children at different Islands in Bangladesh.

Chapter 2: Review of Literature

2.1 Background Information about Bangladesh

2.1.1 Geography and Population

Bangladesh is a densely populated South Asian country, surrounded by India and Myanmar. It has 147,570 square kilometers of area. Population is almost 164.6 million and approximately 1,077 persons live in per square kilometer. The country is divided into 8 divisions, 64 districts and 491upazilas for administrative purpose (SVRS, 2018). Almost 72% of people live in rural areas. Islam is the most dominated religion and 90% people are muslim which is followed by hindu (9%) and other religions (1%) (BBS, 2014).

Figure 2.1: Map of Bangladesh (Source: Worldatlas, 2013)

2.1.2 Socio-economic Situation

2.1.2.1 Housing Characteristics

Housing characteristics and household assets can be used to measure the socioeconomic status of household members. According to National Institute of Population Research and Training (2016) average family member in a household is 4.5 and around 87% of household is headed by the men and only 13% are headed by the women. Access to electricity is increased and there is a disparity between urban (93%) and rural area (65%) in regard to access of electricity. Currently, mobile phone user is 89%. In rural areas the mobile phone user is 87 percent while in urban areas is 93 percent.

2.1.2.2 Water and Sanitation

Access to safe water and sanitation are basic determinants of better health. Limited access to safe drinking water and sanitation facilities and poor hygiene are associated with skin diseases, acute respiratory infections (ARIs), and diarrheal diseases, the leading preventable diseases in Bangladesh. ARI remains the leading cause of child deaths in Bangladesh. Diarrheal deaths and prevalence of diarrheal diseases among children under age 5 have declined, although 5 percent of under 5 children were reported to have had diarrhea in the two-week period in 2011 (NIPORT et al., 2013).Access to an improved source of drinking water is almost universal in Bangladesh (98 percent). The most common source of drinking water in urban areas is a tube well or borehole (67 percent), followed by water piped into the dwelling (14 percent), water piped to the yard or plot (9 percent), and a public tap or standpipe (8 percent) (NIPORT et al., 2016).Households without proper sanitation facilities have a greater risk of diseases like diarrhea, dysentery, and typhoid than households with improved sanitation facilities that are not shared with other households. About 45 percent of households have an improved (not shared) toilet facility. About one-third of the households use a non-improved toilet facility (31 percent); 22 percent of households use pit latrines without slabs, and 3 percent use a hanging toilet and 4 percent of households have no toilet facility (NIPORT et al., 2016).

2.1.2.3 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 (Profile, 2014).

2.1.2.4 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. 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. According to NIPORT et al., (2016) overall, percentage of completion of secondary or higher education increased among both men and women. 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.

2.1.3 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 (WHO, 2010).Bangladesh spends only 3.0% of its GDP in health sector while government health expenditure in relation to GDP is only 0.69% placing Bangladesh among the countries that least spends on health in South-East Asia Region (SEAR) (WHO, 2016).

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 (WHO, 2010). 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). According to Health Bulletin (2018), 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. The private sector facilities are mostly providing for-profit curative services and are gradually taking a big share of services at all levels. In the private sector, there is a wide range of private health practitioners, traditional healers, homeopathic practitioners, village

doctors, and pharmacists. They vary by qualification, skill, experience, and type of health care practiced.

2.1.4 Maternal and Child Health

Bangladesh has made impressive gains in reducing maternal and neonatal mortality over the past several decades, but total number and rates of these deaths remain too high. Moreover, the latest Bangladesh Maternal Mortality Survey (BMMS-2016) suggests that progress in reducing maternal mortality has stalled (NIPORT et al., 2017). Use of key maternal and newborn health (MNH) services remains critically low. Indeed, only 37% pregnant women attend at least four ANC contacts, 47% of births occur in health facilities and 48% (6% in the case of home-based births) of women receive postnatal care from a skilled health-care professional within the first two days after birth (NIPORT et al., 2017). While the BMMS-2016 revealed that use of skilled health services during pregnancy has increased over the past decade, this has not translated into an expected reduction in maternal mortality between 2010 and 2016. This suggests that focusing solely on increasing coverage of these services is not sufficient to translate into improved health.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 (NIPORT et al, 2017).According to Health Bulletin (2018) the mortality rate of under 5 is 45 per 1000 live births and Neonatal mortality rate is 30 per 1000 live births and it accounts for 67% of all under 5 deaths. Under five mortality rate has been declining gradually over the last two decades. However, between the 2014 –2017 BDHSs, the decline in under 5 mortality rate has slowed down noticeably.

2.1.5 Nutrition Situation in Bangladesh

2.1.5.1 Maternal and Child Nutrition

In Bangladesh, 22% children are born with low birth weight and the prevalence of stunting, underweight and wasting among under 5 children is 36%, 33% and 14% respectively (BDHS, 2014). There has been some improvement in child nutritional status over the past decade. According to BDHS (2014) the level of stunting among children under age 5 has declined from 51 percent in 2004 to 36 percent in 2014. In

the last three years it declined by 5 percentage points. Wasting increased to 17 percent in 2007 from 15 percent in 2004 and has gradually declined since then, to 14 percent in 2014. The level of underweight has declined from 43 percent in 2004 to 33 percent in 2014.

2.1.5.2 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 (BNNC, 1997). 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 (Mannan, 2003).

2.1.5.3 National Response to Nutrition

Bangladesh has achieved the Millennium Development Goal (MDG) targets for nutrition and is committed to achieve the targets of Sustainable Development Goals (SDGs) through Universal Health Coverage. The National Nutrition Service (NNS) Operational Plan (OP) 2017-22 focused mainstreaming of nutrition services through Directorate General of Health Services (DGHS) and Directorate General of Family Planning (DGFP) during the implementing period 2017-22. This new OP will focus more on system strengthening and multi-sectoral coordination to ensure universal and equitable coverage of both specific and sensitive nutrition interventions.

2.2 Problem Statement

Undernutrition is the serious health problem and the single largest contributor to child mortality(LTCM, 2017).Globally, undernutrition is responsible for 3.1 million deaths of children under 5 annually which constitute 45% of all child deaths in 2011 (Black et al., 2013). Around 11% of total global DALYs are lost because of child undernutrition (Black et al., 2008).

Stunting affected an estimated 22.2 per cent or 150.8 million children under 5 and wasting continued to threaten the lives of an estimated 7.5 per cent or 50.5 million children under 5 and also an estimated 5.6 per cent or 38.3 million children under 5 around the world were overweight globally in 2017.This prevalence of both stunting and wasting is not satisfactory level and still millions of children remain at risk. In

addition, prevalence of wasting is 50.5 million among under 5 children and around 35 million of wasted children live in Asia, these children have increased risk of SAM and death (LTCM, 2017).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 (Pasricha and Biggs, 2010).

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 birth-weight babies (Victora et al., 2008). 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 (Bryce et al., 2008 and Black et al., 2008).

Undernutrition remains a serious public health problem in Bangladesh. Like South Asian countries, the levels of child undernutrition in Bangladesh are among the highest in the world (Ahmedet al., 2012). 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 (Zongrone et al., 2012). Bangladesh has made significant improvement in achieving some of the health indicators but still maternal and child nutrition remains the neglected agenda.

2.3 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 UNICEF40 will be used to analyze the determinants of undernutrition of under 2 children in context of Bangladesh.

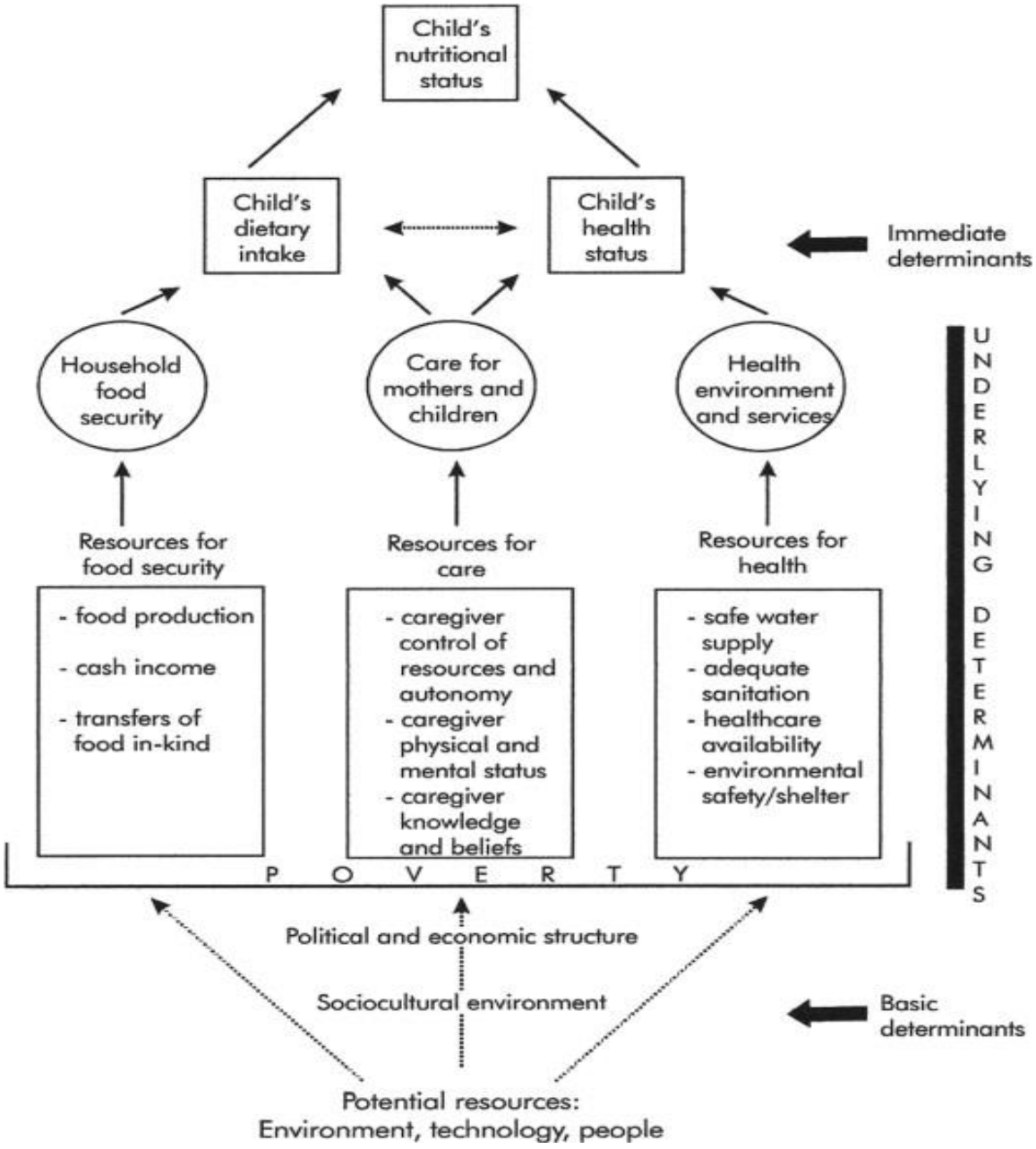

Figure 2.2: Conceptual framework for immediate, underlying, and basic determinants of child undernutrition

Sources: Adapted from UNICEF (1990) and Engle et al., 1999

2.4 Causes of Undernutrition

There are limited studies on determinants of undernutrition among children under 5 years of age in context of Bangladesh. Very little is known about the determinants of undernutrition among children under 5 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 5 children in Bangladesh. 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.

2.4.1 Immediate Causes

2.4.1.1 Dietary Intake

The literature suggests that there is strong association between dietary intake and undernutrition of children of under 5 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 (Zongrone et al., 2012).

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 (Jesmin et al., 2012).

2.4.1.2 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 diarrhea were the significant predictors of child malnutrition.

Children who suffered from ARI, fever and diarrhea 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 (Das and Rahman, 2011). Another study showed that presence of ARI was the risk factor associated with wasting (Rahman et al., 2009).

A study in rural Bangladesh showed that presence of diarrhea within previous 2 weeks of survey was a risk factor associated with stunting. Children with Diarrhea in the previous two weeks were 1.2 and 1.1 times more likely to be moderately and severely stunted than children without diarrhea. The study also noted that highest rate of diarrhea occurred among undernourished children which actually reflect the vicious cycle of the malnutrition–infection interaction (Ahmed et al., 2012).

2.4.2 Underlying Causes

2.4.2.1 Household Food Security

A study by using nationally representative Nutrition Surveillance Project (NSP)'s data 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. Children from food insecure households had 1.2 times higher risk to be stunted and underweight than children from food secure households (Chowdhury et al., 2016).

2.4.2.2 Caring for Women and Children

A study 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 (Siddiqi et al., 2011). Another study also showed that mother's age during child birth was the determinant for stunting (Hong et al., 2006).

Another study 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 (Rayhan and Khan, 2006). Other studies in context of Bangladesh showed that maternal BMI was a risk factors for stunting (Hong et al., 2006; Rahman and Chowdhury, 2007; Das et al., 2008;Mostafa et al., 2010; Kamal, 2011; Siddiqi et al., 2011; Ahmed et al., 2012), underweight (Das et al., 2008; Siddiqi et al., 2011; Ahmed

et al., 2012) and wasting (Rayhan and Khan, 2006; Rahman et al., 2009; Siddiqi et al., 2011; Ahmed et al., 2012).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 (Kamal, 2011; Alom et al., 2012).

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 pre-lacteal 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 (Saha et al., 2008).

2.4.2.3 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 (Islam et al., 2013).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 (Ahmed et al., 2012). Other studies also showed that toilet facility was the significant predictor for stunting and wasting (Kamal, 2011; Alom et al., 2012; Islam et al., 2013).

Evidence showed that place of delivery has a significant effect on the chronic malnutrition of children in context of Bangladesh (Hong et al., 2006; Rahman and Chowdhury, 2007). 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 (Rahman and Chowdhury, 2007).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 (Siddiqi et al., 2011) and underweight (Das et al., 2008) than children whose mothers had ANC visits.

2.4.3 Basic Causes

2.4.3.1 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 (Rahman and Chowdhury, 2007). Other studies also showed that geographical location had a strong association with chronic malnutrition. (Hong et al., 2006; Das et al., 2008; Kamal, 2011; Alom et al., 2012).

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 (Das and Rahman, 2011). Age of the child is a determinant for stunting (Hong et al., 2006; Rahman and Chowdhury, 2007; Kamal, 2011; Alom et al., 2012) underweight (Das and Rahman, 2011; Alom et al., 2012) and wasting (Rahman et al., 2009; Alom et al., 2012) 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 (Ahmed et al., 2012).

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 (Kamal, 2011). Other studies also demonstrated that father's education is a strong determinant for stunting (Rahman and Chowdhury, 2007; Jesmin et al., 2011; Siddiqi et al., 2011; Alom et al., 2012) underweight (Rayhan and Khan, 2006; Siddiqi et al., 2011;Alom et al., 2012) and wasting (Siddiqi et al., 2011; Islam et al., 2013) in context of Bangladesh.

A study 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 (Alom et al., 2012).

Another study 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 (Rahman et al., 2009). Another study showed that media exposure to mother was significantly associated with stunting (Rahman and Chowdhury, 2007).

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 (Siddiqi et al., 2011). Other studies in context of Bangladesh showed that maternal education has a strong significant effect on stunting (Rayhan and Khan, 2006; Rahman and Chowdhury, 2007; Das et al., 2008; Ahmed et al., 2012), underweight (Das and Rahman, 2011; Siddiqi et al., 2011; Ahmed et al., 2012) and wasting (Siddiqi et al., 2011; Islam et al., 2013; Ahmed et al., 2012; Alom et al., 2012).

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 (Hong et al., 2006). Previous studies showed that household economic condition is the most strongest determinants of stunting (Rahman and Chowdhury, 2007; Das et al., 2008; Kamal, 2011; Siddiqi et al., 2011; Alom et al., 2012; Ahmed et al., 2012), underweight (Das and Rahman, 2011; Siddiqi et al., 2011; Alom et al., 2012; Ahmed et al., 2012) and wasting (Siddiqi et al., 2011; Ahmed et al., 2012; Islam et al., 2013).

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 2.1**

Table 2.1: Proxy indicators for immediate, underlying and basic causes of under-nutrition.

Causes	Proxy indicators
Immediate causes	
Dietary intake	• Exclusive breastfeeding <6 months • Major Depressive Disorder (MDD) • Mycophenolate mofetil (MMF) • MAD
Health status or morbidity	• Diarrhea • 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 • Pre-lacteal 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

Chapater-3: Materials and Methods

3.1 Study Area and Period

A Cross-sectional study was carried out from June 2019 to July 2019 at Sandwip and Hatiya Island. Hatiya is an upazila under Noakhali District of Chattogram division and it is located at the mouth of the Meghna River on the Bay of Bengal. It has a total population of about 450,000 including 51% male and 49% female. Sandwip is an upazila under Chattogram District of Chattogram division and it is located at the estuary of the Meghna River on the Bay of Bengal. It has a total population of about 280,000 including 46% male and 54% female.

Figure 3.1: Study area (Source: Wikipedia)

3.2 Apparatus

a) A structured questionnaire was used in the study to collect information on socio demographic and socio-economic characteristics of the households.

b) An Electronic Baby Scale machine (Model: byb01) of Dixy brand was used to measure the weight and length of children who were unable to stand.

c) An Easy Touch GCHb machine and Easy Touch Hemoglobin Test Strips were used to determine the hemoglobin level of children's mother, both of these are made by Bioptic Technology Inc, Taiwan.

d) A 3 meter measuring tape was used to measure the height of mothers and children who are able to stand.

3.3 Sample Size

The sample size was estimated by using the formula, which is give below (Bryman, 2016). In the formula the sample size (n) is for finite populations (f < 0.05), taking into account a 95% confidence level (z), the population size (N), maximum population variability (p = q = 0.5), and assuming 5% sampling error (E).

$$n = \frac{z^2 \cdot N \cdot p \cdot q}{N \cdot E^2 + z^2 \cdot p \cdot q}$$

3.4 Study Design

A community based cross sectional study was carried out. Simple random sampling technique was used to select 450 under- five children from different family of 11 union of Hatiya and 7 union of Sandwip. A total of 270 sample was collected from Hatiya and 180 from Sandwip. Simple random sampling was also used to select an individual for the study among eligible family.

3.5 Anthropometric Measurements

A form in the structured questionnaire was used to record information on anthropometric measurements (weight, Length/Height). The procedures were followed for taking anthropometric measurements and Z score are as described by WHO (2010) Anthro software. The length was measured by measuring tape with minimal cloths. All measurements (Height & weight) were taken three times and if the difference among reading was less than 1 cm for Length/Height and 0.5kg for weight, the mean measurement was taken. Children with length/Height-for-age below -2 standard deviations (SD) of the WHO standards were labelled as stunted and children with weight-for-age below -2 standard deviations (SD) of the WHO standards were identified as underweight (WHO, 2008; WHO, 2006). Weight-for-height of below-3 standard deviations (SD) of the WHO standards was used to identify infants and children as having sever acute malnutrition (SAM) (WHO, 2009) and weight-for-height between -2 and -3 standard deviations (SD) of the WHO standards is used to identify infants and children as having moderate acute malnutrition (MAM) (ACF, 2010).

3.6 Statistical Analysis

Data was analyzed by using Statistical Package for Social Science (SPSS) version 25.0 and WHO Anthro Software. The Z-scores of weight for age, weight for height and height for age were compared with associated factors using chi square test. Fisher's exact test was employed to understand the statistical significance between associated factors of nutritional status. Level of significance was set at $p<0.05$.

Chapter-4. Results

This section describes the findings of the study. The nutritional status of pre-school children of two islands are presented through the three basic indices including underweight, wasting and stunting firstly. Then socio-demographic, caregiver health & wellness and health status/morbidity factors characteristics were explained. Finally, the associations between different variables and nutritional status were described using Chi square test and Fisher's exact tests.

4.1 Nutritional Status of Pre-school Children at Islands

This study showed that about 39.3% children were underweight, 45.5% children were stunted and 20.5% children were wasted. On the basis of age group, 0-6 months (50%), 7-24 months (20%) and 25-59 months (43.8%) children were undernourished and these are shown in fig. **4.1 and 4.2.**

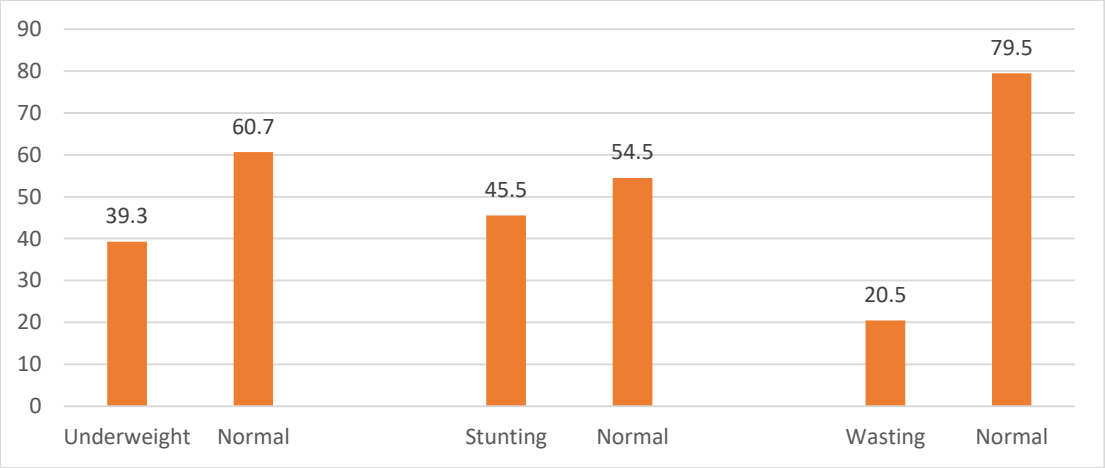

Figure 4.1: Nutritional Status of Pre-school Children at Islands

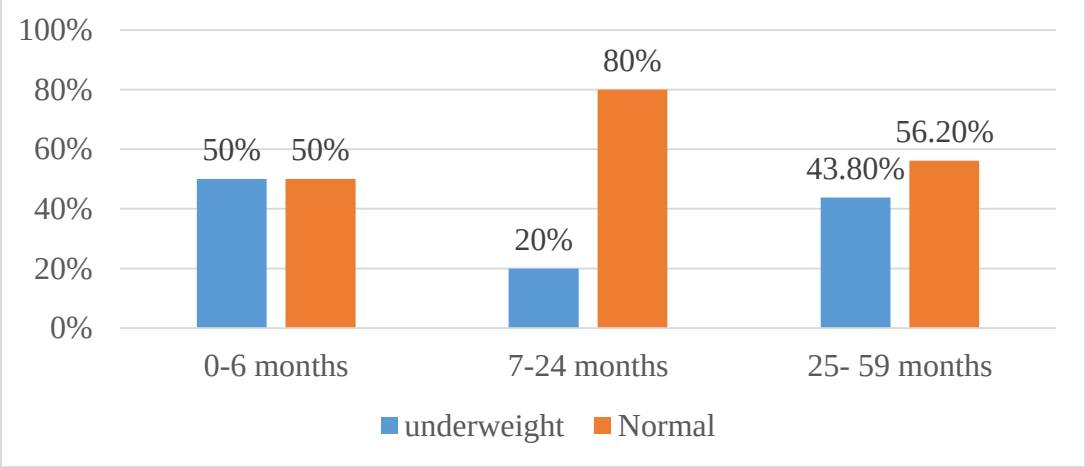

Figure 4.2: Nutritional Status of Pre-school Children at Islands Compared with Age Group.

4.2 Socio-demographic Characteristics of Respondents

4.2.1 Age Distribution

Nutritional status of children is related to child's age. This study had ages ranging from 0 months to 59 months and it was distributed into 3 different categories: 0-6 months (12.5%), 7-24 months (22.3%), 25-59 months (65.2%).

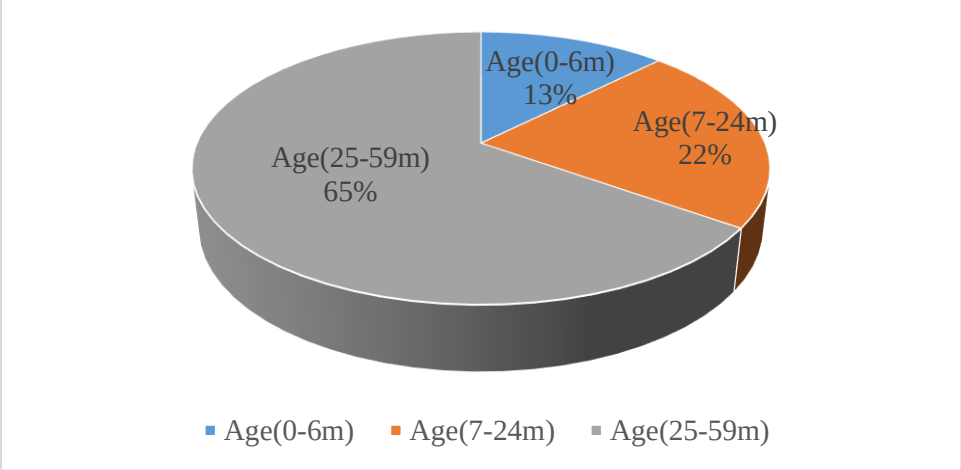

Figure 4.3: Age distribution (%) of children

4.2.2 Gender Distribution

In this study among 448 children, about 236 (52%) of children were male and 212(48%) were female.

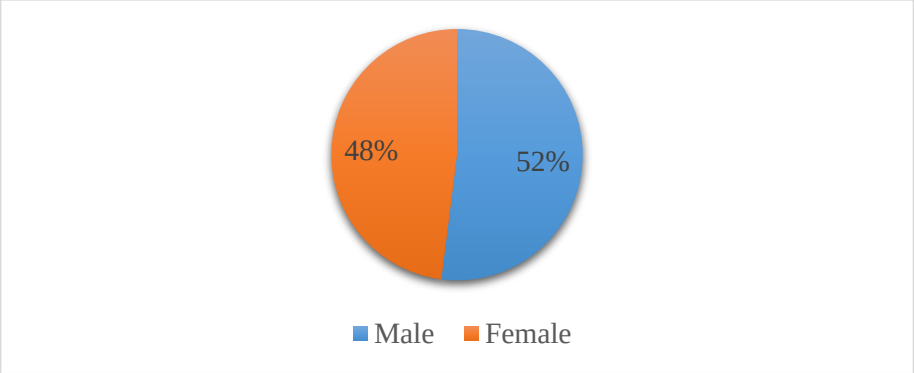

Figure 4.4: Gender distribution (%) of children

4.2.3 Mother's Education

About 27.4% mother had primary education (up to 6th grade), majority of mother about 54.5% had secondary education (up to 10th grade) and 18.1% mother had higher secondary degree (over 10th grade).

4.2.4 Mother's Health Status

The mother's nutritional status was measured by using Body Mass Index (BMI) formula and according to WHO recommended standard value about 40.1% mothers were undernourished, 55.8% mothers were normal and about 4.1% mothers were

over-weight. According to WHO, 1989 guidelines and standard values the study showed that about 38.8% mothers were anemic and 61.2% mothers were non-anemic.

4.3 Associated Factors of Underweight (weight for age)

This study showed that about 39.3% of the children were underweight and also informed that underweight was associated with socio-demographic, caregiver's health & wellness and health status/morbidity factors.

4.3.1 Association of Underweight with Socio-demographic Factors

The results exposed that child's age group, sex, mother's education, mother's occupation, immunization status of children, birth order of children, and supplementation of food had statistically significant association with underweight. **Table 4.1** illustrates these association.

Table 4.1: Association of demographic characteristics with underweight

Variable		Underweight n (%)	Normal n (%)	Total N (%)	Pearson's $\chi 2$ (df)	p value
Age (Month)	0 – 6	28(15.9)	28(10.3)	56(12.5)	20.823(2)	< .001
	7 – 24	20(11.4)	80(29.4)	100(22.3)		
	25 – 59	128(72.2)	164(60.3)	292(56.2)		
Gender	male	105(59.7)	131(48.2)	236(52.7)	5.666(1)	0.017
	female	71(40.3)	141(51.8)	212(46.3)		
Mother's Education	Up to 6th	108(61.36)	136(50)	244(54.46)	27.54 (2)	< .001
	Up to 10th	57(32.38)	66(24.3)	123(27.45)		
	Above 10th	11(6.25)	70(25.7)	81(18.08)		
Mother's Occupation	housewife	167(94.9)	239(87.9)	406(90.6)	6.196(1)	0.013
	Job holder	9(5.1)	33(12.1)	42(9.4)		
Birth Order	Up to 2	83(46.89)	168(61.99)	251(56.02)	9.909 (1)	< .001
	Above 2	94(53.10)	103(38.01)	197(43.97)		
No. of Family Member	Up to 4	79(44.9)	140(51.5)	219(48.9)	1.854(1)	0.173
	Above 4	97(55.1)	132(48.5)	229(51.1)		
Immunization status	Fully	141(80.1)	253(93)	394(87.9)	16.777(1)	< .001
	Partially	35(19.9)	19(7)	54(12.1)		
Father's Education	Up to 6th	98(55.7)	137(50.4)	235(52.5)	1.28(2)	0.503
	Up to 10th	41(23.3)	64(24.6)	108(24.1)		
	Above 10th	37(21)	68(25)	105(23.4)		
Food Supplement	Yes	25(14.2)	156(57.4)	181(40.4)	82.623(1)	< .001
	No	151(85.8)	116(42.6)	267(59.9)		
Father's Occupation	Farmer	83(46.89)	112(41.3)	195(43.52)	1.437 (4)	0.837
	Abroad	32(18.07)	56(20.7)	88(19.64)		
	Business	24(13.55)	38(14)	62(13.83)		
	Day labor	10(5.64)	17(6.3)	27(6.02)		
	Job holder	28(15.81)	48(17.7)	76(16.96)		

* Chi-square test and P < 0.050 was considered statistically significant

4.3.2 Association of Underweight with Caregiver's Health & Wellness Factors

The results revealed that underweight was significantly associated with mother's nutritional status, mother's anemic condition. **Table 4.2** illustrates this association.

Table 4.2: Association of underweight with caregiver's health & wellness factors

Variable		Underweight n (%)	Normal n (%)	Total N (%)	Pearson's $\chi 2$ (df)	p value
Mother's nutritional Status	Underweight	115(65.3)	65(23.9)	180(40.2)		
	Normal	54(30.7)	196(72.1)	250(55.8)		
	Overweight	7(4)	11(4)	18(4)	78.465(2)	< .001
Anemia	Yes	107(60.8)	67(21)	174(38.8)		
	No	69(39.2)	205(75.4)	274(61.2)	58.829(1)	< .001
Asthma	Yes	36(20.5)	57(21)	93(20.8)		
	No	140(79.5)	215(79)	355(79.2)	0.016(1)	0.898

* Chi-square test and P < 0.050 was considered statistically significant

4.3.3 Association of Underweight with Health Status or Morbidity Factors

The results showed that underweight was significantly associated with child's diarrhea, pneumonia and worm infestation. The results of Chi-Square test with p = <0.05 were illustrated in **Table: 4.3.**

Table 4.3: Association of underweight with health status or morbidity factors

Variable		Underweight n (%)	Normal n (%)	Total N (%)	Pearson's $\chi 2$ (df)	p value
Diarrhea	Yes	159(90.3)	94(34.6)	253(56.5)		
	No	17(9.7)	178(65.4)	195(43.5)	135.268(1)	< .001
Pneumonia	Yes	121(68.8)	32(11.8)	153(34.2)		
	No	55(31.2)	240(88.2)	295(67.8)	154.086(2)	< .001
Fever	Yes	117(66.5)	157(42.3)	274(61.2)		
	No	59(33.5)	115(42.3)	174(38.8)	3.449(1)	0.063
Acute Respiratory Infections	Yes	65(36.9)	90(33.1)	155(34.6)		
	No	111(63.1)	182(66.9)	293(65.4	0.698(1)	0.404
Worm infestation	Yes	139(79.42)	135(49.45)	274(61.16)		
	No	36 (20.57)	138(50.54)	174(38.83)	40.344 (1)	< .001

* Chi-square test and P < 0.05 was considered statistically significant

4.4 Associated Factors of Wasting (Weight for Height)

This study revealed that about 20.5% of the children were wasted and also informed that wasting was associated with socio-demographic, caregiver's health & wellness and health status/morbidity factors.

4.4.1 Association of Wasting with Socio-demographic Factors

This study showed that wasting was significantly associated with only child's age group. The results of Chi-Square test with p = <0.05) were illustrated in **Table: 4.4**

4.4: Association of wasting with socio-demographic factors

Variable		Wasting n (%)	Normal n (%)	Total N (%)	Pearson's $\chi 2$ (df)	P - Value
Age (Months)	0 – 6	0(0.00)	56(15.7)	56(12.5)	27.361(2)	< .001
	7 – 24	12(13)	88(24.7)	100(22.3)		
	25 – 59	80(87)	212(59.6)	292(65.2)		
Gender	Male	56(60.9)	180(50.6)	236(52.7)	3.116(1)	0.078
	Female	36(39.1)	176(49.4)	212(47.3)		
Mother's Education	Up to 6th	55(59.8)	189(53.08)	244(54.46)	4.081 (2)	0.129
	Up to 10th	27(29.3)	96(26.96)	123(27.45)		
	Above 10th	10(10.9)	71(19.94)	81(18.08)		
Mother's Occupation	Housewife	83(90.2)	323(90.7)	406(90.6)	0.023(1)	0.88
	Job holder	9(9.8)	33(9.3)	42(9.4)		
Birth Order	Up to 2	50(53.76)	201(56.6)	251(56.02)	0.244 (1)	0.621
	Above 2	43(46.23)	154(43.4)	197(43.97)		
No. of Family Member	Up to 4	48(52.2)	171(48)	219(48.9)	0.502(1)	0.479
	Above 4	44(47.8)	185(52)	229(51.1)		
Immunization Status	Fully	81(88)	313(84.9)	394(86.9)	0.001(1)	0.974
	partially	11(12)	43(12.1)	54(12.1)		
Father's Education	Up to 6th	43(46.7)	192(53.9)	235(52.5)	1.599(2)	0.45
	Up to 10th	24(26.1)	84(23.6)	108(24.10)		
	Above 10th	25(27.2)	80(22.5)	105(23.4)		
Father's Occupation	Farmer	36(38.70)	159(44.8)	195(43.52)	5.754 (4)	0.218
	Abroad	14(15.05)	74(20.8)	88(19.64)		
	Businessman	15 (16.12)	47 (13.2)	62 (13.83)		
	Day labour	9 (9.67)	18 (5.1)	27(6.02)		
	Job holder	19(20.43)	57(16.1)	76(16.96)		
Food Supplement	Yes	39(42.4)	142(39.9)	181(40.4)	0.190(1)	0.661
	No	53(57.6)	214(60.1)	267(59.6)		

* Chi-square test and P < 0.050 was considered statistically significant

4.4.2 Association of Wasting with Caregiver's Health & Wellness Factors

This study revealed that wasting had no significantly association with caregiver's health & wellness factors but comparatively associated with mother's nutritional status, mother's anemic and asthmatic condition. The results of Chi-Square test with p = <0.05) were illustrated in **Table: 4.5**

Table 4.5: Association of wasting with caregiver's health & wellness factors

Variable		Wasting n (%)	Normal n (%)	Total N (%)	Pearson's $\chi 2$ (df)	P - Value
Mother's health Status	Underweight	45(48.9)	135(37.9)	180(40.2)	3.683(2)	0.158
	Normal	44(47.8)	206(57.9)	250(55.8)		
	Overweight	3(3.3)	15(4.2)	18(4)		
Anemia	Yes	40(43.5)	134(37.6)	174(38.8)	1.049(1)	0.306
	No	52(56.5)	222(62.4)	274(61.2)		
Asthma	Yes	20(21.7)	73(20.5)	93(20.8)	0.068(1)	0.795
	No	72(78.3)	283(79.5)	355(79.2)		

* Chi-square test and P < 0.050 was considered statistically significant

4.4.3 Association of wasting with health status or morbidity factors

This study exposed that wasting had no significantly association with child's health status or morbidity factors but comparatively associated with diarrhea, pneumonia, worm infestation. The results of Chi-Square test with p = <0.05) were illustrated in **Table: 4.6**

Table 4.6: Association of wasting with health status or morbidity factors

Variable		Wasting n (%)	Normal n (%)	Total N (%)	Pearson's $\chi 2$ (df)	P - Value
Diarrhea	Yes	51(55.4)	202(56.7)	253(56.5)	0.051(1)	0.822
	No	41(44.6)	154(43.3)	195(43.5)		
Pneumonia	Yes	33(35.9)	120(33.7)	153(34.2)	3.327 (1)	0.068
	No	59(64.1)	136(66.2)	295(65.8)		
Fever	Yes	63(68.5)	211(59.3)	274(61.2)	2.610(1)	0.106
	No	29(31.5)	145(40.7)	174(61.2)		
Acute Respiratory Infections	Yes	32(34.8)	123(34.5)	155(34.6)	0.002(1)	0.967
	No	60(65.2)	233(65.4)	293(65.4)		
Worm infestation	Yes	55(59.78)	219(61.51)	274(61.1)	0.092(1)	0.760
	No	37(40.2)	137(38.48)	174(38.83)		

* Chi-square test and P < 0.050 was considered statistically significant

4.5 Associated factors of Stunting (Height for age)

This study revealed that about 45.5% of the children were stunted and it was significantly associated with socio-demographic, caregiver's health & wellness and health status/morbidity factors.

4.5.1 Association of stunting with socio-demographic factors

The findings explained that stunting was significantly associated only child's age group and sex but comparatively related to mother's education, mother's occupation, immunization status of children, birth order of children and supplementation of foods. The results of Chi-Square test with p = <0.05) were illustrated in **Table: 4.7**

Table 4.7: Association of stunting with socio-demographic factors

Variable		Stunting N (%)	Normal N (%)	Total N (%)	Pearson's χ2 (df)	P - Value
Age (months)	0 – 6	20(9.8)	36(14.8)	56(12.5)	11.72(2)	0.003
	7 – 24	60(29.4)	40(16.4)	100(22.3)		
	25 – 59	124(60.8)	168(68.9)	292(65.2)		
Gender	Male	124(60.8)	112(45.9)	236(52.7)	9.872(1)	0.002
	Female	80(39.2)	132(54.1)	212(47.3)		
Mother's education	Up to 6th	107(52.5)	137(56.1)	244(54.46)	1.122 (2)	0.570
	Up to 10th	56(27.5)	67(27.45)	123(27.45)		
	Above 10th	41(20.1)	40(16.39)	81(18.09)		
Mother's occupation	Housewife	186(91.2)	220(90.2)	406(90.6)	0.134(1)	0.714
	Job holder	18(8.8)	24(9.8)	42(9.4)		
Birth order	Up to 2	115(56.37)	136(55.4)	251(56.02)	0.018 (1)	0.892
	Above 2	89(43.6)	108(44.3)	197(43.97)		
No. of Family Member	Up to 4	94(45.1)	125(51.2)	219(48.9)	1.180(1)	0.277
	Above 4	110(53.9)	119(48.8)	229(51.1)		
Immunization status	Fully	174(85.3)	220(90.2)	394(87.9)	2.486(1)	0.115
	Partially	30(14.7)	24(9.8)	54(12.1)		
Father's Education	Up to 6th	111(54.4)	124(50.8)	235(52.5)	0.927(2)	0.629
	Up to 10th	45(22.1)	63(25.8)	108(24.1)		
	Above 10th	48(23.5)	57(23.4)	105(23.4)		
Food Supplement	Yes	78(38.2)	103(42.2)	181(40.4)	0.730(1)	0.393
	No	126(61.8)	141(57.8)	267(59.6)		
Father's Occupation	Farmer	79(38.72)	116(47.5)	195(78.62)	9.242 (4)	0.055
	Abroad	51(25)	37(15.16)	88(19.64)		
	Businessman	28(13.72)	34(13.93)	62(13.83)		
	Day labour	15(7.35)	12(4.9)	27(6.02)		
	Job holder	31(15.19)	45(18.4)	76(16.96)		

* Chi-square test and P < 0.050 was considered statistically significant

4.5.2 Association of stunting with caregiver's health & wellness factors

The results of this study revealed that the stunting was significantly associated only mother's nutritional status and mother's anemic condition. The results of Chi-Square test with p = <0.05) were illustrated in **Table: 4.8**

Table 4.8: Association of stunting with caregiver's health & wellness factors

Variable		Stunting n (%)	Normal n (%)	Total N (%)	Pearson's χ2 (df)	P - Value
Mother's Nutritional Status	Under-weight	98(48)	82(33.6)	180(40.2)	17.933(2)	< .001
	Normal	93(45.6)	157(64.3)	250(55.8)		
	Over-weight	13(6.4)	5(2)	18(4)		
Anemia	Yes	92(45.1)	82(33.6)	174(38.8)	6.177(1)	0.013
	No	112(54.9)	162(66.4)	274(61.2)		
Asthma	Yes	45(22.1)	48(19.7)	93(20.8)	0.385(1)	0.535
	No	159(77.9)	196(80.3)	355(79.2)		

* Chi-square test and P < 0.050 was considered statistically significant

4.4.3 Association of stunting with health status or morbidity factors

The results showed that the stunting was significantly associated with diarrhea but comparatively related with other factors including pneumonia, worm infestation, acute respiratory infection (ARI) and fever. The results of Chi-Square test with p = <0.05 were illustrated in **Table: 4.9**

Table 4.9: Association of stunting with health status or morbidity factors

Variable		Stunting n (%)	Normal n (%)	Total N (%)	Pearson's χ2 (df)	P - Value
Diarrhea	Yes	128(62.7)	125(51.2)	253(56.5)		
	No	76(37.3)	119(48.8)	195(43.5)	5.994(1)	0.014
Pneumonia	Yes	78(38.04)	75(307)	153(34.15)		
	No	127(61.95)	167(69.3)	295(65.84)	2.455 (1)	0.117
Fever	Yes	118(57.8)	156(63.9)	274(61.2)		
	No	86(42.2)	88(36.1)	174(38.8)	1.735(1)	0.188
Acute Respiratory Infections	Yes	67(32.8)	88(36.1)	155(34.l6l)	0.510(1)	0.475
	No	137(67.2)	156(63.9)	293(65.4)		
Worm infestation	Yes	131(64.53)	143(58.3)	274(61.1)		
	No	72(35.46)	102(61.6)	174(38.83)	1.776 (1)	0.182

* Chi-square test and P < 0.050 was considered statistically significant

Chapter-5. Discussion

This study showed that about 39.3% of the children were underweight and also informed that underweight was significantly associated with child's age group, sex, mother's nutritional status, mother's education, mother's occupation, mother's anemic condition, birth order of children, diarrhea, pneumonia, worm infestation, supplementation of food and immunization status of children. Furthermore, about 20.5% of the children were wasted and it was significantly associated with only child's age group and about 45.5% of the children were stunted and also informed that stunting was significantly associated with child's age group, sex, diarrhea, mother's nutritional status and mother's anemic condition.

5.1 Socio-demographic Factors

The results of this study indicated that the risk of being undernourished increased significantly with increase of age. Children aged 25 to 59 months were more likely to be undernourished (72.2%), stunted (60.8%), and wasted (87%) than children 0-6 & 7-24 months of age. Prevalence of malnutrition among children 0-6 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 diarrhea 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 underweight (Ahmed et al., 2012; Das and Rahman et al., 2012; Bloss et al., 2004; Jeyaseelan and Lakshman, 1997) increased with age.

Although many studies all over the world showed mother's education is an important predictor for undernutrition but this study showed that in context of Bangladesh father's education also important determinant for malnutrition. Children whose fathers had primary education (up to 6^{th} grade) were more likely to be undernourished (55.7%), stunted (46.7%) and wasted (54.4%) than children whose father had higher education (above 10^{th} grade). Father's educational qualification related to occupation and family income. Same as, this study showed that the children whose fathers were

farmer more likely to be undernourished (47.2%), stunted (38.9%) and wasted (39.1%) than children whose father had job holder or business man. Several studies in Bangladesh found the similar findings (Kamal, 2011; Siddiqi et al., 2011; Jesmin et al., 2011; Rahman and Chowdhury, 2007). This study results suggest that the risk of being undernourished decreases with increasing father's 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.

Furthermore, this study showed that mother's education is an important predictor for undernutrition. Children whose mothers had primary education (up to 6^{th} grade) were more likely to be undernourished (61.7%), stunted (52.2%) and wasted (59.8%) than children whose mothers had higher education (above 10^{th} grade). Besides this, the study showed that mother's occupation is an important predictor for undernutrition. The children whose mothers were housewife more likely to undernourished (94.9%), stunted (91.2%) and wasted (90.2%) than job holder. Previously many studies showed the same findings (Mahgoub et al., 2006; Hien and Kam, 2008; Siddiqi et al., 2011; Ahmed et al., 2012; Das and Rahman). 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.

The relationship between birth order and child nutrition is particularly important for Bangladesh, where a higher number of children is still considered as a higher means of income. This study provides contradictory relationship between order of birth and nutritional status of children under 5 years of age. Specifically, this study finds that higher birth order has low child malnutrition. A possible explanation for this association could be that the mothers have previous experience to rare and care the children that increase more attention and care from parents: antenatal and postnatal care and child checkup increases with the higher birth order due to previous bad

experience. As a result, births of higher order might suffer from less health hazards as well as malnutrition. This finding is contradictory with previous studies while assessing child nutritional status by birth order as a confounding factor in Bangladesh (Khan and Raza, 2014) and in other countries(Marston and Cleland, 2003; Ukwuani and Suchindran, 2003; Shapiro-Mendoza et al., 2005).

Therefore, the present finding suggests that the efforts these factors in Bangladesh may not only increase child malnutrition but also decrease maternal and child health outcomes.

5.2 Caregiver's Health & Wellness Conditions

Mother's nutritional status showed significant association with stunting and undernutrition. It also comparatively associated with wasting. Children whose mothers had low BMI were higher risk of being underweight (65.3%), wasted (48.9%0 and stunted (48%) 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 underweight of their child. This study finding is similar to other studies which also showed that maternal malnutrition is a risk factor for stunting (Bloss et al., 2004; Hong et al., 2006; Das et al., 2008; Mostafa et al., 2010; Kamal, 2011; Siddiqi et al., 2011; Rahman and Chowdhury, 2007; Ahmed et al., 2012) underweight (Rayhan and Khan, 2006; Das and Rahman, 2011; Kamal, 2011;Ahmed et al., 2012) and wasting (Rayhan and Khan, 2006; Rahman et al., 2009; Kamal, 2011; Ahmed et al., 2012).

Mother's Heamoglobin level was significantly associated with underweight of children. Children whose mothers had low hemoglobin level (anemic) were higher risk of being undernourished (60.8%) than children whose mother had normal hemoglobin level. Because, anemic mothers have significant diminution in working capacity causing difficulties in performing house hold chores and child care, thus affecting growth para meters of children. One study showed similar association that anemia is a life-long burden for women one which also endangers their children's growth parameters and nutritional status (Terefe et al, 2015).

5.3 Health Status or Morbidity Factors

The children who had fever were more to be underweight (66.5%), stunted (57.8%) and wasted (68.5%) compared to the children who had no fever. This result indicates that children with disease are more vulnerable to development of undernutrition than their healthy counterparts. This study found consistent result with other studies (Das et al., 2008; Das and Rahman, 2011). 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.

In this study, the highest rate of diarrhea was present among malnourished children which indicate the vicious cycle of malnutrition-infection interaction. Study findings illustrated that children with diarrhea had more risk to be underweight (90.3%), stunted (62.3%) and wasted (55.4%) than healthy children. This study result is consistent with the other studies (Roy, 2000; Wamani et al., 2006; Ahmed et al., 2012). It indicates that undernutrition, wasting, stunting can be developed quickly by presence of diarrhea or other infections. Diarrhea may be reduced food intake or lost the body weight which helped to develop wasting among children.

Furthermore, the results showed that worm infestation was significantly associated with undernutrition. The children with worm infestation had more risk to be underweight (79.4%), stunted (64.7%) and wasted (60.4%) than who had no worm infestation. Because, in developing countries most of the people live without access to proper sanitation facilities and are unaware of the importance of basic hygiene practices like hand washing after visiting toilet. Worm infestation is related to poor sanitation and lack of clean drinking water. Worm infestation is one of the major causes of childhood malnutrition, anemia, and stunted physical and mental growth, psychosocial problems. It also causes recurrent gastrointestinal and upper respiratory tract infection leading to high morbidity and mortality in children (Kappus et al., 1994).

This study also revealed that pneumonia was higher among malnourished children compare with normal, because children usually avoid food intakes or take less amount of foods during pneumonia.

5.4 The Way Forward

From the above discussion, we see that the development of undernutrition of under 5 children were strongly correlated with morbidity of children, socio-demographic factors. 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. 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. Government can expand this programme all over the country to prevent and manage common childhood diseases. Diarrhea, an immediate cause, was associated with acute malnutrition. Though Bangladesh government has adopted a water and sanitation policy and strategic plan since 1998 (but the implementation of this policy is very weak in the field level. 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 reduce the incidence of diarrhea.

Chapter-6: Conclusions

The nutritional status of under five years of children is not only susceptible indicator of the health and nutrition of a country but also can be considered as a measurement of the quality of life as well as a development indicator as it portrays the intensity of development as a whole governed by poverty, low socio-economic status and the prevalence of chronic diseases. Studying malnutrition, on a continuous basis, is essential since it replicates the accumulative outcome of socio-economic, health and nutritional drawbacks and which may vary overtime. The results of this study confirm that there are quiet rooms to perk up the child nutritional status at Islands of Bangladesh. To reduce the burden of malnutrition among children, a joint effort by the government, nongovernmental organizations and the community is absolutely necessary in an equitable manner to improve the nutritional status of children. In addition to the ongoing programs to improve child health, Government may wish to design targeted nutrition intervention strategies with better understanding of target group to reduce childhood malnutrition. Additional to the program to confirm the easier access to health information and health education to parents, surveillance and assessment need to be regularly reviewed with special attention to be given to vulnerable groups such as poorest or children in the Island area. A healthy mother can give birth to healthy children, thus for upgrading the nutritional status of children, focus of early intervention program should not only be on children but also on their mothers. 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 Island area. Different national and international organizations are running small scale nutrition interventions in Islands. Sometimes these programmes are overlapping. So, 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. Increase government's budget allocation for Islands and continual international financial support for nutritional programme are also crucial for the reduction of undernutrition among children under 5 years of age.

Chapter-7: Recommendations and Future perspectives

At policy level

- ✓ Promote a multi-sectoral approach: The ministry of health should involve relevant stakeholders and other ministries like agriculture, water and sanitation and education ministry including community in the planning and implementation of nutrition programme.
- ✓ Support poverty reduction: Ministry of finance in collaboration with agriculture and relevant stakeholders should implement nutrition sensitive social safety net programme to alleviate poverty, improve household food security and increase women empowerment at Islands.
- ✓ 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

- ✓ Infant and Young Child Feeding (IYCF) practices should be strengthened through mass media campaign at all level of community.
- ✓ Balanced energy protein supplementation (macronutrient) for pregnant undernourished mother should be started. Micronutrient supplementation for mother and child and should be provided through EPI.
- ✓ For prevention and management of common childhood diseases both facility should be expanded all over the country specially Islands. Necessary training, equipment and supplies should be provided to effectively run this programme.
- ✓ National level mass media and community based awareness campaign of hygiene and sanitation should be implemented for prevention of diarrhea.
- ✓ Government should promote female education in the community level through advocacy and mass media campaign.

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Annex 1: Pre-structured Questionnaire

Nutritional Status and Associated Factors among Pre-School Children at Two Islands of Bangladesh.

PART-A: Participant Consent Form

My name is Md. Abdul Aziz, and I am a student at Chattogram Veterinary and Animal Sciences University. I am conducting a qualitative research study on "Nutritional Status and Associated Factors among Pre – School Children at two Islands of Bangladesh." The purposes of this study are to determine the nutritional status of preschool children at Islands of Bangladesh and the driving factors of nutritional status. You and your child's participation in the study will involve an interview with an estimated length of 15 minutes to 20 minutes. This study poses little to no risk to its participants. I will do my best to ensure that confidentiality is maintained by not citing your actual name within the actual study. You may choose to leave the study at any time, and may also request that any data collected from you not be used in the study.

By signing below you agree that you have read and understood the above information, and would be interested in participating in this study.

Date: ……

_____

Signature

PART-B: Socio-demographic Information

1.1 Age in months: ……

1.2 Gender: …….

1.3 Height: …….. 1.4 weight: ……

1.5 Birth order: ……..1.6 Number of family member: ……

1.7 Level of mother's education:

☐ Up to grade 6 ☐ Up to grade 10 ☐ Above grade 10

1.8 Level of father's education:

☐ Up to grade 6 ☐ Up to grade 10 ☐ Above grade 10

1.9 Mother's Occupation:

☐ Housewife ☐ Jobholder

1.10 Father's Occupation:

☐ Day Labor ☐ Jobholder ☐ Businessman ☐ Farmer

1.11 Immunization status:

☐ Fully ☐ Partially

1.12 Food supplement:

☐ Yes ☐ No

PART-C: Caregiver's Health and Wellness

1.1 Mother's age: ……..1.2 Mother's weight: ……

1.3 Mother's hemoglobin level: ……...

1.4 Mother's Asthmatic condition: ……..

Part –D: Child's Health Status/ Morbidity factors

1.1 Presence of Diarrhea:

☐ Yes ☐ No

If yes then frequency of diarrhea …….

1.2 Presence of Pneumonia:

☐ Yes ☐ No

1.3 Presence of Fever:

☐ Yes ☐ No

If yes then frequency of fever…….

1.4 Presence of ARI:

☐ Yes ☐ No

1.5 Presence of worm infestation:

☐ Yes ☐ No

Annex 2: Photo gallery

Photos: Data collection

Brief biography

Md. Abdul Aziz son of Md. Abu Bakker Siddique and Anjuara Begum passed the Secondary School Certificate Examination in 2009 and then Higher Secondary Certificate Examination in 2011. Md. Abdul Aziz obtained his B.Sc. (Hons.) in Food Science & Technology in 2017 from Chittagong Veterinary and Animal Sciences University (CVASU), Bangladesh. Now, he is a candidate for the degree of M.S in Applied Human Nutrition and Dietetics under the Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, Chittagong Veterinary and Animal Sciences University (CVASU).