Assessment of Nutritional Status of Primary School Going Children in Island and Hill-Tract Area of Bangladesh: A Cross Sectional Study

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Roll No: 0120/01

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Session: January-June, 2020

The thesis submitted in the partial fulfilment of the requirements for the Degree of Master of Science in Applied Human Nutrition & Dietetics

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November, 2022

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November 2022

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This is to certify that we have examined the above Master's thesis and have found that is complete and satisfactory in all respects, and that all revisions required by the thesis examination committee have been made.

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DEDICATED TO MY BELOVED PARENTS & TEACHERS

Acknowledgements

Table of Contents

List of Table

List of Figure

List of Abbreviation

Abbreviation	Elaboration
BDHS	Bangladesh Demographic and Health Survey
NIPORT	National Institute of Population Research and Training
WHO	World Health Organization
BMI	Body Mass Index
ARI	Acute Respiratory Infection
BBS	Bangladesh of Bureau of Statistics
MoHFW	Ministry of Health and Family Welfare
LGRD & Co	Ministry of Local Government, Rural development and Co-operatives
PHC	Primary Health Care
HNPSP	Health, Nutrition and Population Sector Programme
HPSP	Health and Population Sector Programme
BMMS	Bangladesh Maternal Mortality Survey
ANC	Antenatal Care
NGO	Non-governmental Organization
SDG	Sustainable Development Goal
DGHS	Directorate General of Health services
DGFP	Directorate General of Family Planning
SAM	Severe Acute Malnutrition
IYCF	Infant and Young Child Feeding
DHS	Demographic and Health Survey
MDD	Minimum Dietary Diversity
MAD	Minimum Acceptable Diet
NNP	National Nutrition Program
CVASU	Chattogram Veterinary and Animal Sciences University

Abstracts

Children's nutritional status affects their health, physical growth and development, education, and future success. Malnutrition is a major underlying cause of child mortality and morbidity. The purpose of this study was to evaluate nutritional status and associated factors of primary school going children in islands and hill tracts area. A descriptive cross-sectional study using a structured questionnaire was conducted and a convenience sampling method was used in the selection of 400 students (200 from Sandwip and 200 from Bandarban) and their mothers. For each of the included children, socio-demographic data, and anthropometric data such as age, weight and height was taken. Statistical analysis was performed to identify significant determinants for stunting (height for age), wasting (weight for height) and underweight (weight for age). Chi square tests were used to establish the association of the nutritional status of the children with key variables under interest and level of significance was set at $p < 0.05$. The study results showed that in Sandwip 38.5% of the children were underweight, 20.5% of the children were wasted and 45% of the children were stunted and in Bandarban 40.5% of the children were underweight, 18.5% of the children were wasted and 48% of the children were stunted. Child's age group, gender, mother's nutritional status, mother's education, mother's occupation, birth order of children, diarrhea, pneumonia, worm infestation and immunization status of children were associated with the nutritional status of primary school going children.

Keywords: Nutritional status, Malnutrition, Stunting, Wasting, Underweight.

Chapter 1: Introduction

A world that is better nourished is a better world. Food is the source of nutrients, nourishment, or aliment that organisms and cells need to survive. Nutrition is the study or practice of consuming and utilizing food. As molecular biology, biochemistry, and genetics have advanced, nutrition has grown more focused on the biochemical stages and sequences via which substances inside of humans and other living beings are changed from one form to another - metabolism and metabolic pathways. The consumption of food is referred to as nutrition when it comes to the dietary requirements of the body. A healthy lifestyle is built on a foundation of proper nutrition, which includes a sufficient, well-balanced diet and regular exercise. Impaired physical and mental growth, lowered immunity, greater susceptibility to disease and decreased productivity can all be results of poor nutrition (Shrivastava et al., 2014).

Malnutrition is a complex problem that affects the entire world society. In underdeveloped nations with insufficient resources, malnutrition is one of the most serious public health issues. For the socioeconomic growth of the nation and in order to achieve the millennium development objectives, nutrition is thought to be extremely important. Inability to obtain nourishing meals is a common cause of malnutrition. Malnutrition is brought on by poor feeding habits, such as inadequate breastfeeding, serving the child the improper meals, and failing to make sure the child eats enough nutrient-rich food (Chataut and Khanal, 2016). Protein energy malnutrition is a common health issue in third world countries. Common signs of undernutrition in children include stunting and wasting. Acute nutritional deficiency and/or disease (such as diarrhoea) in children can result in wasting, which is indicated by a reduction in weight for height. Prolonged nutritional deficit and/or disease result in stunting, characterized by a reduction in height for age. Stunting and wasting are associated with functional consequences. Undernutrition represents Insufficient nutritional and energy intake and puts people at risk of losing their ability to sustain their health. Malnutrition and undernutrition are often used interchangeably in most literature (Abdulahi et al., 2017). Under nutrition includes being underweight, stunted, and wasted and deficient in vitamins and minerals. Under nutrition makes children in particular much more vulnerable to disease and death (Nasreddine et al., 2018). Child

malnutrition is a public health issue since it is a significant cause of child mortality, morbidity, and intellectual and physical disability. One of the important prerequisites for optimum health is a solid nutritional level. Malnutrition, especially in young infants, is the most prevalent and widely disregarded form of human deprivation (Vipin, 2009). Inadequate nutritional intake, infectious diseases, or a combination of both can result in malnutrition (Olack et al., 2011; Mengistu et al., 2013; UNICEF, 2015).

Nutritional status is the sensitive indicator of a child's health and the best indicator of well-being of a population. It is the condition of health of an individual influenced by nutrient intake and utilization in the body. To improve overall health, it is crucial to evaluate a child's nutritional state; a person's nutritional status as a child is the primary determinant of their current health status as an adult. A vital first step in raising quality of life is ensuring adequate nutrition. Children's physical, mental, and emotional development is strongly influenced by nutrition, thus providing healthy food to expanding populations is a priority, especially during the formative years of life (Roopadevi and Aravind, 2016). It is critical to understand the nutritional status of the person or target community in order for interventions intended to promote health through dietary care or food and nutrition policies to be effective. Although there are other tools for nutritional assessment, such as biochemical, clinical, and dietary data analysis, anthropometry is the one that is most frequently used since it is non-invasive, affordable, and, most importantly, it produces results that are quite satisfying. The factors weight, height (or length), sex, and age are used to create anthropometric indices in the anthropometric assessment of children's nutritional status. Three common indicators of malnutrition in children include 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).

Around 149 million children under the age of five were predicted to be stunted by 2020, along with 45 million wasting children and 85 million underweight children. These diseases are associated with about 45% of child fatalities (WHO, 2021). Nearly half of all child deaths worldwide are related to malnutrition, which can worsen the effects of disease (Mengistu et al., 2013). Most of over three quarters of the world's malnourished children live in the south-east Asia region. More than 80% of child deaths are caused by mild to moderate malnutrition, which accounts for around half of all child deaths. There are six million chronically undernourished children in

Bangladesh. Infants and children are particularly susceptible to undernutrition, especially the numerous concurrent manifestations, as seen by the effect of stunting, wasting, and underweight on mortality through lower muscle mass. Unsatisfactory and undesired food consumption, severe and recurrent infections, or a combination of both can lead to health and nutrition issues. These issues are also directly related to insufficient health services and an unhealthy environment (Saunders et al., 2010). Children who struggle with malnutrition have an increased risk of dying from common childhood diseases such diarrhoea, pneumonia, malaria, measles, and AIDS (UNICEF, 2010).

The primary causes of malnutrition include a lack of nutritious food, inadequate infant and child feeding and care practices, such as inadequate breastfeeding, micronutrient deficiencies, such as a lack of vitamin A or zinc, and frequent infections, which are frequently made worse by intestinal parasites (Franz, 2012; SCI, 2012). The biggest threat to global public health is malnutrition, but it is now widely believed that this problem only affects people in developing countries. According to the literature, malnutrition is linked to slowed growth, delayed mental development, and diminished intellectual capacity. Additionally, they are unable to maintain basic biological functions like healing from illness and overcoming infections. Increasing children's growth and development speeds up a country's economic development. Bangladesh continues to have one of the highest rates of malnutrition worldwide (UNICEF, 2015). Since children are the main victims of the interaction of nutritional, socioeconomic, and health factors that cause malnutrition, social scientists and planners are currently very concerned about the nutrition of infants and young children. In Bangladesh, undernutrition is a major public health issue. According to BDHS (2014), stunting, underweight, and wasting are all very common among children under the age of five, with prevalence rates of 36%, 33%, and 14%, respectively. Rural children are most likely to be underweight (35 percent) than urban children (26 percent). During childhood, poor nutrition can cause irreversible, serious physical and cognitive impairment. Poor nutrition has long-term effects, including adult small stature, decreased educational achievement, and diminished productivity. Additionally, the effects of undernutrition are intergenerational, meaning they are handed down down the generations when low BMI mothers (who are undernourished) give birth to babies with low birth weights. Delivering evidence-based interventions is the key to effectively combating the undernutrition issue. Education of the mother, family

3

wealth, children's sex, and birth order are the main determinants of malnutrition (Bairagi and Chowdhury, 1994). In Bangladesh this is further aggressive and critical because of unbalanced diet and poverty stress.

But since gaining independence in 1971, Bangladesh has achieved enormous strides in the fields of health and human development (Chowdhury, 2007; Khan et al., 2011). With an annual rate of reduction of 5.5%, child mortality per 1000 live births in Bangladesh decreased from 144 in 1990 to 41 in 2012. The fourth Millennium Development Goal has already been accomplished by Bangladesh, which has demonstrated that its success is more impressive than that of other South Asian nations, particularly India, Pakistan, and Afghanistan (de Onis et al., 2012). Bangladesh unfortunately has a significant prevalence of malnutrition among children. Children's nutritional status is a sensitive indication of community health and nutrition, particularly the prevalence of undernutrition, which impacts all aspects of human development and causes growth to falter in the early years. A thorough investigation is therefore required to show the connection between health-related issues and others' nutritional status. An essential method for determining people, groups, or communities whose growth is not following the predicted pattern is nutritional assessment by anthropometric measurement (NIPORT, 2016). In order to formulate any public health policy to combat malnutrition, one of the first steps must be the assessment of the nutritional condition of a population.

1.1 General objective:

The goal of this research is to identify the determinants of undernutrition among primary school going children in order to provide recommendations to policymakers and stakeholders to improve the nutritional status of primary school going children living in island and hill tract area of Bangladesh.

1.2 Specific Objectives:

- ✓ To determine the prevalence of stunting, undernutrition, and wasting of primary school going children in island & hill tract.
- ✓ To explore the key determinants of undernutrition (stunting, underweight, and wasting) among primary school going children.

Chapter 2: Review of Literature

2.1   Background information of Bangladesh:

2.1.1 Geography and population:

Bangladesh is a South Asian nation with a large population that is encircled by India and Myanmar. Its area is 147,570 square kilometres. Nearly 165.1 million people live there, with 1119 people per square kilometre. For administrative purposes, the nation is divided into 8 divisions, 64 districts, and 495 upazilas. In rural areas, around 70% of people reside. 91.04% of the population is Muslim, making it the most prevalent religion, followed by Hinduism (7.95%), and other religions (1%) (BBS, 2022). According to population census 2022, there are 16,50,159 members of ethnic communities living in Bangladesh. The ethnic population of the Chittagong Hill Tracts is related to the Arakan or Barma Kuki-Chinese generation, while certain ethnic groups originated in the southern region.

Figure 2.1: Map of Bangladesh (Source: Wordatlas, 2021)

2.1.2 Socio-economic Situation

2.1.2.1 Housing Characteristics

The socioeconomic status of household members can be determined using housing characteristics and household assets. According to the National Institute of Population Research and Training (2016), there are typically 4.5 family members per household, and men head 87% of them while women only head 13%. Bangladesh accomplished the admirable goal of electrifying every residence in the nation. According to BBS data, a total of 55.89% children (aged 5 years or above) across the country use mobile phone. Meanwhile 72.31% of the total population aged 18 years or above use mobile phone. In metropolitan areas, 93 percent of people use a mobile phone, compared to 87 percent in rural areas.

2.1.2.2 Water and Sanitation:

Sanitation and access to clean water are fundamental elements of good health. Skin illnesses, acute respiratory infections (ARIs), and diarrheal diseases are the most prevalent avoidable diseases in Bangladesh. These diseases are correlated with poor hygiene, limited access to safe drinking water, and sanitary facilities. In Bangladesh, ARI is still the top factor in child fatalities. Although 5% of children under 5 were reported to have experienced diarrhea in the past two weeks in 2011, the number of diarrheal deaths and the incidence of diarrheal infections have decreased (NIPORT et al., 2013). In Bangladesh, nearly everyone has access to a better source of drinking water (98 percent). The most common source of drinking water is a tube well or borehole (85.66%), followed by water pipe (11.74%) (BBS, 2022). Diseases including diarrhoea, dysentery, and typhoid are more common in houses without adequate sanitation facilities than in households with improved sanitation facilities that are not shared with other households. An improved (not shared) toilet facility is present in about 45% of households. A little more than one-third of the households (31%) use an unimproved toilet facility; 22% of households use pit latrines without slabs; 3% of households use a hanging toilet; and 4% of households have no toilet facility (NIPORT, 2016).

2.1.2.3 Food Production:

Traditional subsistence farming is the predominant type of agricultural output in Bangladesh. Rice, wheat, corn, legumes, fruits, vegetables, meat, fish, seafood, and

dairy products are just a few of the agricultural goods produced in Bangladesh. The main food staple in Bangladeshi cuisine is rice. Rice is the most dominating crop and more than 80% land is used for rice production.

2.1.2.4   Education

The preliminary data from the "Population and Housing Census 2022" states that Bangladesh now has 74.66 percent literacy rate. In the latest census taken in 2011, the literacy rate was 51.77 percent. Rural areas have a literacy rate of 71.56 percent whereas urban areas have an average 81.28 percent. The literacy rate is higher among men (76.56%) than women (72.82). The Bangladesh government launched a primary education program in 1990 with the goal of achieving universal primary enrolment by 2005. All children are entitled to free, equal basic education from the government. Almost 95% of people have gone to school. According to student enrolment, there is no gender difference at the primary level. However, men complete secondary or higher education at a higher rate than women. The overall percentage of people who completed secondary or higher education rose for both men and women, according to NIPORT et al., (2016). In 2011, it went up for both men and women, going from 12% for men to 15% for women. Urban areas have higher levels of educational attainment than rural areas do in terms of secondary or higher education completion.

2.1.3 Health and Health Care System

Hospitals, outpatient facilities, diagnostic centers, clinical trial sites, telemedicine, outsourcing, and businesses that provide medical supplies and equipment are all part of the Bangladeshi healthcare industry. The healthcare industry has doubled in size in the last 8 years, growing at a CAGR of 10.3% since 2010, when healthcare expenditures were valued at USD 6.76 billion. The governmental and private sectors both provide healthcare services, and the system is mostly centralized. The Ministry of Health and Family Welfare (MoHFW) plans and oversees the nation's curative and preventative health services. However, the Ministry of Local Government, Rural Development, and Cooperatives (LGRD & Co) is responsible for managing the delivery of health care, including PHC services, in the urban region. Since 1998, the government has been pursuing a sector-wide approach (SWAp) to boost service efficacy and offer the populace of the nation demand-responsive services. Health, Nutrition, and Population Sector Programme (HNPSP) was created in 2003 to replace the original Health and Population Sector Programme (HPSP) of the years 1998 to

2003 with nutrition (WHO, 2010). Bangladesh is one of the nations in South-East Asia that spends the least on health, allocating only 5.4% of the budget to the sector and only 0.80% of GDP to government health spending.

Primary Health Care provides promotional, preventative, curative, and rehabilitative services in accordance with the major health issues in the community. Community (ward), union, and upazila are the three levels that deliver PHC services. Government action has been taken to open community clinics in order to revitalize PHC services. These community clinics, which provide healthcare to 6000 rural residents, are a singular example of community involvement. Since the management of these clinics is the responsibility of a group of local community leaders and representatives known as the Community Clinic Management Group (WHO, 2010). In a community clinic, domiciliary health staff members known as health assistants (HAs) and family welfare assistants (FWAs) alternately provide services three days a week. The Union Health and Family Welfare Center (UNHFWC) is staffed by Medical Assistants (MAs) and Family Welfare Visitors, who oversee the community's field activities and provide outpatient treatment services (midwife). Health Bulletin (2018) states that the Upazila Health Complex (UHC), which is staffed by licensed medical professionals, offers outpatient and inpatient health care services at the sub district level and acts as the first level referral facility. The majority of curative services are offered by private sector facilities for profit, and they are steadily gaining a significant portion of services at all levels. There are many different types of traditional healers, homeopaths, village doctors, and pharmacists working in the private sector. They differ in terms of training, aptitude, experience, and the kind of medical care provided.

2.1.4 Maternal and Child Health

Bangladesh has undertaken sizable efforts to enhance maternal and neonatal health, working with partners from the government and the civil society, but total numbers and rate of these deaths remain too high. Additionally, the most recent Bangladesh Maternal Death Survey (BMMS-2016) indicates that efforts to lower maternal mortality appear to have reached a standstill (NIPORT et al., 2017). Key services for maternity and new-born health (MNH) are still insufficiently used. In fact, only 37% of pregnant women attend at least four ANC visits, 47% of births take place in hospitals, and 48% of women receive postnatal care from a qualified health care

provider within the first two days after giving birth (6% in the case of home births) (NIPORT et al., 2017). Although the BMMS-2016 found that more women are now using professional healthcare services during pregnancy than in the previous ten years, this has not resulted in the anticipated decline in maternal mortality between 2010 and 2016. This shows that concentrating only on expanding access to these services is insufficient to result in better health. In Bangladesh, more than half (53%) of deliveries still take place at home with untrained traditional birth attendants (TBAs) providing assistance. Only 29% of births take place in a hospital, with 12% taking place in a state hospital, 15% in a private hospital, and 2% in an NGO hospital. 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). Mortality rate, neonatal (per 1000 live births) in Bangladesh in 2020 was 18. Health Bulletin (2018) states that the infant mortality rate is 30 per 1000 live births and the mortality rate for children under five is 45 per 1000 live births, which together account for 67% of all deaths of children under five. Over the previous 20 years, there has been a progressive decline in the mortality rate for children.

2.1.5   Nutrition Situation in Bangladesh

2.1.5.1 Maternal and Child Nutrition

In Bangladesh, 28% children are born with low birth weight and the prevalence of stunting, underweight and wasting among under 5 children is 28%, 22.6% and 9.8% respectively (World Bank, 2014). Over the past ten years, there has been some improvement in children's nutritional status. Stunting rates among children under the age of five have decreased from 51 percent in 2004 to 36 percent in 2014, according to BDHS (2014). It decreased by 5 percentages over the previous three years. Wasting grew from 15% in 2004 to 17% in 2007, and since then, it has gradually decreased to 14% in 2014. The percentage of underweight people has decreased from 43% in 2004 to 33% in 2014.

2.1.5.2   National Food and Nutrition Policy

In accordance with the policy, programs and strategies for development must take nutritional goals, components, and considerations into account. The consensus document that emphasizes human rights makes this policy execution strong. It will complement other government policies and has reachable, comprehensive aims and

objectives that encompass a wide range of issues (BNNC, 1997). However, the biggest weakness in policy implementation is the absence of implementation guidelines, an overly ambitious goal, a lack of monitoring and evaluation guidelines, a lack of strong commitment, a lack of earmarking of funds, insufficient management of the policy coordinator's authority, and a failure to pay attention to the lessons learned (Mannan, 2003).

2.1.5.3   National Response to Nutrition

Bangladesh has committed to achieving the Sustainable Development Goals (SDGs) through Universal Health Coverage and has already met the Millennium Development Goal (MDG) targets for nutrition. During the 2017–22 implementation period, the National Nutrition Service's Operational Plan (OP) focuses on mainstreaming nutrition services through the Directorate General of Health Services (DGHS) and Directorate General of Family Planning (DGFP). To achieve widespread and equitable coverage of both specific and sensitive nutrition interventions, this new OP will place additional emphasis on system strengthening and multi-sectoral cooperation.

2.2   Problem Statement

Undernutrition is a serious health concern and the single largest contributor to child mortality (LTCM, 2017). In 2011, 3.1 million children under the age of five died as a result of undernutrition worldwide, accounting for 45% of all child fatalities (Black et al., 2013). Around 11% of total global disability-adjusted life-years (DALYs) are lost because of child under-nutrition (Black et al., 2008).

Globally in 2020, it was estimated that 45 million children under the age of 5 were wasted (too short for height), 38.9 million were overweight or obese and 149 million were stunted (too short for age). Around 45% of deaths among children under the age of are linked to undernutrition. Millions of children continue to be at danger as a result of this frequency of both stunting and wasting, which is not satisfactory. Additionally, 35 million wasted children live in Asia, where the frequency of wasting is 50.5 million in children under the age of five. These children are more at risk of SAM and death (LTCM, 2017). Despite the tremendous economic progress that most Asian nations are currently experiencing, undernutrition is still a significant problem for them, particularly for South Asian nations (Pasricha and Biggs, 2010).

The first two years of life are critical for a child's health and cognitive development.

During this time, poor nutrition can cause irreversible, serious physical and cognitive impairment. Long-term effects could include adult short height, lower educational attainment, reduced productivity, and chronological malnutrition, which is a condition that is passed down through generations as low BMI moms give birth to low birth weight infants (Victora et al., 2008).). Additionally, there are immediate effects of undernutrition at this period, including mortality, illness, and disability. If undernourished children gain weight quickly after birth, they are at a significant risk of acquiring chronic conditions later in life. According to the Lancet Child Survival Series 2008, undernutrition is the primary cause of one-third of under-five-year-old fatalities and illness load. By focusing successful treatments on under-2-year-olds, these issues can be reduced (Bryce et al., 2008 and Black et al., 2008). In Bangladesh, undernourishment is still a major public health issue. Bangladesh's rates of child undernutrition are among the highest in the world, along with those of South Asian nations (Ahmed et al., 2012). Bangladesh has made tremendous progress in meeting several health metrics, but maternal and child nutrition are still unaddressed issues.

2.3   Conceptual Framework

The conceptual model emphasizes the complexity of the several interrelated factors that can affect nutritional status at various levels, including immediate, underlying, and basic, underscoring the fact that it is not merely a food, health, or care issue. This enables needs assessments to explore beyond only a population's food needs and supports a better awareness of factors influencing nutrition status. The conceptual model can be used as a checklist to identify and prioritize the population's short- and long-term requirements and service gaps, with a focus on the vulnerable groups that have been identified.
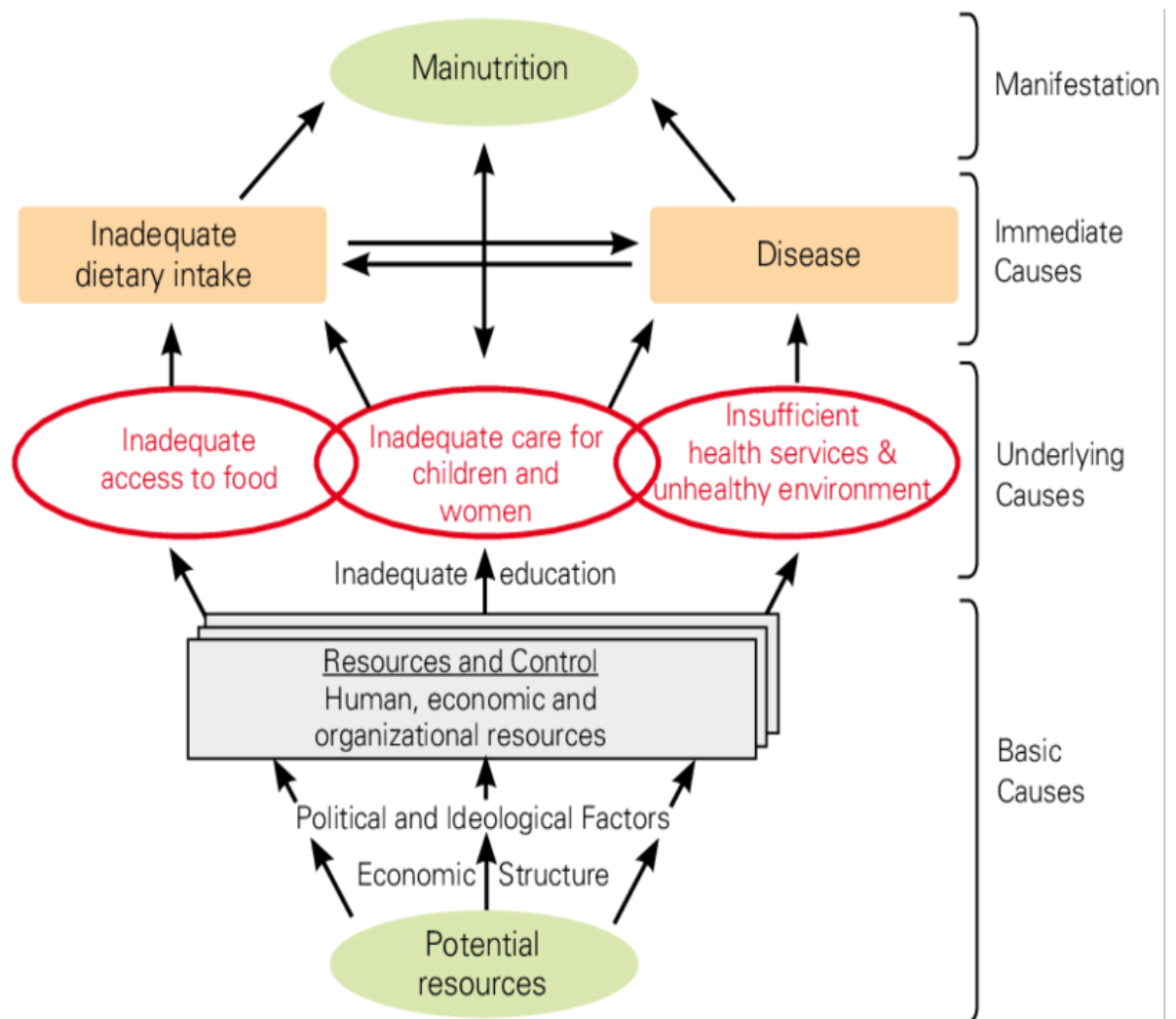
Figure 2.2: Conceptual framework for immediate, underlying and basic determinants of child undernutrition

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

2.4   Causes of Undernutrition

There are limited studies on determinants of undernutrition of primary school going children aged basically 6-11 years in context of Bangladesh. Very little is known about determinants of undernutrition among children. This thesis analysed the literature to understand the immediate, underlying, and fundamental causes that influence the development of undernutrition in children under the age of five in Bangladesh in order to assess the factors that contribute to it.

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. A study was conducted to determine the relationship between IYCF indicators and undernutrition in children under the age of two using data from the 2007 Bangladesh DHS. The results indicated that dietary factors such as exclusive breastfeeding under the age of six months, MDD, and MAD were significant factors associated with undernutrition in children under the age of two. Children under the age of six months who were exclusively breastfed were protected from wasting. Children who had both an MDD and a MAD showed lower levels of stunting and underweight than those who did not receive either of those certifications (Zongrone et al., 2012).

Another investigation carried out in Bangladesh revealed a substantial correlation between stunting and the frequency of complementary feeding. When compared to children who didn't receive frequent supplemental feeding, those who did were less likely to be stunted (Jesmin et al., 2012).

2.4.1.2   Health Status or Morbidity History

Children's nutritional status and morbidity are closely related. The occurrence of certain disorders like fever, ARI, and diarrhea were the main predictors of child malnutrition, according to a study that examined the causes of child malnutrition in Bangladesh using BDHS 2004 data. Children who experienced ARI, fever, or diarrhea within the previous two weeks of the survey had 1.2, 1.3, and 1.2 times higher odds of being underweight, respectively, than children who did not experience these health issues (Das and Rahman, 2011). Another study showed that presence of ARI was the risk factor associated with wasting (Rahman et al., 2009).

2.4.2   Underlying Causes

2.4.2.1. Household Food Security

Using data from the Nutrition Surveillance Project (NSP), a study that is nationally representative, revealed that household food insecurity is a significant factor in undernutrition. The proportion of stunted children in households with food insecurity was higher than that in households with enough food. Compared to children from secure families, children from food insecure households had a 1.2 times higher risk of

stunting and underweight (Chowdhury et al., 2016).

2.4.2.2. Caring for Women and Children

Mother's age at childbirth is linked to children's undernutrition. According to Siddiqi et al., 2011, stunting and underweight are 1.2 and 1.3 times more common in children whose mothers are under 20 years old than in those who are over 20. According to Hong et al., 2006, the mother's age at the time of childbirth was a factor in stunting.

The results of another study that looked at the causes of undernutrition in children in Bangladesh revealed that mothers' nutritional status had a considerable impact on their children's nutritional status. Compared to children whose moms had low BMI, children whose mothers had normal BMI were 30% less likely to be underweight (Rayhan and Khan, 2006). According to other research conducted in Bangladesh, maternal BMI was a risk factor 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).

According to Kamal, 2011, research done in Bangladesh revealed a strong correlation between children's chronic undernourishment and their birth order. Another studies' findings showed that new-born's in the first, third, and fourth orders had a decreased risk of severe stunting than births in the fifth or higher orders (Alom et al., 2012).

There was evidence that the nutritional status of children improved when suggested feeding practices were followed. In Bangladesh, a cohort research was conducted to determine the causal relationship between new-born feeding behaviours (such as first-hour breastfeeding initiation, complementary feeding, and pre-lacteal feeding practices) and child growth. The study's findings showed that children who followed the suggested eating practices had a lower risk of stunting, underweight, and wasting than children who did not follow the recommended feeding practices (Saha et al., 2008).

2.4.2.3   Environmental Factors and Utilization of Health Services

Using data from the 2007 BDHS, research done in Bangladesh to study the predictors of undernutrition revealed that the source of drinking water was a predictor for undernutrition in children. Children who drank water from pipes and tube wells were 21% and 29% less likely to be wasted than children who drank water from other

sources, according to study results (Islam et al., 2013). The usage of unhygienic toilets was substantially connected with children's undernutrition, according to a study conducted in rural Bangladesh to identify the causes of undernutrition in children using data from the NNP baseline survey. Children with moderate stunting and underweight were more likely to live in households with unhygienic toilets than children with hygienic toilets (Ahmed et al., 2012). Other investigations confirmed that the presence of toilet facilities was a major predictor of stunting and wasting (Kamal, 2011; Alom et al., 2012; Islam et al., 2013).

Evidence suggested that, in the context of Bangladesh, the place of birth has a substantial impact on children's chronic malnutrition (Hong et al., 2006; Rahman and Chowdhury, 2007). According to a study conducted in Bangladesh, children born in hospitals had a 1.4 and 1.5 times lower risk of moderate and severe stunting than children born at home using traditional delivery methods (Rahman and Chowdhury, 2007). According to studies done in Bangladesh, children whose mothers did not receive ANC services had a 1.2 and 1.5 times higher risk of stunting (Siddiqi et al., 2011) and underweight (Das et al., 2008) than children whose mothers did receive ANC services.

2.4.3   Basic Causes

2.4.3.1 Socio-demographic Factors

Stunting was highly correlated with geographic location, according to a study that examined the impact of several socio-demographic, societal, and health factors on chronic malnutrition in Bangladeshi children. Compared to other divisions in Bangladesh, the frequency of stunting was highest among children in the Sylhet division (Rahman and Chowdhury, 2007). A high correlation between geographic location and chronic malnutrition was also found in other research (Hong et al., 2006; Das et al., 2008; Kamal, 2011; Alom et al., 2012).

Research conducted in Bangladesh showed that the risk of being undernourished increased with increasing age. According to the study, children between the ages of 12 and 23 months were 6.5 times more likely to be underweight than 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 revealed that the gender of the child had a strong substantial impact on undernourishment and that male children were more likely to be stunted, underweight, and wasted. According to the study's findings, female children were 30% and 20% less likely than male children to be moderately stunted and underweight, respectively (Ahmed et al., 2012).

The nutritional status of the children is highly correlated with the education of the father. According to the findings, severely stunted children were 2.3 and 1.9 times more likely to have a father with no formal education than those with only a primary education, respectively (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.

According to a study, fathers' occupations have a big impact on how their children fare when it comes to nutrition. The study's findings showed that children were more likely to be wasted and stunted if their fathers were involved in agriculture compared to business and service (Alom et al., 2012).

Another study found a strong correlation between mothers' media exposure and their children's undernutrition. According to study results, children whose mothers had no media exposure compared to children whose mothers had media exposure had a 2.5 times higher probability of being severely wasted (Rahman et al., 2009). Another investigation revealed a strong correlation between mothers' media exposure and stunting (Rahman and Chowdhury, 2007).

According to research conducted in Bangladesh, children with mothers who only completed primary school and those with no education had a 36% and 35% greater frequency of stunting than children with mothers who had higher education (Siddiqi et al., 2011). In other research conducted in Bangladesh, it was demonstrated that maternal education significantly reduces 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).

In Bangladesh, studies were conducted to determine the association between wealth disparity and chronic undernutrition in children. The results showed that the wealth quintile had a substantial, significant impact on chronic undernutrition. According to

study findings, children from the lowest wealth quintile had a 3 times higher risk of having chronic malnutrition than children from the richest wealth quintile (Hong et al., 2006). Several 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). This study chose a few proxy indicators under each cause to investigate the basic, underlying, and immediate causes of malnutrition. These proxy indicators will help interpret the findings. These proxy indicators are described in the **Table 2.1**.

Table 2.1: Proxy indicators for immediate, underlying and basic causes of malnutrition

Causes	Proxy indicators
Immediate Causes	
Dietary intake	❖ Exclusive breastfeeding <6 months
	❖ MAD
	❖ MDD
	❖ MMF
Health Status or morbidity	❖ Diarrhea
	❖ Fever
	❖ ARI
Underlying Causes	
Household Food Security	
Care for Women and Children	❖ Mother's BMI
	❖ Mother's age at child birth
	❖ Initiation of breastfeeding
	❖ Pre-lacteal feeding
	❖ Birth order
	❖ Introduction of soft, solid and semi-solid foods after 6 months

Environmental Factors and Utilization of Health Service	❖ Sources of Drinking water ❖ Toilet facilities ❖ Mother's ANC visits ❖ Place of Delivery
Basic Causes	
Socio-demographic Factors	❖ Region ❖ Sex and Age of the child ❖ Type of residence ❖ Father's education and occupation ❖ Mother's education ❖ Access to media ❖ Wealth Index

Chapter 3: Materials and Methods

3.1 Study Area and Period

A cross-sectional community based study was carried out from September 2022 to October 2022 in different schools of Sandwip and Bandarban. The schools were selected randomly taking into consideration that they will represent the overall scenario of primary school going children in the selected area.

Sandwip is an island located along the south-eastern coast of Bangladesh in the chattogram district. It has a population of about 450,000. Its total area is 762.42 km^2 The Sandwip channel separates it from the chattogram coast, which is around the Meghna river's mouth in the Bay of Bengal. The island is bordered on the north by Companiganj, on the south by the Bay of Bengal, on the east by the Sitakunda, Mirsharai, and Sandwip Channel, and on the west by the estuary of the Noakhali Sadar, Hatiya, and Meghna. The coordinates of Sandwip are 22.4833°N 91.4417°E. The study population was collected from Sarikait Syed Ahmed Govt. Primary School, Choukatoli Govt. Primary School, Umeda Govt. Primary School from Sandwip.
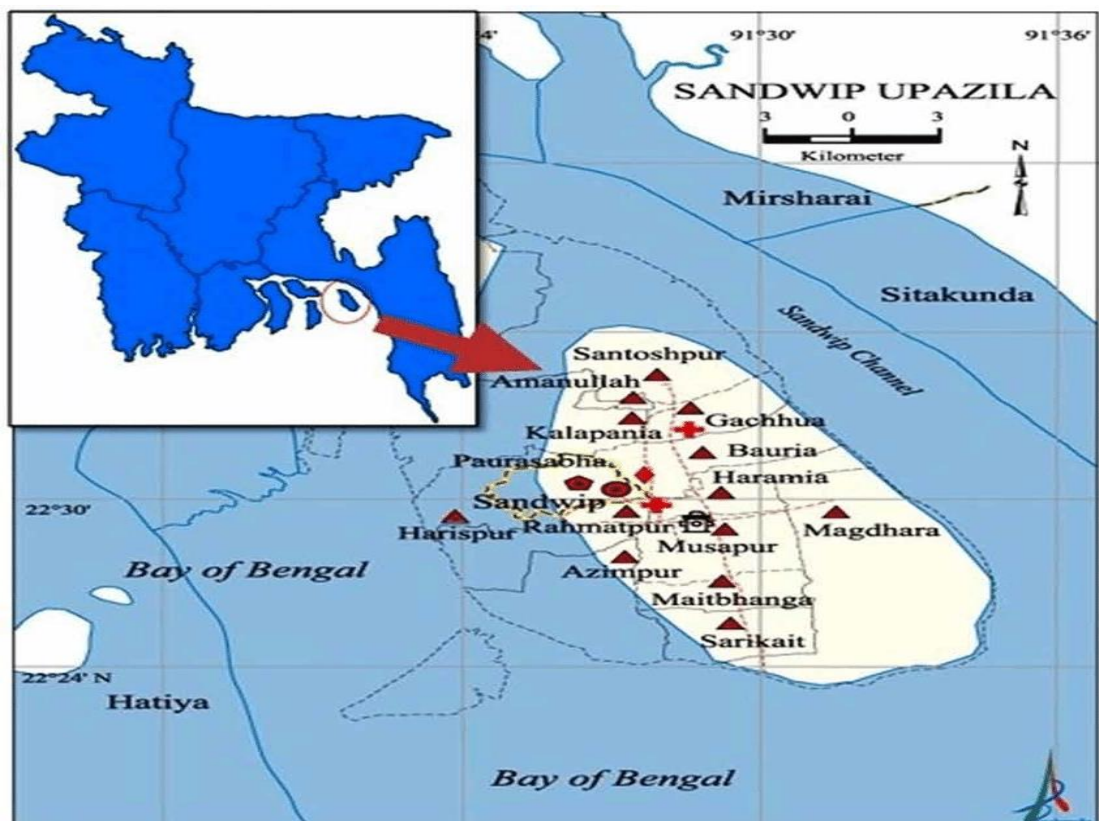
Figure 3.1: Map of Sandwip

Bandarban district is not only the most remote district of the country, but also a district with the least population. Bandarban is situated in south-east part of Bangladesh and a part of Chattogram division. It is one of the three districts that make up the Chattogram Hill Tracts, the others being Rangamati district and Khagrachhari district. Located between 21°11' and 22°22' north latitude and 92°04' and 92°41' east longitude, the Bandarban District has a total area of 4479.03 km^2. It is bordered on the north by Rangamati District, on the south by Arakan (Myanmar), on the east by Chin Province (Myanmar), and on the west by Chittagong and Cox's Bazaar District. It has a population of about 481,000. The study population was collected from Ruma Bazar Model Govt. Primary School from Bandarban.
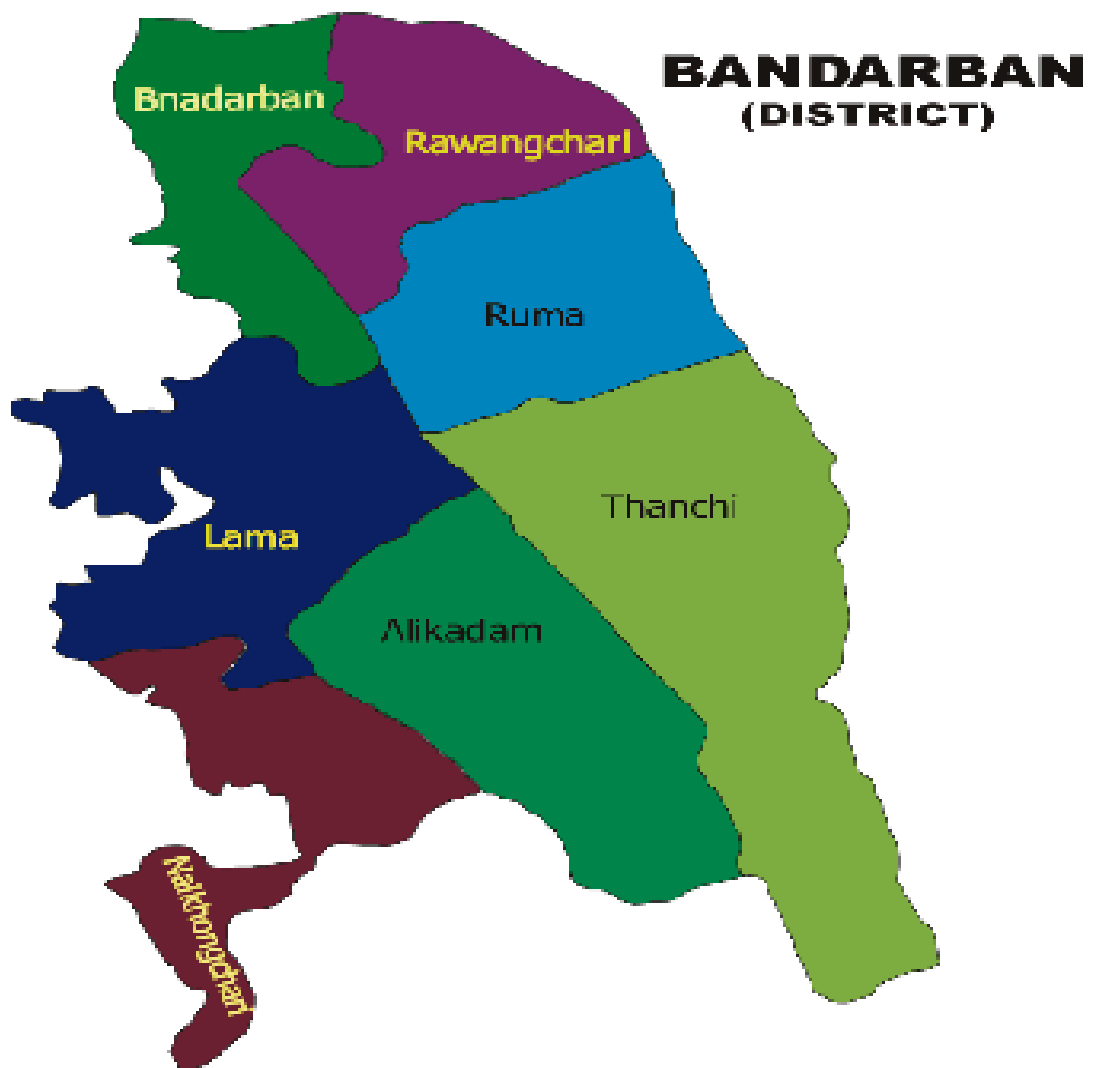
Figure 3.2: Map of Bandarban

3.2 Study Population

The study population is supposed to be primary school-going children aged 5 to 11 years old from both sex and their corresponding mother as a respondent.

3.3 Apparatus

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

b) A digital weight machine was used to measure the weight of the children and mother.

c) A 3 meter measuring tape was used to measure the height of the children.

3.4 Sample Size

The sample size is estimated by using the following formula (Cochran, 1977).

$$n = \frac{z^2 pq}{e^2}$$

In the formula, sample size (n) is for finite populations (f < 0.05), taking into consideration a 95% confidence level (z), (p) is the estimated proportion of population which has the attribute in question, (q) is 1-p, maximum population variability (p = q = 0.50), assuming 5% sampling error (e).

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.05)^2}$$

z-score at 95% confidence level is 1.96

$$n = 385$$

Extra 15 students were selected to round up 400. So, the sample size is 400.

3.5 Study Design

A cross-sectional community based study was carried out. Simple random technique sampling was used to select 400 primary school going children, 200 children from Sandwip and 200 children from Bandarban. Simple random sampling was also used to select an individual for the study.

3.6 Anthropometric Measurements

Anthropometric measurements (weight, length/height) were noted on a form in the structured questionnaire. The procedures followed in taking anthropometric measurements and Z score are as described by WHO (2010). The length was measured with a measuring tape with minimal clothing. All measurements (height and

weight) were taken three times, and the mean measurement was used if there was a discrepancy in readings of less than 1 cm for length/height and 0.5 kg for weight.

Children were classified as stunted if their length/height-for-age fell below -2 standard deviations (SD) of the WHO standards, and underweight if their weight-for-age fell below -2 SD of the WHO standards (WHO, 2008; WHO, 2006). In order to identify infants and children with severe acute malnutrition (SAM), weight-for-height values below -3 standard deviations (SD) of the WHO standards were used (WHO, 2009), and weight-for-height values between -2 and -3 standard deviations (SD) of the WHO standards were used to identify infants and children with moderate acute malnutrition (MAM) (ACF, 2010).

3.7 Statistical analysis

Data was analysed by using Statistical Package for Social Science (SPSS) version 26.0. Stunting, wasting and undernutrition were compared with associated factors using Pearson's chi-square test (χ^2). Fisher's exact test was used 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 statuses of primary school going children living in islands and hill tracts are presented firstly. Then socio-demographic factors, caregiver health & wellness factors and health status/morbidity factors characteristics were explained. Finally, the associations between different variable and nutritional status were described using chi-square test.

4.1 Nutritional statuses of primary school going children

This study showed that about 38.5% children were undernourished, 45% children were stunted, and 20.5% children were wasted in sandwip and about 40.5% children were undernourished, 48% children were stunted, and 18.5% children were wasted in Banbarban. This is shown in **figure 4.1.**
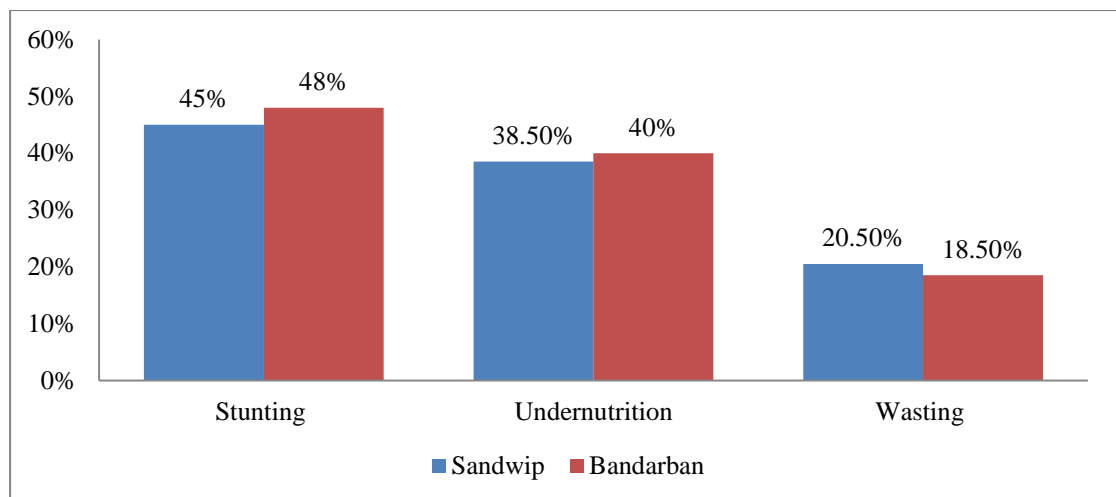
Figure 4.1: Nutritional statuses of primary school going children in Sandwip & Bandarban

4.2 Socio-demographic characteristics of respondents

4.2.1 Age Distribution

Nutritional status of children is related to child's age. This study has ages ranging from 5 years to 11 years and it was divided into 3 categories: 5-6 years, 7-8 years, and 9-11 years.

4.2.2 Gender Distribution

In the study, 102 children (51%) were male and 98 children (49%) were female from both sandwip and bandarban.

4.3 Associated Factors of Undernutrition (Weight for age)

This study showed that about 38.5% children were undernourished in sandwip and about 40.5% children were undernourished in bandarban, and also informed that undernutrition was associated with socio-demographic factors, caregiver health & wellness factors and health status/morbidity factors.

4.3.1 Association of Undernutrition 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 had statistically significant association with undernutrition. **Table 4.1** illustrates these associations.

Table 4.1: Association of demographic characteristics with undernutrition

Variable		Undernutrition Sandwip (student)	Undernutrition Bandarban (student)	Pearson's χ2 (df)	P value
Age (years)	5-6	14	15	10.58(2)	0.005
	7-8	23	43		
	9-11	40	23		
Gender	Male	36	37	0.018(1)	0.892
	Female	41	44		
Mother's Education	Upto 6th	45	31	6.433(1)	0.011
	Upto 10th	32	50		
Mother's Occupation	Jobholder	05	15	5.16(1)	0.02
	Housewife	72	66		
Birth Order	Upto 2	31	50	7.28(1)	0.006
	Above 2	46	31		
Family Member	Upto 4	33	42	1.28(1)	0.25
	Above 4	44	39		
Immunization Status	Fully	70	64	4.33(1)	0.03
	Partially	07	17		
Father's Occupation	Jobholder	16	14	10.32(2)	0.69
	Daylabour	22	40		
	Businessman	39	27		

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

4.3.2 Association of Undernutrition with caregiver health & wellness Factors

The results showed that undernutrition was significantly associated with mother's nutritional status. **Table 4.2** illustrates these associations.

Table 4.2: Association of undernutrition with caregiver health & wellness Factors

Variable		Undernutrition Sandwip (student)	Undernutrition Bandarban (student)	Pearson's χ2 (df)	P value
Mother's nutritional status	Underweight	21	19	10.89(2)	0.00
	Normal	53	58		
	Overweight	03	04		
Asthma	Yes	08	10	2.71(1)	.89
	No	69	71		

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

4.3.3 Association of Undernutrition with health status or morbidity Factors

The results revealed that undernutrition was significantly associated with child's diarrhoea, pneumonia, worm infestation. The results of chi square test with p = < 0.05 were illustrated in **Table 4.3.**

Table 4.3: Association of undernutrition with health status or morbidity Factors

Variable		Undernutrition Sandwip (student)	Undernutrition Bandarban (student)	Pearson's χ2 (df)	P value
Diarrhea	Yes	50	40	3.89(1)	0.04
	No	27	41		
Pneumonia	Yes	48	37	4.40(1)	0.03
	No	29	44		
Fever	Yes	38	35	0.59(1)	0.43
	No	39	46		
ARI	Yes	29	32	0.05(1)	0.81
	No	48	49		

Worm infestation	Yes	47	36	4.35(1)	0.03
	No	30	45		

<p align="center">* Chi square test and P < 0.05 was considered statistically significant</p>

4.4 Associated Factors of Wasting (Weight for height)

This study showed that about 20.5% children were wasted in sandwip and about 18.5% children were wasted in bandarban and also informed that wasting was associated with socio-demographic factors, caregiver health & wellness factors 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.**

Table 4.4: Association of wasting with socio-demographic factors

Variable		Wasting Sandwip (student)	Wasting Bandarban (student)	Pearson's $\chi2$ (df)	P value
Age (years)	5-6	10	8	10.01(2)	0.03
	7-8	12	12		
	9-11	19	17		
Gender	Male	22	20	1.1891)	0.27
	Female	19	17		
Mother's Education	Upto 6th	27	25	35.57(1)	0.000
	Upto 10th	14	12		
Mother's Occupation	Jobholder	08	07	0.036(1)	0.80
	Housewife	33	30		
Birth Order	Upto 2	19	17	0.02(1)	0.84
	Above 2	22	20		
Family Member	Upto 4	20	18	0.016(1)	0.89
	Above 4	21	19		
Immunization Status	Fully	35	32	0.10(1)	0.74
	Partially	06	05		

Father's Occupation	Jobholder	08	06	1.90(2)	0.38
	Daylabour	13	19		
	Businessman	20	12		

<div align="center">* Chi square test and P < 0.05 was considered statistically significant</div>

4.4.2 Association of wasting with caregiver health & wellness Factors

The study revealed that wasting has no significant association with caregiver health & wellness factors but comparatively associated with mother's nutritional status 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 health & wellness Factors

Variable		Wasting Sandwip (student)	Wasting Bandarban (student)	Pearson's χ2 (df)	P value
Mother's nutritional status	Underweight	16	12	1.78(2)	0.36
	Normal	24	23		
	Overweight	1	2		
Asthma	Yes	9	6	0.41(1)	0.50
	No	32	31		

4.4.3 Association of wasting with health status or morbidity Factors

The study exposed that wasting has no significant association with health status or morbidity factors but comparatively associated with fever, ARI, diarrhoea, 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 Sandwip (student)	Wasting Bandarban (student)	Pearson's χ2 (df)	P value
Diarrhea	Yes	22	20	0.018(1)	0.96
	No	19	17		
Pneumonia	Yes	15	15	0.192(1)	0.66
	No	26	22		

Fever	Yes	24	20	0.02(1)	0.25
	No	17	17		
ARI	Yes	14	12	0.965(1)	0.06
	No	27	25		
Worm infestation	Yes	24	21	0.26(1)	0.87
	No	17	16		

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

4.5 Associated Factors of Stunting (Height for Age)

This study revealed that about 45% children were stunted in sandwip and about 48% children were stunted in bandarban and also informed that wasting was associated with socio-demographic, caregiver health & wellness and health status/morbidity factors.

4.5.1 Association of stunting with socio-demographic factors

This study showed that stunting was significantly associated with child's age group, sex and immunization status of children but comparatively associated with mother's occupation, birth order of children. 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 Sandwip (student)	Stunting Bandarban (student)	Pearson's χ2 (df)	P value
Age (years)	5-6	15	20	10.68(2)	0.007
	7-8	28	25		
	9-11	47	51		
Gender	Male	50	58	5.70(1)	0.01
	Female	40	38		
Mother's Education	Upto 6th	58	60	95.06(1)	0.00
	Upto 10th	32	36		
Mother's Occupation	Jobholder	19	25	0.48(1)	0.76
	Housewife	71	71		

28

Birth Order	Upto 2	48	50	0.87(1)	0.45
	Above 2	42	46		
Family Member	Upto 4	43	46	0.07(1)	0.77
	Above 4	47	50		
Immunization Status	Fully	49	49	5.27(1)	0.02
	Partially	41	47		
Father's Occupation	Jobholder	15	14	0.238(2)	0.86
	Daylabour	29	47		
	Businessman	46	35		

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

4.5.2 Association of stunting with caregiver health & wellness Factors

This study showed that stunting was significantly associated with mother's nutritional status. The results of chi square test with p = < 0.05 were illustrated in **Table 4.8.**

Table 4.8: Association of stunting with caregiver health & wellness Factors

Variable		Stunting Sandwip (student)	Stunting Bandarban (student)	Pearson's χ2 (df)	P value
Mother's nutritional status	Underweight	36	37	7.80(2)	0.03
	Normal	47	50		
	Overweight	07	09		
Asthma	Yes	18	26	1.29(1)	0.25
	No	72	70		

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

4.5.3 Association of stunting with health status or morbidity factors

This study showed that stunting was significantly associated with diarrhea and worm infestation, but comparatively related with other factors like pneumonia, 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 Sandwip (student)	Stunting Bandarban (student)	Pearson's χ^2 (df)	P value
Diarrhea	Yes	51	68	4.04(1)	0.04
	No	39	28		
Pneumonia	Yes	35	38	0.009(1)	0.92
	No	55	58		
Fever	Yes	52	60	0.45(1)	0.061
	No	38	36		
ARI	Yes	29	34	0.21(1)	0.64
	No	61	62		
Worm infestation	Yes	48	67	5.33(1)	0.02
	No	42	29		

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

Chapter 5: Discussion

This study showed that about 38.5% children and about 40.5% children were undernourished in sandwip and bandarban respectively and also informed that undernutrition was also significantly associated with child's age group, gender, mother's nutritional status, mother's education, mother's occupation, birth order of children, diarrhea, pneumonia, worm infestation and immunization status of children. Additionally, 20.5% children and about 18.5% children were wasted in sandwip and bandarban respectively and it was significantly was associated with child's age group and about 45% children were stunted in sandwip and about 48% children were stunted in bandarban and also informed that stunting was significantly associated child's age group, gender, diarrhea and mother's nutritional status.

5.1 Socio-demographic Factors

The study's findings showed that as children aged, their risk of malnutrition grew considerably. In comparison to children 5 to 6 and 7 to 8 years of age, children aged 9 to 11 years were more likely to be undernourished, stunted, and wasted than those aged 5 to 6 and 7 to 8 years. If children do not get enough nutritious food or balanced diet, they will become nutrient deficient and subsequently malnourished. Additionally, they are more prone to developing diarrhea or other infections during this time due to contaminated food or poor hygiene practices. These variables may interact to cause undernutrition among the study population. As also found in this study, the likelihood of being underweight increased with age, according to research conducted in Bangladesh and other developing countries (Ahmed et al., 2012; Das and Rahman et al., 2012; Bloss et al., 2004; Jeyaseelan and Lakshman, 1997).

This study showed that the children whose fathers' are day labourer rather than job holder or businessmen are more prone to being malnourished. This study results suggest that the risk of being undernourished decreases with increasing father's income (Kamal, 2011; Siddiqi et al., 2011; Jesmin et al., 2011; Rahman and Chowdhury, 2007).

Additionally, this study demonstrated that a significant predictor of undernutrition is the mother's educational level. Compared to children whose mothers had greater education (up to 10th grade), children whose mothers had only received primary school (up to the 6th grade) were more likely to be stunted, wasted and

undernourished. Education of the mother is more significant for the health of the children since educated mothers are better able to make decisions about the health and nutrition of their children. They are able to make better dietary decisions, better use of healthcare resources, better care decisions, and better hygienic choices for their child. In Bangladesh, where having more children is still regarded as a greater means of income, the association between birth order and a child's nutrition is particularly crucial. According to this study, there is a contradictory connection between a child's nutritional condition and the sequence of their birth. In particular, this study reveals that higher birth order is associated with lower child malnutrition. A possible explanation for this association might be that mothers have prior experience caring for and raising children; due to previous negative experiences, antenatal and postnatal care as well as child check-ups increase with higher birth order. As a result, birth of higher order might experience fewer health risks and cases of malnutrition. While assessing child nutritional status by birth order as a confounding factor in Bangladesh, this finding is in conflict with earlier studies (Khan and Raza, 2014) and in other countries (Marston and Cleland, 2003; Ukwuani and Suchindran, 2003; Shapiro-Mendoza et al., 2005). The results of the current study therefore imply that the efforts made in Bangladesh to address these issues may actually worsen maternal and child health outcomes as well as contribute to an increase in childhood malnutrition.

5.2 Caregiver's Health and Wellness Conditions

Stunting and undernutrition were significantly correlated with the mother's nutritional status. Additionally, it was compared to wasting. The probability of being undernourished, wasted and stunted was higher in children whose mothers had low BMIs than in children whose mothers had normal BMIs. Maternal undernutrition is one of the most complicated underlying causes. The root causes of maternal undernutrition are poverty, social squalor, and societal gender norms. Maternal malnutrition is caused by a number of factors, including early marriage, frequent childbirth, limited access to health care, and unequal food distribution within households in families where men predominate. Undernourished mothers frequently give birth to low weight babies and are likely unable to adequately care for and breastfeed their babies, which may contribute to the child's undernutrition.

The results of this study are consistent with those of prior investigations that found maternal malnutrition to be 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) undernourished (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).

5.3 Health status or morbidity factors

Children with fever exhibited higher rates of undernutrition, stunting, and wasting compared to children without fever after adjusting the effect of confounders. This finding suggests that compared to their healthy peers, children with disease are more susceptible to developing undernutrition. This study's findings were consistent with those of other studies (Das et al., 2008; Das and Rahman, 2011). Children typically avoid eating or consume fewer calories when they are sick. Avoiding or reducing food intake, a lack of nutrient-rich diet, poor parental care, and a lack of treatment for medical conditions may all be interrelated factors that contribute to underweight development in our research population.

In this study, malnourished children had the highest risk of diarrhea, highlighting the vicious circle between starvation and infection interaction. The results of the study showed that children with diarrhea were more likely than healthy children to be undernourished, stunted, and wasted. The findings of this study are in line with those of other investigations (Roy, 2000; Wamani et al., 2006; Ahmed et al., 2012). It suggests that the presence of diarrhea or other diseases can hasten the development of undernutrition, wasting, and stunting. Due to diarrhea, children may eat less or lose weight, contributing to the development of wasting.

The findings also revealed a strong correlation between worm infection and malnutrition. The probability of undernutrition, stunting, and wasting was higher in worm-infested children than in worm-free children. Because most people in underdeveloped nations lack access to good sanitation facilities and are not aware of the significance of simple hygiene measures like washing hands after using the restroom. Poor hygiene and a lack of clean water are factors in worm infestation. One of the main causes of childhood malnutrition, anaemia, stunted physical and mental

development, and psychosocial issues is worm infestation. Additionally, it results in recurrent upper respiratory infections and gastroenteritis, which increase morbidity and mortality in children.

This study also showed that the prevalence of pneumonia was higher in malnourished children compared to healthy children, due to the fact that children with pneumonia typically avoid food intake or consume less food than usual.

Chapter 6: Conclusions

The study presents the results of the research conducted in two areas of Bangladesh, Sandwip and Bandarban, regarding the prevalence of undernourishment, wasting, and stunting among children, and the socio-demographic and caregiver-related factors associated with these conditions. The study found that a considerable percentage of children in both areas suffered from malnutrition, which was significantly associated with variables such as age, gender, mother's education and occupation, birth order, diarrhea, pneumonia, worm infestation, and immunization status. The study also found that maternal malnutrition was a significant predictor of undernutrition, wasting, and stunting among children, and that birth order was not positively associated with child malnutrition as expected. These results suggest the importance of addressing social and economic factors in reducing child malnutrition, particularly maternal malnutrition and women's education, to improve the health outcomes of children in Bangladesh.

The nutritional status of children is not only a reliable indicator of a nation's health and nutrition, but it can also be viewed as a measurement of quality of life and a development indicator because it shows the intensity of development as a whole, which is influenced by chronic disease prevalence, poverty, and low socioeconomic status. Malnutrition interferes with child growth, has a negative impact on physical well-being. Malnutrition is a complex issue that requires ongoing research because it mirrors the long-term effects of socioeconomic, health, and nutritional problems that can change over time. The findings of this study confirm that there are quite rooms to improve the nutritional status of children at islands and hill tracts of Bangladesh. The government may want to establish targeted nutrition intervention techniques with a better understanding of the target group in addition to the ongoing programs to enhance child health in order to decrease childhood malnutrition. Additional program should be taken to confirm the easier access to health information and health education to parents. Early intervention programs should place equal emphasis on mothers and children because a healthy mother can give birth to children who will also be healthy, improving the nutritional condition of children. A balanced protein energy supplement can be given to mothers to improve their nutritional status, which will improve the babies' birth outcomes. It is necessary to increase the scope of

various social safety net programs in the island and hill tracts region. Different national and international organizations are running nutrition interventions on a small scale in in the island and hill tracts area. These programs can overlap. In order to increase coverage while utilizing the limited resources available, there is a need for collaboration among them. The implementation of key policies that assist the advancement of women's rights and better female education needs to be strengthened. Promotion of female education requires ongoing campaigning. The current human resource functioning at various levels needs to be strengthened in order to implement the nutritional program. For the government to reduce child undernutrition, increased budgetary support for the islands and hill tracts and ongoing international financial support for nutritional programs are both essential. The implementation of the nutritional program requires support from the ministries of health, agriculture, education, rural development, and other stakeholders.

Chapter 7: Recommendations and Future Perspectives

- Children and youths should be encouraged to eat more frequently and not miss meals in order to meet their dietary and metabolic demands and promote a healthy weight increase. They must be encouraged to eat a variety of foods, including those high in energy and nutrients, such as fruits, green leafy vegetables, pulses and legumes, meat, fish, and poultry, as well as milk and its by-products.
- A collaborative effort between the government, nongovernmental groups, and the community is unavoidably required in an equitable manner to enhance the nutritional status of children in order to lessen the burden of malnutrition among children.
- Regular reviews of monitoring and assessment are required, paying particular attention to vulnerable groups like poorest or young children of islands or hill tracts.
- The nutritional condition of children was shown to be highly correlated with their age, mother's education, and immunization status, among other personal traits. These factors might be given primary consideration while creating any action plan for the child including these activities.

Limitation of the study:

Every experiment has, in general, some limits, although these limitations typically relate to the nature, scope, and goals of the research as well as scheduling, financial, and personnel considerations. There were limitations on how this research could be carried out right now. The shortcomings of this research are as follows-

- For information regarding the study, the investigation is based on the data provided by the respondents selected at random during conversations with them.
- The research was conducted just for particular community.
- Only a couple of the many and ever-evolving characteristics of children were selected for the research.

Recommendations for further research:

The narrow scope of the researcher's study did not provide all the information required for a precise evaluation of the nutritional status of children. As a result, the following ideas for research topics in the future might be made:

- Sandwip and Bandarban region in Bangladesh served as the study's location. It will help provide a comparative picture of the nutritional status of the children in the country, which will be helpful for the creation of effective policies.

- Several characteristics such as age, mother's education & nutritional status, immunization status of the children etc. showed significant connections with the nutritional status of the children in the current research. Therefore, more research is required to determine the nature of the interaction between the other pertinent topics in order to validate the current results.

- Research is required, in particular, to identify the ongoing issues children have with regulating their nutritional status and to look into possible solutions.

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Appendix A: Pre-structured Questionnaire

> **Nutritional Status Assessment among Primary School Going Children of island and hill tracts area of Bangladesh.**

PART-A: Participant Consent Form

My name is Minhazur Rahman, and I am a student at Chattogram Veterinary and Animal Sciences University. I am conducting a qualitative research study on "Nutritional Status Assessment among Primary school going Children." The purposes of this study are to determine the nutritional status of children and the driving factors of nutritional status of island and hill tracts area of Bangladesh. 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.

Signature: _____

PART-B: Socio-demographic Information

1.1 Age (year): …………………

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 class 6

☐ Up to class 10 or above

1.8 Level of Father's education:

☐ Up to class 6

☐ Up to class 10

1.9 Mother's Occupation:

☐ Housewife   ☐ Jobholder

1.10   Father's Occupation:

☐ Jobholder   ☐ Day Laborer ☐ Businessman

1.11   Immunization Status:

☐ Fully   ☐ Partially

PART-C: Caregiver's Health and Wellness

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

1.3 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 Cough (ARI):

☐ Yes   ☐ No

1.5 Presence of worm infestation:

☐ Yes   ☐ No

Appendix B: Prevalence of Stunting, Undernutrition and Wasting (Z-score)

Variables	Stunting			Undernutrition			Wasting		
	Normal	Moderate <-2 to -3 SD	Severe <-3 SD	Normal	Moderate <-2 to -3 SD	Severe <-3 SD	Normal	Moderate <-2 to -3 SD	Severe <-3 SD
Sandwip	110	65	25	77	101	22	159	32	09
Bandarban	104	68	28	81	99	20	163	29	08

Appendix C: Photo Gallery

Brief Biography

Minhazur Rahman, son of Md. Solaiman and Farida Yeasmin, passed the Secondary School Certificate Examination in 2011 and then Higher Secondary Certificate Examination in 2013. Minhazur Rahman 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).