Study on Dietary Pattern and Nutritional Status of Underprivileged Children in Chattogram Metropolitan Area, Bangladesh

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Roll No. 0219/03

Registration No. 764

Session: July-December, 2019

A thesis submitted in the partial fulfillment of the requirements for the degree of Master of Science in Applied Human Nutrition & Dietetics.

Department of Applied Food Science and Nutrition

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August 2022

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August, 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 ELDER BROTHER & TEACHERS

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Acknowledgements

First and foremost, I would like to express my gratitude to the **"Almighty Allah"** from my deepest sense of gratitude, whose blessing has enabled me to complete the thesis for the degree of Master of Science in Applied Human Nutrition & Dietetics.

I express my sincere and deepest gratitude to supervisor, **Md. Fahad Bin Quader**, Associate Prof. Department of Applied Chemistry and Chemical Technology, Chattogram Veterinary and Animal Sciences University for his effective steerage during my whole study period who ploughed through several preliminary versions of my text, making critical suggestions and posing challenging questions. His expertise, invaluable guidance, constant encouragement, affectionate attitude, understanding patience, and healthy criticism added considerably to my experience.

I want to express my deep thanks to **Mohammad Mozibul Haque**, Assistant Professor, Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, CVASU, for the insightful discussion, offering valuable advices inspirations.

I also offer my special gratitude and heartfelt thanks to **Afra Binte Iftekhar** (BSc. & MS.), Faculty of Food Science and Technology, CVASU, for her guiding support and wholehearted cooperation during my research work.

I owe my special thanks to the director and the scientists associated with this research work, Department of Applied Food Science and Nutrition. This acknowledgement also goes from my heart to the all teaching and technical staffs who helped me and provided me the laboratory facilities and cooperation to conduct my whole survey dexterously.

Finally, I must express my very profound gratitude and cordial thanks to my loving family, friends, and well-wishers for their cooperation, cheerfulness and inspiration during the study. I gratefully acknowledge thanks to my beloved elder brother and parents for their understanding, inspirations, moral support, kindness and blessings, forbearance and endless love to complete my study.

The Author

November, 2022

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List of Abbreviation

%	:	Percentage
&	:	And
CMA	:	Chattogram Metropolitan Area
BDHS	:	Bangladesh Demographic and Health Survey
HIV	:	Humane Immune Deficiency Virus
BMI	:	Body Mass Index
MDG	:	Millennium Development Goal
VAD	:	Vitamin A Deficiency
FCS	:	Food Consumption Score
MUAC	:	Mid Upper Arm Circumference
NGO	:	Non-Government Organization
CDC	:	Convention on the Rights of the Child
BBS	:	Bangladesh Bureau of Statistics
SPSS	:	Statistical Package for Social Sciences
UNICEF	:	United Nations Children's Fund
WHO	:	World Health Organization
CP	:	Crude Protein
SEAR	:	South East Asia Region

Abstract

The prime aim of the study was to assess the nutritional status and associated factors for children at Chattogram metropolitan area, Bangladesh. A community based cross sectional survey was carried out in the study. A total of 200 person of underprivileged children comprising 61 boys and 54 girls from CRB, Agrabad, Sholoshahar and cantonment were participated in this study. A pre-prepared questionnaire was used to find out the association among various factors with nutritional status. The nutritional status of underprivileged children are presented through the three segments according to the age range. Nutritional status of children are determined by BMI Z-score for age and MUAC. According to the BMI Z-score for age given by WHO the percentages of severely wasted, wasted and normal ranged children are 19.5%, 32.5% and 25.5% respectively in this survey. Again 17.5% children were over weighted and 5% were obese as per as the survey. Based on MUAC, according to the age group less than 5 years children, the prevalence of moderate acute malnutrition and severe acute malnutrition were not found. Age range between 5 to 10 years children, the prevalence of moderate acute malnutrition was found 2.46% and severe acute malnutrition was found 0.82%, the prevalence of moderate acute malnutrition and severe acute malnutrition were not found for the age group more than 10 years and also informed that malnutrition was significantly associated with location, lunch pattern and milk consumption of underprivileged children.

Keywords: BMI, MUAC, Malnutrition, Wasting, Underprivileged.

Chapter 1: Introduction

A proper nutrition is essential for good health. Indicates that child malnutrition is a prevalent and serious public health issue that is particularly severe in South-East Asia .The physical and mental growth of children is directly influenced by their nutritional condition. The disadvantaged children in urban slums lack the fundamental nutrition and dietary needs, which may be the cause of their growth failure. At any age, it is crucial to maintain a healthy nutritional state. In this age range, malnutrition will have an impact on academic achievement. Child under nutrition has a significant impact on child mortality, which serves as a health indicator. Asia is the home to over 70% of under-fives who are stunted (Monoarul Haque & Islam, 2018). Poor household economic conditions, periodic food shortages, child labor (a sign of low household income and poverty), the burden of disease, lack of awareness of the long-term effects of adolescent malnutrition, the quantity and quality of food, and lack of access to health and nutrition services are all associated with under nutrition of adolescents in developing countries. Low family income, illiteracy, and frequent food shortages were linked to insufficient nutritional intake in Bangladesh, which may have contributed to under nutrition. For health and nutrition to be improved in a sustained method, dietary knowledge and availability of resources are essential (Alam et al., 2010). Infants and young children are particularly at risk of micronutrient deficiencies because of their high nutritional needs relative to energy intake and the frequent episodes of infection (including sub-clinical infection) at this age which often results in reduced appetite, decreased nutrient absorption, and increased loss of nutrients from the body (Talukder et al., 2000).

Due to inadequate food consumption, health and nutritional issues are common and long-lasting in Bangladesh. In Bangladesh, like in other poor nations, the issue of health and nutrition is quite severe. This is particularly true and causes great anxiety for the youngsters. It is not only a significant health issue but also a significant barrier to the socioeconomic growth of the country. Numerous chronic illnesses, including obesity, coronary heart disease, hypertension, diabetes mellitus, and some kinds of cancer, may be influenced by nutrition and lifestyle choices made throughout childhood and adolescence (T.Ch. et al., 2007). Bangladesh has a high rate of malnutrition. According to the 2014 Bangladesh Demographic and Health Survey (BDHS), 14% of wasting

children and 36% of under-five children are stunted. According to data, children in rural areas are more likely than those in urban areas to be stunted (Monoarul Haque & Islam, 2018). Malnutrition in some societies may be influenced by family food allocation patterns. Supplemental feeding programs are now a widely accepted technique for boosting health and avoiding infections since malnutrition is so common among children aged 6 in underdeveloped nations (Sarkar et al., 2020). The distant and mountainous Chittagong Hill Tract is a distinctive, attractive, and welcoming location. The Chittagong Division includes the district of Bandarban in southern Bangladesh (Monoarul Haque & Islam, 2018).

1.1 Aims and Objectives
Aim:

In the Chattogram Metropolitan Area, this thesis examines the nutritional status and associated indicators of malnutrition among disadvantaged children.

The objectives of this study are:

✓ To evaluate the eating habits and other behaviors of street children.
✓ To assess the nutritional consumption and trends of impoverished children in the Chattogram Metropolitan Area of Bangladesh.

1.2 Significance of the study
Determining the predominance of poor nutritional status in vulnerable children under the age of 16 in Chattogram Metropolitan Area. Additionally, group interventions offer helpful access points to strengthen and encourage families in meeting the unique care needs of children. As a result, gathering evidence to alert existing humanitarian activities and coordinating between the risk variables and health. Therefore, the slum population needs to be informed at all levels about the connection between poor child nutrition and related health problems.

Chapter 2: Review of Literature

2.1 Background

In accordance with UNICEF, a street child is one who lives on the street (in the broadest sense of the term, i.e., unfurnished residential, wasteland, etc.) much as their family has become their real home, a situation in which there is no security, guidance, or direction from responsible people". Although the exact number of children and youth who live and work on the streets of the world's cities is unknown, current research indicates that tens of millions of children do so, and that their numbers are rapidly increasing due to factors such as the HIV prevalence, transition, rapid industrialization, and worldwide demographic change.

According to UNICEF, there are two complementary categories of young people: on-the-street kids, who live on the streets but usually sleep at home, and some off kids, who seldom or never go home. Most street children are on-the-street instead of-the-street, as indicated by the literature. Even though they have received extensive and well-deserved criticism, these phrases are still the most used today and make a significant difference. Dissociation from home, society, and cultural connections is linked to worse healthcare outcomes, as has been extensively demonstrated (Woan et al., 2013).

2.2 Malnutrition

Malnutrition, in principle, is a phrase that covers both inadequate and over-nutrition. People are considered undernourished or over nourished if their diet does not provide them with enough calories and protein for growth and function, or if their health prevents them from fully using the food they eat (under nutrition) or if they intake quite so many calories (over nutrition) (Das & Gulshan, 2017). Malnutrition encompasses both inadequate and excessive dietary intake.

2.2.1 Under nutrition

Under nutrition includes micronutrient deficit, including a lack of vital vitamins and minerals, as well as protein-energy malnutrition. 3.5 million fatalities and 35% of the burden of illness among children under the age of five (under-five children) globally are attributable to under nutrition (Das & Gulshan, 2017). Only childhood malnourishment is responsible for 11% of all disability-adjusted life years (DALYs) worldwide. Only 20 nations in Africa, the Middle East, Asia, and the Western Pacific, including Bangladesh, are home to around 80% of the world's undernourished children

(Ahmed et al., 2012). Bangladesh still has a significant public health issue with under nutrition.

2.2.2 Over nutrition

Although obesity is still not a major issue, it is becoming more common among women and children under the age of five. According to a recent nationwide study, the proportion of kids with weight-for-height or body mass index (BMI) z-scores 3 has climbed from 0.1 in 1995 to 0.5%. The percentage of women who were overweight or obese (BMI 25 kg/m2) grew from 2.7% in 1996-1997 to 10.1% in 2007 (Ahmed et al., 2012).

2.2.3 Overview of Malnutrition

Due to inadequate food consumption, health and nutritional problems are common and chronic in Bangladesh. Like in other poor nations, Bangladesh is experiencing a very significant public health crisis with regard to nutritional issues (Turin et al., 2007). This is especially true and causes the kids significant anxiety. Reduced anthropometric condition, which is a measure for malnutrition, denotes a discrepancy between intake and what the body needs for healthy development and function (Sarkar et al., 2020). Poor nutrition throughout childhood may hinder the physical and/or mental development of children, leading to a higher risk of highly infectious illnesses or serious diseases and a larger economic burden on society. Malnutrition among mothers and their children undoubtedly has a negative impact on the growth of development in the national and global economic spheres, along with on nutrition and sustainable development. Poor nutrition is clearly a major contributor to the 3.5 million fatalities and 35% of illnesses among children under the age of five that occur each year across the world, with children in developing world accounting for the majority of these cases. Stunted growth or chronic malnutrition (low height for age), wasting or severe malnutrition (low weight-for-height), or being underweight for their age all seem to be characteristics of malnourished children. In the 1990s, it was reported that 50.6 million under-five children were malnourished in underdeveloped countries, with more than 20% of the seriously malnourished suffering from a critical disease that required hospitalization. Between 1990 and 2000, the incidence of stunting and underweight decreased globally, from 34 to 27% and 27 to 22%, respectively. In 2011, it was projected that 16% of children under the age of five were underweight globally. South Asia had a noticeably comparatively large frequency of underweight children when

compared to other regions of the globe. On the other hand, Latin America and the Caribbean (3%) and Central and Eastern Europe/Commonwealth of Independent States (2%, respectively) make for a relatively tiny portion of the worldwide prevalence of underweight. That year, Asia was entitled to 70% of all wasted children worldwide, with South Asia having the worst rate of wasting (16%) (Das & Gulshan, 2017).

This is a substantial barrier to governance and economic growth in addition to being a serious health concern. Growing evidence suggests that nutrition and lifestyle choices made in childhood and adolescence may have long-term effects on numerous chronic illnesses, including obesity, coronary heart disease, hypertension, diabetes mellitus, and some forms of cancer. Additional feeding programs have become a universally recognized technique for public health and prevention of disease due to the prevalence of malnutrition among children in developing nations (Sarkar et al., 2020). More than half of child fatalities are related to malnutrition (America et al., n.d.). Children under the age of five were underweight in 39.7% of cases, stunted in 46.2%, wasted in 14.5%, and overweight in 1.4% of cases in 2005. The frequency of stunting and underweight was "extremely high," while the prevalence of wasting suggested a "serious situation," according WHO standards. In children, the prevalence of severe underweight, stunting, and wasting was 10.9%, 19.0%, and 2.9%, respectively (America et al., n.d.).

Beginning in the early 1980s, there was a sharp drop in the incidence of malnutrition, which included a decrease in the percentages of stunted, wasted, and underweight children from 1984 to 1985. Evidently, the years 1994–1995 and 2004–2005 show that Bangladesh achieved tremendous progress in the last three decades in the battle against child malnutrition. Experts and decision-makers, however, must acknowledge that the high prevalence of malnutrition continues to be one of the major causes of illness and death in children. Bangladesh had 41% of children who were stunted in 2011, 43.2% in 2007, and 51% in 2004. Yet, it still lags short of reaching the 2015 Millennium Development Goal (MDG) objective of 34% malnutrition prevalence (Sarkar et al., 2020).

The developing world has seen rapid urbanization in recent decades, and 80 percent of the world's major cities are now found there. Slum dwellers make about 60% of the population there. Geographic migration will expose migrants to changing environments as they move from rural to urban locations. Residents in urban slums are subjected to

unfavorable environmental circumstances (overcrowding, poor quality drinking water and sanitation, and no removal of waste). Lack of information and the challenging living circumstances in the slums are likely to lead to unhealthy dietary habits, poor health care access and hygiene awareness, and ignorance of the causes of illness and the appropriate cures. The condition is made more severe by a shortage of essential medical facilities, medications, immunizations, and medical staff. Children who live in such contexts are more vulnerable to health and nutritional issues (T.Ch. et al., 2007).

The biggest city in Bangladesh and its capital is Dhaka. Over 20% of Bangladesh's population, or thirty million people, dwell in metropolitan areas. This number increased to 46 million by the year 2005, and predictions showed that by 2015, 68 million people—more than a third of Bangladesh's population—would reside in urban regions. The number of urban slums has increased significantly in recent years, particularly in emerging countries, and the urban poor are now projected to number over 11 million, or 37% of the urban population. The greatest discrepancy between the privileged and the poor is seen in metropolitan areas, where 14% of the population live underneath the poverty line nationwide (Rahman et al., 2021). Slums in Dhaka have mostly grown on public or leased properties. Slum dwellers have been living there unofficially for at at least twenty years. There are several slums that are owned by private rentals as well. The majority of slums are communities of low-income, lower-class residential homes. The current investigation was conducted in the Chattogram city slums.

2.3 Nutritional Status in Bangladesh

The incidence of malnutrition in Bangladesh is one of the highest in the world. More than 9.5 million young children, or more than 54% of preschoolers, have stunted growth, 56% are underweight, and more than 17% are wasted. Due to child malnutrition, there were notable differences in the prevalence of the three anthropometric measurements across all of the administrative units. Khulna showed the lowest frequency of underweight (49.5%) whereas Sylhet recorded the greatest prevalence of stunting (61.4%) and wasting (64.0%). (20.9 percent). Despite the high levels, stunting rates have progressively declined over the last ten years (FAO, 2010). High levels of micronutrient deficiencies, particularly those of vitamin A, iron, iodine, and zinc, affect children in Bangladesh. Although intake of vitamin A-rich foods is still low, Bangladesh should be praised for making technical progress in the last 15 years to

reduce pre-school children's vitamin A deficiency (VAD). This suggests that further attention and assistance are required for the root causes of VAD. Children in Bangladesh are also prone to anemia, and there are few initiatives in place to raise their iron levels. (FAO, 2010).

2.3.1 Associated Factors for Nutritional status

The dietary requirements and nutritional intake of children are influenced by a variety of factors. These characteristics may be described as either biological or non-biological. Biological variables include things like age, gender, growth, disease conditions, and heredity. Among the non-biological aspects, socioeconomic status is the most important. One of the major socioeconomic factors influencing food consumption variability and nutritional requirements is poverty. Living in unsanitary surroundings with a greater risk of health problems, such as those caused by lead and other environmentally safe heavy metals, is restricted by poverty. Parasites, especially hookworms, schistosomes, and malaria, induce blood loss, which raises food requirements. These parasites are often more abundant in unfavorable environments. Religion, foodstuff, and social position are only a few socio-cultural aspects that have an impact on dietary requirements and intake. Religion and culture have an impact on what individuals eat and what they regard to be edible, which affects their nutritional intake and their need for more nutrients (Jackson et al., 2004).

2.3.2 Factors Affecting Children's Nutritional Status

The nutritional status of children may be affected by the following factors.

2.3.3 Dietary adequacy

Children's growth and development were greatly influenced by the nutrients they consumed in their early years. The capacity for healthy eating is influenced by two factors. The first was having sufficient access to both quality and quantity of food, which is determined by socioeconomic factors, dietary preferences, cultural practices, and food security. The second component was the ability to ingest, absorb, and use the food. With little to no animal products and only seasonally accessible fruits and vegetables, the majority of rural family meals in developing countries are composed entirely of locally produced starchy staples. Fast food and convenience meals were popular choices among families because they were inexpensive, convenient, and delicious. Additionally, they regularly ate snacks instead of meals (Pandey, 2018).

Boring and repetitive diets with few meals may lead to under nutrition, particularly in kids from households where poverty is a problem. Fast food is defined as food that is rapidly manufactured, served, and eaten outside the house. In other words, it characterizes foods prepared with less nutrients (Banik et al., 2020). Girls may get less nutrition and lower-quality food since boys are preferred in many SEAR cultures. In certain parts of India, food intake for boys and girls was regulated due to fears about their fast development. Sociocultural influences have an impact on children's eating habits and behavior (Pandey, 2018).

According to studies on children's diets, although food eaten at home was connected to socioeconomic considerations, food consumed outside the house was more impacted by peer pressure and had no relation to a child's familial background or social status (Aljaaly, 2012). The primary problem with these meals was that they typically had more amounts of calories, fat, saturated fat, trans fat, cholesterol, sugar, and salt than foods made at home while having lower amounts of vitamins A, C, folate, calcium, iron, and zinc. The youngster generally ate less fruits and vegetables than is recommended. Families with only one parent or those with low incomes tended to miss breakfast more often. According to various studies, having breakfast was connected to a lower BMI or protection against obesity (*Modern Nutrition in Health and Disease - Google Books*, n.d.). Many studies now suggest that cultural factors—rather than socioeconomic conditions—play a more major role in determining food allocation and nutritional adequacy, despite the fact that poverty was traditionally regarded to be the primary factor affecting food intake. Even in places with plenty of food available, a family member's average daily calorie intake may not be adequate.

2.3.4 Physiological condition and lifestyle

Malnutrition risk was shown to be higher for both boys and girls. Growth forces increased nutritional needs throughout childhood. Athletes who are required to maintain a set weight for competition may engage in extreme weight reduction techniques that could be detrimental to their performance and health. Eating disorders are more likely to manifest in young athletes who are dieting and worried about their weight, and low-energy diets are more likely to be lacking in micronutrients such calcium, iron, magnesium, zinc, and vitamin B6. Bangladesh, the eighth most populated nation in the world, has a significant incidence of mental health issues, with an estimated frequency of 6.5% to 31.0% among adults and 13.4% to 22.9% among

children. These figures, meanwhile, are probably higher for caretakers. In Bangladesh, it is estimated that 3.4 out of every 1000 children have CP, with a severity that is noticeably greater than worldwide averages. Of these children, 79.6% have spastic type, 68.2% are unable to walk, 67.6% have speech difficulties, and 23.7% have epilepsy (Power et al., 2019).

According to studies, physical activity levels drastically decrease from infancy to adolescent. The American College of Sports Medicine's current recommendations for physical activity, which call for engaging in vigorous cardio-respiratory endurance exercises at least three times per week, engaging in flexibility exercises at least three times per week, and engaging in strength- or endurance exercises at least twice per week, are not met by the average American college student, according to studies. Regular physical exercise has been found to lessen the risk of coronary heart disease, stroke, diabetes, high blood pressure, colon cancer, breast cancer, and depression. Additionally, because energy expenditure was a primary factor of weight control and energy balance, physical activity was necessary. Conversely, kid livelihoods in low-income countries may require intense physical work, which directly influenced their energy requirements and body mass index. Physical activity levels significantly predicted adiposity, and reductions in physical activity were connected to elevations in BMI later. Physical inactivity has been associated with risk factors for cardiovascular disease in adolescents, such as obesity, hypertension, higher blood lipids, and cholesterol (Aljaaly, 2012).

2.3.5 Psychosocial factors
Children and teenagers were often significantly guided by their peers, their own dietary decisions, and their own changing awareness of which foods constitute a healthy and suitable diet, even though parents might still serve as helpful models (Pandey, 2018). Children's eating habits are influenced by cognitive, physical, social, and lifestyle factors, which all play a part. Childhood was a time when concerns about body image and weight control were prevalent. Serious eating disorders and psychological discomfort are two conditions that may have a significant impact on one's health (Aljaaly, 2012).

Childhood lifestyle, dietary practices, and views may alter tremendously as a consequence of the quest for identity, the desire for independence and acceptability,

and the fascination with beauty. Body image concerns and nutritional risk throughout childhood, especially among girls and boys, were greatly impacted by these issues.

2.3.6 Food security

One needs access to food in order to be well nourished. The three core components of food security are food availability, food stability, and food access, however food utilization may also be included. National food security is the state of having sufficient domestic food production and food imports. The main development goal for many developing nations, including Bangladesh, is to achieve food security (Roy et al., 2019). Food insecurity may be caused by a lack of food, limited purchasing power, uneven distribution, or inadequate utilization of food at the household level. A vital aspect of household food security is the family's capacity to produce and acquire food. Moreover, there is a considerable amount of effort put into how food is prepared and distributed throughout the home. The nutrition of the family is immediately impacted by all of those factors.

The consumption patterns index served as a proximate indication of food security. The frequency of food intake was determined using the WFP-created food consumption score (FCS). The FCS indicator's cut-offs, which have been applied across regions and lifestyle categories, are consistent and clearly stated. Based on a composite score that included dietary diversity, food frequency, and the relative nutritional value of different food categories, it was determined. The responder was asked how often they had eaten certain meals throughout a recall interval of the following seven days (Headey & Ecker, 2012).

2.3.7 Health, water and sanitation

Just two of the numerous factors that impacted population health behaviors were the environment and knowledge. These behaviors include having access to healthcare, managing contagious diseases, and seeking qualified medical help when afflicted. People's poor health is often associated with the inability to participate in important activities that benefit society and higher treatment expenditures at the price of food. Poor health increases both nutritional vulnerability and susceptibility to food insecurity. During the last five decades, there has been minimal progress in the health and nutritional quality of children worldwide, and little is known about the socio-demographic and economic variables that affect their nutritional status in low- and middle-income countries (Leroy et al., 2018).

Sanitation was especially important in urban areas, where people were often crowded. Poor sanitation, which also has an impact on how food is handled and eaten, is what leads to disease epidemics. Water accessibility is a key indicator of food security. Nutritional security depends on having access to water that is both of adequate quality and quantity. Households need water for activities like cooking, cleaning, dressing, and drinking. This water must be of sufficient quantity and safety for consumption. Diarrhea affects young children who are exposed to poor water and sanitary conditions; it is most common among people who live in low- or middle-income countries. A recent meta-analysis investigating the impact of integrated water, sanitation, and hand washing interventions on anthropometry revealed only small gains in linear growth and negligible effects on underweight or wasting in children under the age of five. Poor cognitive outcomes have been associated with diarrhea and other infectious diseases, according to observational study data (Tofail et al., 2018).

2.3.8 Socio-economic condition

The availability of food, the accessibility of healthcare services, and the overall growth of the country are all directly impacted by the political and economic climate of the country. At the national level, socioeconomic variables include population characteristics, literacy rates, the distribution and use of the available natural resources, market conditions, and the modernization of the agricultural sector. At the national and sub - national or community levels, cultural views about what to eat and own, social institutions like family size, caste or ethnicity, and relations, livelihood systems (occupations), and household characteristics like the proportion of working adults all affect food security. Low socioeconomic status was more likely to be connected to childhood malnutrition (Assefa et al., 2013).

2.3.9 Educational status

Health education activities that are organized on a central level and carried out as a vertical program evaluated nutrition knowledge as a component of health programs in low-income nations and suggested alternatives.

Article 17 of the constitution of Bangladesh guarantees free and mandatory education to all children. Law mandates that children between the ages of six and ten attend school. Unfortunately, it is often believed that Bangladeshi education is of a lower standard. According to UNICEF, access to education is still a problem for children who are working, handicapped, aboriginal children, reside in remote areas, or are extremely

poor. In less expensive areas, just 50% of children attend school. In comparison to females, boys are more likely to quit school early or never go. Because students commonly fall short of the required skills for the program, repetition rates are significant. It often takes a child more than five years to complete classes one through five. The number of lessons is further reduced by frequent school closings. Many universities still have overcrowded, dark classrooms that make it difficult for students to study (America et al., n.d.).

2.3.10 Annual family income

A large number of people live in rural areas that lack services like market access, suitable roads, and centers for healthcare and education. Estimates indicate that 35% of people living in rural areas are considered to be poor.

They typically lack property and other things, are uneducated, and regularly experience constant food insecurity. They may also be affected by serious diseases or physical limitations. Another 29% of people living in rural areas fall into the moderate poverty category. Their meals are not nutrient-rich, despite the fact that they may have a little piece of land, some cattle, and typically enough food to eat. They face the danger of being sick or experiencing natural disasters that push them further into poverty. Women are among the poorest of the rural poor, especially when they are the lone managers of their homes.

Strong national efforts to combat poverty camouflage differences in welfare trends across Bangladesh's urban and rural areas. The national poverty rate decreased in both rural and urban areas of Bangladesh, while urban Bangladesh's pace of drop was noticeably slower, mostly because of lower intensities of poverty reduction in Dhaka and growing poverty in Chittagong. Extreme poverty has not diminished to a lesser extent in urban areas. In urban areas, 7.7% of people in 2010 and 7.6% of people in 2016 lived in severe poverty. Due to Bangladesh's continued urbanization, more individuals (3.3 million) than in 2010 now lives in Bangladesh's cities' severe poverty (Ahmed et al., 2012).

2.4 UNICEF framework of malnutrition

The conceptual model emphasizes the complexity of the several interrelated factors that may affect nutritional status at various levels, including immediate, underlying, and fundamental, emphasizing the fact that it is not merely a food, health, or care problem.

This enables needs assessments to explore beyond only a population's food requirements and supports a better awareness of variables influencing nutrition status. The conceptual model may 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. This is predicated on the idea that in order to prevent a community from diseases and malnutrition, care, food security, proper health services, and a healthy home environment are necessary. These must be offered if they are not available. This will guarantee that the resources that are available are utilized efficiently (*UNICEF Nutrition Conceptual Framework | Download Scientific Diagram*, n.d.).
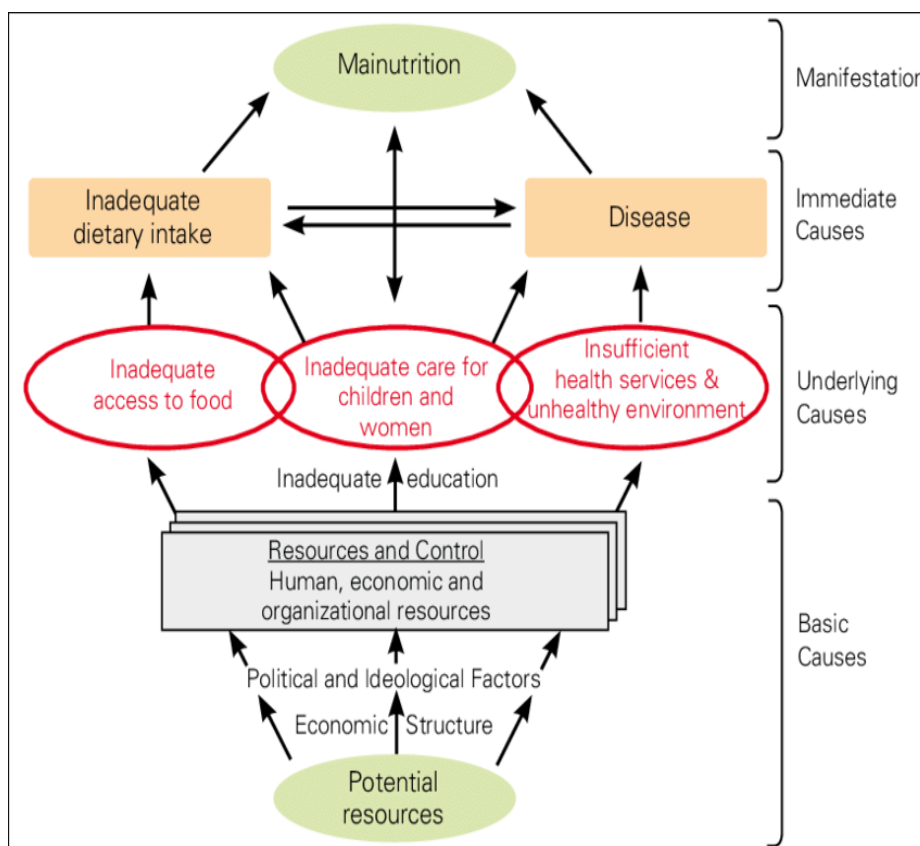
Fig 2.1 UNICEF framework of malnutrition

Chapter 3: Materials and Methodology

Methodology is used to collecting and analyze the data, two activities that are essential to every kind of research. It is a vital and fundamental part of doing any kind of scientific investigation or study. Appropriate precaution and authenticity should be used while conducting the research due to this reason. The researcher may get real and trustworthy data with the assistance of an appropriate strategy by evaluating the facts to draw the best conclusion. In addition to the study area, sampling strategy, data collecting procedures, methodology for various variables, research tools, and data processing techniques, these chapters also discuss the methodological approach and study design.

3.1 Study area and Period

From May 2022 to August 2022, slum areas around CRB Junction, Agrabad Shishu Park, Sholshohor Railway station, and Bayezid Cantonment Railway station were the subject of a cross-sectional community-based research. A descriptive and cross-sectional study included boys and girls from various Chattogram Metropolitan Area areas. It is situated in Bangladesh's southern Chittagong Division. The environment in slum areas is continually changing, which has an impact on the nature and personality of these areas. This is particularly important since many slum dwellers are among the poorest people and rely on inferior sources for both jobs and food. Even outside of the specific locations, slum ecosystems' effects on the environment, social conditions, and economic factors are profound. The health of children is another area where climate change is already having an impact.
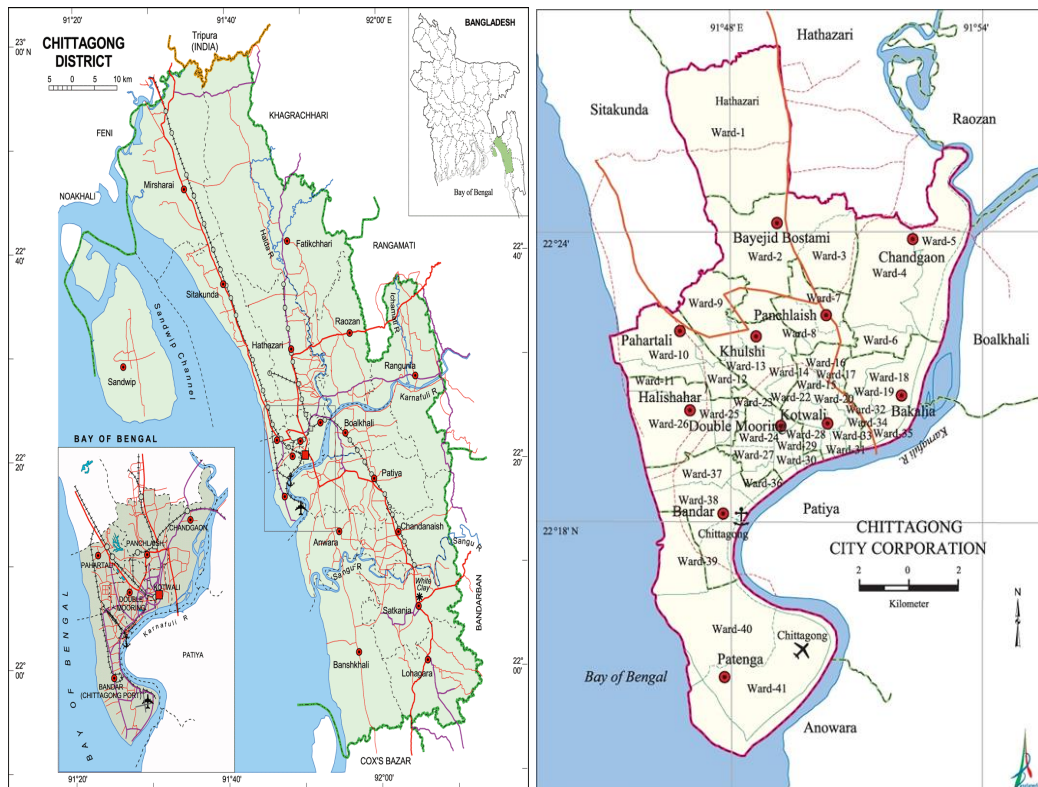
Figure 3.1 Map of study area [Chattogram District (in left) and Chattogram Metropolitan Area (in right)]

3.2 Apparatus

a) A structured questionnaire (CDC, 2020) was used in the study to collect information on dietary habit, anthropometric data, socio-demographic and socio-economic characteristics of the children.

b) An analog weight machine was used to measure the weight of children.

c) MUAC tape was used to measure reading of Mid Upper Arm Circumference of children.

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

3.3 Sample Size

The sample size was estimated by using the formula, which is give below (Figure-3.2). 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).

Confidence level, z= 95%

Population Size, N = 1500

Sampling error, E = 5%

Maximum population variability, p = q =0.5

Sample Size, n=?

Putting all the value in equation finally we get the sample size is 85.

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

Source: Bryman Simple Random Sampling, 2016.

3.4 Study design

A community based cross sectional study was carried out. Simple random sampling technique was used to select 200 under- fifteen-year-old children from different parts of Chattogram Metropolitan Area. Simple random sampling was also used to select an individual for the study among eligible family.

3.5 Ethical consideration

This study was conducted in accordance with ethical principle of Helsinki declaration 1964. Written consent was obtained from each respondent after explaining the purpose of the study. Only interested children were interviewed to collect the necessary information.

3.6 Study variables

Pre-structured questionnaire is used in the study. A 7-day food frequency questionnaire on selected food items was used to obtain information on the habitual dietary pattern of each participant. Six major questions are used to find out impairments of the children. Pre-structure questionnaire was divided into socio-demographic variable, socio-economic variable, anthropometric measurements and other factors. 1) Socio-demographic characteristics includes age, family size and gender; 2) Socio-economic variables includes education of caregiver, relation with caregiver; 3) Anthropometric measurements were height, weight, mid-upper arm circumference (MUAC), and body mass index (BMI); and 4) Other variables were health status including worm, diarrhea

,asthma and any type of disability, nutritional knowledge, Physical activity, Hygiene practice, Food intake, dietary pattern, source of water and nutritional status, health, and morbidity status.

Physical activity remark in indoor game (ludo, carom board, chess and others) and outdoor game (football, cricket, badminton and others). Like other studies have demonstrated, having sports equipment at home was favorably connected with physical activity in both girls and boys (Sirard et al., 2010). This variable was determined on the basis of time per day.

Respondent personal hygiene maintain was wash their hand regularly with soap before and after eating, wash their hand regularly with soap after toilet, cut nail regularly, brush their teeth, take their bath regularly. There was a considerable disease burden attributed to inadequate water, sanitation and hygiene facilities and practices, particularly in low income countries (Cairncross et al., 2010).

An interview schedule was developed to elicit information about the food intake by the 24-hour recall method. The food frequency schedule was based on consumption patterns of various foodstuffs and their frequency of use. The two different sets of diet diversity scores reflect the differences in micronutrient requirements across the life course (Ruel et al., 2010). Respondent intake food was converted into calorie. This variable was determined on the basis of calorie.

3.7 Assessment of anthropometric measurements

MUAC was measured by marking midway between acromion (shoulder) and the olecranon (elbow) on the vertical axis of the upper arm with the arm bent at right angle and between the lateral and medial surface of the arm. MUAC was assessed according to age. According to (*BMI-for-Age (5-19 Years)*, n.d.). MUAC distribution was as follows:

Category	MUAC according to age		
	Under 5 years	6 to 12 years	13 to 15 years
Normal	>12.5cm	>14 cm	> 18cm
Moderate acute malnutrition (MAM)	<12.5cm	13-14 cm	16-18cm
Severe acute malnutrition (SAM)	<11.5cm	<13cm	< 16cm

3.8 Body mass index (BMI)
a) Height measurement:

A measuring tape was used to measure height in cm. Children were measured against the wall without wearing shoe and their heads positioned with their eyes looking straight ahead (Frankfort plane) so that the line of vision was parallel to the body and the measuring tape was brought down to the top of the head. The height at the nearest 0.1 cm was registered. For a given anthropometric measurement, the same measurer was used to prevent variance (Wolde et al., 2014).

b) Weight measurement:
A weight balance operated by battery was used to record the weight of the children. The balance was calibrated each of the time before use. During the procedure the subjects have worn light clothes and were in bare foot. Body mass index (BMI) was calculated by the following formula.

$$\text{BMI} = \frac{\text{weight in kilograms}}{(\text{height in meters})^2}$$

According to CDC guideline BMI was categorized as:

BMI Category	Underweight	Normal	Overweight
	<18.5	18.5-24.9	25-29

3.9 24-hour dietary recall (24HR)

A 24-hour dietary recall (24HR) is a structured interview intended to capture detailed information about all foods and beverages (and possibly, dietary supplements) consumed by the respondent in the past 24 hours, most commonly, from midnight to midnight the previous day. A key feature of the 24HR is that, when appropriate, the primary caregivers of respondents were asked for more detailed information than first reported. For example, caregiver of a respondent reporting chicken for dinner or a sandwich for lunch would be asked about the preparation method and type of bread. This open-ended response structure is designed to prompt caregivers of the respondents to provide a comprehensive and detailed report of all foods and beverages consumed.

3.10 Data Processing and Statistical Analysis

Information on the survey methodology and sampling have been published elsewhere. When necessary, qualitative data were transformed into quantitative data. The information gathered from the respondents was first entered onto a master sheet, after which it was collected, tabulated, and analyzed in line with the study's goals. All of the acquired data was processed using a computer application called SPSS (Statistical Package for Social Sciences). Standard deviation, range, mean, and other descriptive statistical techniques were employed. Tables were used in the presentation for ease of understanding (in Chapter 4). The product moment correlation coefficient (r) of Pearson was applied. Multiple regression analysis (enter technique) was used to identify the variables influencing child nutritional status, BMI and MUAC. To find significant explanatory factors that had an impact on an adolescent's nutritional status, a step-wise multiple regression analysis was used (Shori et al., 2017).

Chapter 4: Results

At first the frequency table with demographic characteristics include age range, gender, family member, location, occupation of father, source of drinking water, and level of activity, BMI for age and MUAC. Nutritional status of children are determined by using BMI for age and MUAC according to WHO. Finally, the associations between different variables and nutritional status were described using Chi square test.

4.1 Demographic characteristics of underprivileged Children in Chattogram Metropolitan area

Table 4.1 Frequency Table including demographic characteristic

Variable	Category	Frequency	Percentage
Age groups	Less than 5 years	34	17.0
	5-10 years	122	61.0
	More than 10 years	44	22.0
Family Member	1 to 5	145	72.5
	More than 5	55	27.5
Gender	Female	129	64.5
	Male	71	35.5
Location	CRB	46	23.0
	Agrabad	49	24.5
	Sholoshohor	25	12.5
	Cantonment	80	40.0
Occupation of father	Rickshaw puller	34	17.0
	Workers	73	36.5
	Driver	31	15.5
	Business	14	7.0
	Jobless	17	8.5
	Public servant	13	6.5
	Others	18	9.0
Source of drinking water	Tap	4	2.0
	Boiled	63	31.5
	Tube well	79	39.5
	WASA	42	21.0
	Pump	3	1.5
	Mineral water	2	1.0
	others	5	2.5
	Filter	2	1.0

Level of activity	Sedentary	75	37.5
	Moderate active	125	62.5
BMI Z Score	Severely wasted	39	19.5
	Wasted	65	32.5
	Normal	51	25.5
	Over weight	35	17.5
	Obese	10	5.0
MUAC status	Normal	196	98.0
	MAM	3	1.5
	SAM	1	0.5

Source: WHO (BMI, MUAC status)

4.1.1 Age Distribution

Nutritional status of children is related to child's age. This study had ages ranging from 1 year to 16 years old and it was distributed into 3 different categories: 1 to 5 years (17.0%), 5 to 10 years (61.0%), more than 10 years (22.0%).
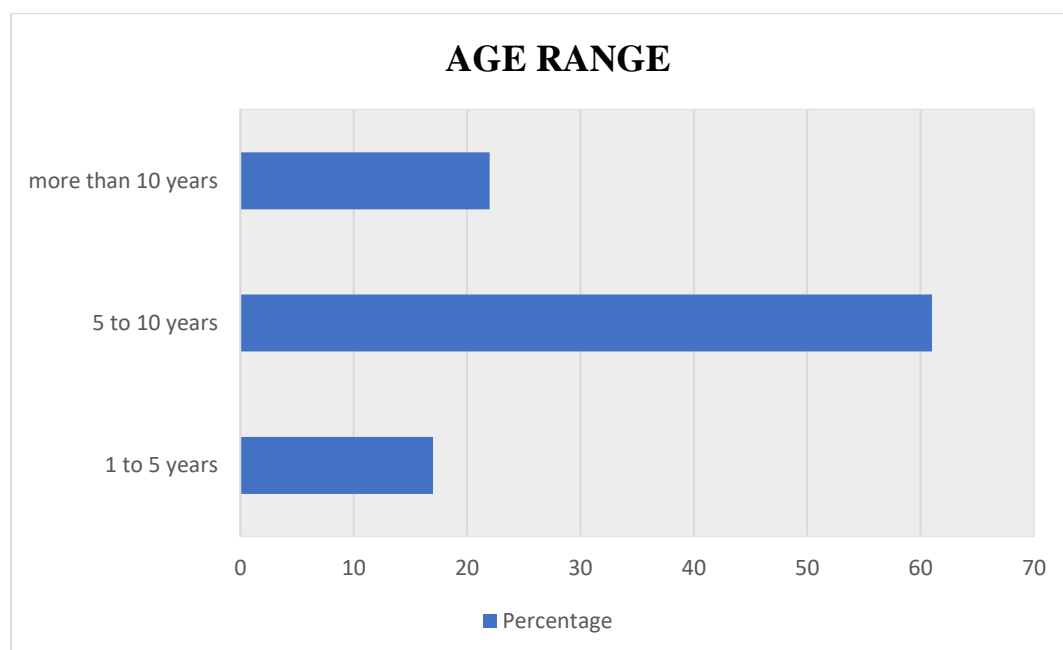
Figure 4.1 Age distribution (%) of children

4.1.2 Family Size

In my survey, there have been found 72.5% families have 1-5 members and 27.5% families are more than 5 members.

4.1.3 Gender Distribution

In this study among 200 under privileged children, about 129(64.5%) of children were girls and 71(35.5%) were boys.

4.1.4 Father's occupation

According to my study, fathers of the children are employed in different occupations. Among these, 34(17.0%) are rickshaw puller, 73(36.5%) workers, 31(15.5%) drivers, 14(7.0%) businessman, 13(6.5%) public servant, 18(9.0%) are involved in occupations like fisherman, sweeper, guard etc. and 17(8.5%) of the fathers do not have any job.

OCCUPATION OF FATHER
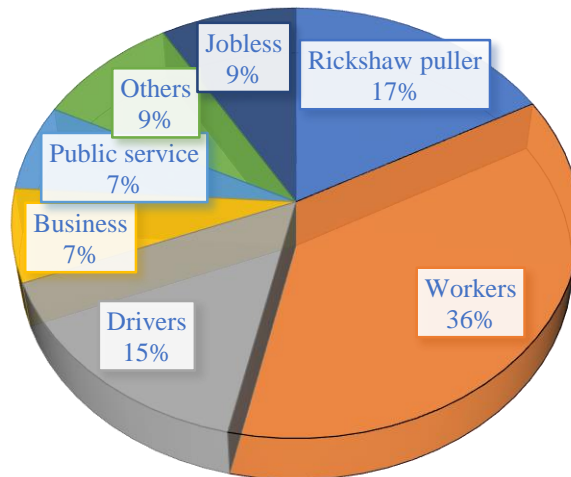
Figure 4.2 Distribution (%) of the occupation of father

4.1.5 Source of drinking water

Among the children, 4 use tap water for drinking, 63 boiled water, 79 tube well, 42 WASA, 3 pump, 2 mineral water, 2 filter water and 5 use other sources as their drinking water which is 2.0%, 31.5%, 39.5%, 21.0%. 1.5%, 1.0%, 1.0% and 2.5% respectively.
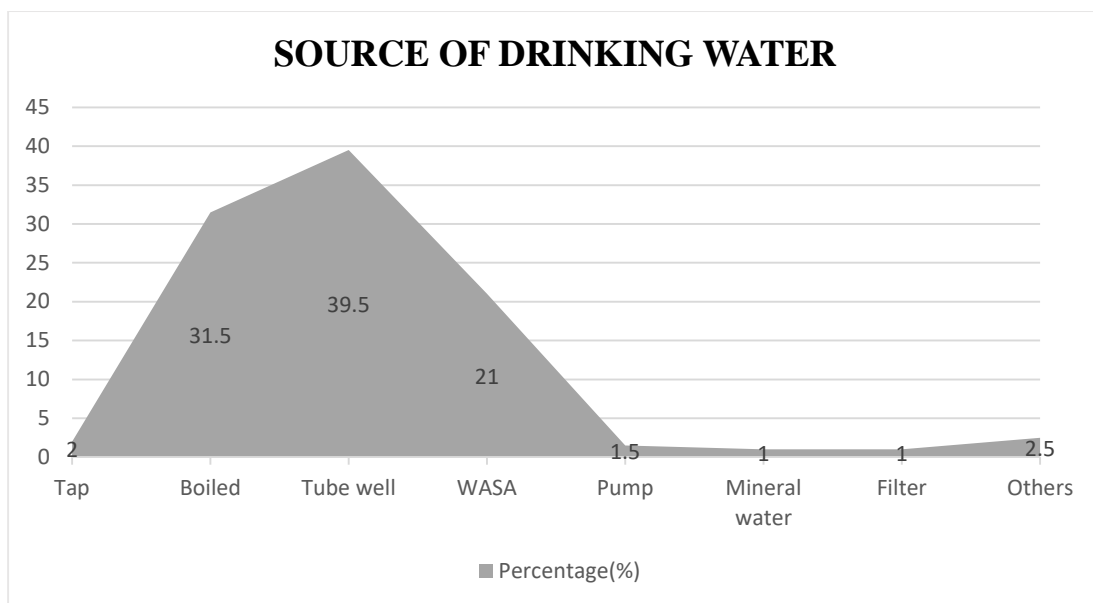
Figure 4.3 Distribution (%) of sources of drinking water

4.2 Nutritional Status of underprivileged children in Chattogram Metropolitan Area

Nutritional status of children are determined by using BMI for age and MUAC according to WHO. According to BMI Z score study, it is found that 19.5% children are severely wasted, 32.5% wasted, 25.5% normal, 17.5% over weight and 5.0% are obese. Based on MUAC measurement the percentage of normal, moderate acute malnourished and severe acute malnourished are 98.0%, 1.5% and 0.5% respectively. These are shown in the figure.
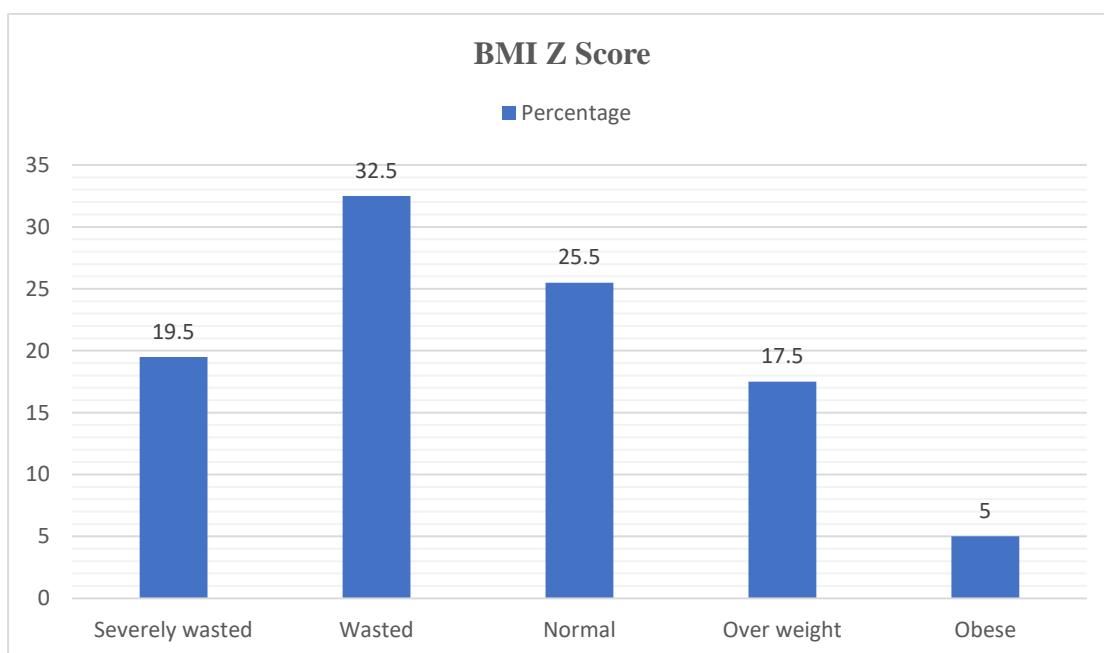
Figure 4.4 BMI Z Score of under privileged Children in CMA

Table 4.2 Nutritional Status of under privileged Children according to MUAC in CMA

MUAC Status		
Variables	**Frequency**	**Percentage**
Normal	196	98.0
MAM	3	1.5
SAM	1	0.5
Total	200	100.0
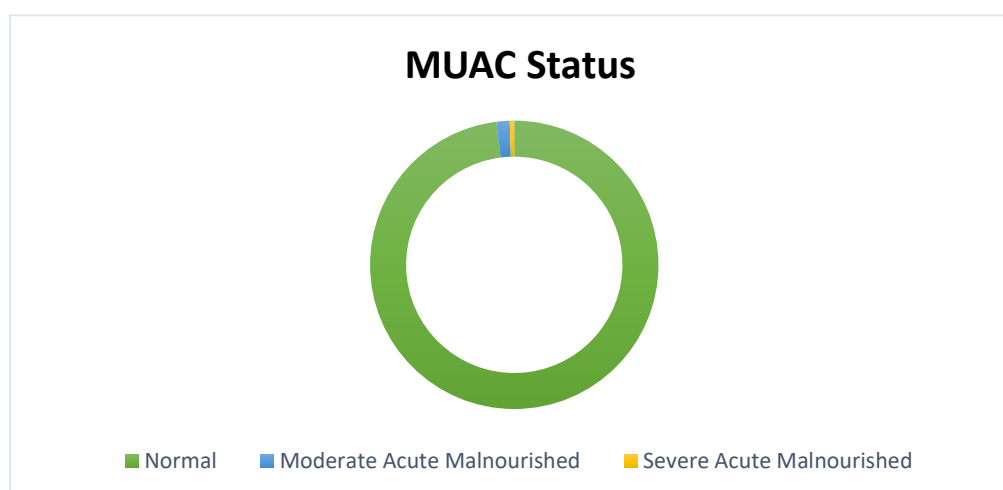
Figure 4.5 MUAC Status of under privileged Children in CMA

4.3 BMI Z Score and Associated factors

4.3.1 BMI Z Score and Demographic factors

Table 4.3 illustrates BMI among various factors and nutritional status of the under privileged Children. No significant association was found the age range, family size, gender, and family member, occupation of father, activity level and source of drinking water. Statistical positive significance was found between the BMI status and Location. In this study, child nutritional status is related to the location of the children. About 15.22% of the children are severely wasted in CRB and 36.96%, 19.57%, 26.09% and 2.17% are wasted, normal, over weighted and obese respectively. From the children of Agrabad , about 14.3%, 22.5%, 42.9%, 12.2% and 8.2% children have severely wasted, wasted, normal BMI, over weight and obesity respectively. According to the study, 26.3% children are severely wasted at Cantonment area and 38.8% are wasted, 13.8% are normal, 17.5% are over weighted and 3.8% children have obesity. Lastly, Sholoshahar area have been found about 16.0% severely wasted children, 20.0% wasted, 44.0% normal, 8.0% over weighted and 12.0% obese among the children.

Table 4.3 Association between BMI Z Score and other variables among the under privileged children of Chittagong metropolitan area.

Variable	Category	BMI Z Score					Total	P-value
		Severe Wasted n (%)	**Wasted n (%)**	**Normal n (%)**	**Over Weight n (%)**	**Obese n (%)**		
Age Range	Less than 5 years	5(14.7)	10(29.4)	11(32.4)	4(11.8)	4(11.8)	34	0.337
	5 to 10 years	21(17.2)	41(33.6)	33(27.1)	21(17.2)	6(4.9)	122	
	More than 10 years	13(29.6)	13(29.6)	8(18.2)	9(20.5)	1(2.3)	44	
Gender	Female	25(19.4)	37(28.7)	35(27.1)	25(19.4)	7(5.4)	129	0.619
	Male	14(19.7)	27(38.0)	17(23.9)	4(5.6)	9(12.7)	71	
Location	CRB	7(15.2)	17(36.9)	9(19.6)	12(26.1)	1(2.2)	46	0.004*
	Agrabad	7(14.3)	11(22.5)	21(42.9)	6(12.2)	4(8.2)	49	
	Cantonment	21(26.3)	31(38.8)	11(13.8)	14(17.5)	3(3.8)	80	
	Sholoshahar	4(16.0)	5(20.0)	11(44.0)	2(8.0)	3(12.0)	25	
Family Member	1 to 5 members	26(17.9)	42(28.9)	40(27.6)	28(19.3)	9(6.2)	145	0.305
	More than 5 members	13(23.6)	22(40.0)	12(21.8)	6(10.9)	2(3.6)	55	
Activity Level	Sedentary	18(24.0)	24(32.0)	15(20.0)	16(21.3)	2(2.7)	75	0.200
	Moderate Active	21(16.6)	40(32.0)	37(29.6)	18(14.4)	9(7.2)	125	
Occupation of father	Rickshaw Puller	11(32.4)	7(20.6)	10(29.4)	4(11.8)	2(5.8)	34	0.164
	Worker	15(20.6)	27(36.9)	14(19.1)	11(15.1)	6(8.2)	73	
	Driver	2(6.5)	9(29.0)	9(29.0)	10(32.3)	1(2.9)	31	
	Business	3(21.4)	2(14.3)	7(50.0)	2(14.3)	0(0.0)	14	
	Jobless	2(11.8)	4(23.5)	5(29.4)	5(29.4)	1(5.9)	17	
	Public Service	2(15.4)	5(38.5)	4(30.8)	1(7.7)	1(7.7)	13	
	Others	4(22.2)	10(55.6)	3(16.7)	1(5.6)	0(0.0)	18	
Source of drinking water	Tap	0(0.0)	2(50.0)	2(50.0)	0(0.0)	0(0.0)	4	0.124
	Boiled	10(15.9)	16(25.4)	23(36.5)	10(15.9)	4(6.4)	63	
	Tube well	17(21.5)	30(37.9)	17(21.5)	14(17.7)	1(1.3)	79	
	WASA	11(26.2)	14(33.3)	7(16.7)	5(11.9)	5(11.9)	42	
	Pump	0(0.0)	0(0.0)	0(0.0)	2(66.7)	1(33.3)	3	
	Mineral Water	1(50.0)	1(0.0)	0(0.0)	0(0.0)	0(0.0)	2	
	Filter Water	0(0.0)	1(20.0)	2(40.0)	2(40.0)	0(0.0)	5	

* Data frequency percentage of each group & $p < 0.1$ was considered statistically significant

4.3.2 BMI Z Score and 24 hours dietary pattern

Table-4.4 illustrates BMI Z Score with 24 hour dietary history. No significant association was found with breakfast, lunch and dinner. Statistically among the children who intake only carbohydrate during breakfast, 17.8% children are severely wasted, 24.4% have normal BMI who intake both carbohydrate and protein, from the children having balanced diet on breakfast 21.7% are normal. Children having carbohydrate, protein and fat during lunch are 15.7% over weighted and 5.2% are obese. About 47.4% children are wasted who intake only carbohydrate, vitamins and minerals without any protein or fat.

Table 4.4 Association between BMI Z Score and 24 hours dietary pattern among the under privileged children of Chittagong metropolitan area.

Variable	Category	BMI Z Score					Total	P-value
		Severe Wasted n(%)	Wasted n(%)	Normal	Over Weight n(%)	Obese n(%)		
Breakfast	Zero Intake	1(16.7)	1(16.7)	2(33.3)	2(33.3)	0(0.0)	6	0.857
	Carbohydrate	18(17.8)	35(34.7)	30(29.7)	15(14.9)	3(2.9)	101	
	Carbohydrate, Protein	8(17.8)	13(28.9)	11(24.4)	8(17.8)	5(11.1)	45	
	Carbohydrate, Fat	0(0.0)	1(100.0)	0(0.0)	0(0.0)	0(0.0)	1	
	Carbohydrate, Protein ,Fat	1(100.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1	
	Carbohydrate, Vitamins, Minerals	6(26.1)	8(34.8)	4(17.4)	3(13.0)	2(8.7)	23	
	Balanced diet	5(21.7)	6(26.0)	5(21.7)	6(26.0)	1(4.4)	23	
Lunch	Zero Intake	3(37.5)	1(12.5)	2(25.0)	1(12.5)	1(12.5)	8	0.293
	Carbohydrate	2(15.4)	7(53.9)	1(7.7)	2(15.4)	1(7.7)	13	
	Carbohydrate, Protein	18(15.7)	36(31.3)	37(32.2)	18(15.7)	6(5.2)	115	
	Carbohydrate, Protein, Fat	11(21.6)	15(29.4)	10(19.6)	13(25.5)	2(3.9)	51	
	Balanced diet	2(15.4)	7(53.9)	1(7.7)	2(15.4)	1(7.7)	13	
Dinner	Zero Intake	3(13.6)	9(40.9)	4(18.2)	5(22.7)	1(4.5)	22	0.901
	Carbohydrate	1(33.3)	1(33.3)	1(33.3)	0(0.0)	0(0.0)	3	
	Carbohydrate, Protein	23(20.2)	30(26.3)	33(28.9)	22(19.3)	6(5.3)	114	
	Carbohydrate, vitamins, Minerals	2(10.5)	9(47.4)	5(26.3)	2(10.5)	1(5.3)	19	
	Balanced diet	10(23.8)	15(35.7)	9(21.4)	5(11.9)	3(7.1)	42	

* Data frequency percentage of each group & p < 0.1 was considered statistically significant

4.3.3 BMI Z Score and weekly dietary pattern

Table 4.5 illustrates BMI Z Score with weekly dietary pattern. No significant association was found with fruits, milk, Meat or fish, egg, vegetables and pulse intake. Statistically among the children who do not take any fruits in a week, 63.6% are wasted and 27.3% are over weighted. Only 10.0% have severe wasted who intake milk twice a day and children having milk once a week are 24.4% severely wasted , from the children having balanced diet on breakfast 21.8% are normal. Although meat or fish, egg and pulse consumption is positively related to the normal BMI status, we have 21.0% severely wasted, 31.9% wasted and 17.4% over weighted children among who intake meat or fish thrice or more a week.

Table 4.5 Association between BMI Z Score and weekly dietary pattern among the under privileged children of Chittagong metropolitan area.

Variable	Category	BMI Status					Total	P-value
		Severe Wasted n(%)	Wasted n(%)	Normal n(%)	Over weight n(%)	Obese n(%)		
Fruits	Zero Intake	1(9.1)	7(63.6)	0(0.0)	3(27.3)	0(0.0)	11	0.122
	Once a week	17(27.9)	18(29.5)	16(26.2)	6(9.8)	4(6.6)	61	
	Twice a week	3(14.3)	8(38.1)	4(19.1)	6(28.6)	0(0.0)	21	
	Thrice or more in a week	18(16.8)	31(28.9)	32(29.9)	19(17.8)	7(6.5)	107	
Milk	Zero Intake	6(17.7)	11(32.4)	8(23.5)	8(23.5)	1(2.9)	34	0.476
	Once a week	10(24.4)	16(39.1)	8(19.5)	4(9.8)	3(7.3)	41	
	Twice a week	2(10.0)	4(20.0)	8(40.0)	6(30.0)	0(0.0)	20	
	Thrice or more in a week	21(20.0)	33(31.4)	28(26.7)	16(15.2)	7(6.7)	105	
Meat	Zero Intake	0(0.0)	0(0.0)	1(100.0)	0(0.0)	0(0.0)	1	0.971
	Once a week	6(19.4)	10(32.3)	9(29.0)	5(16.1)	1(3.2)	31	
	Twice a week	4(13.3)	10(33.3)	9(30.0)	5(16.7)	2(6.7)	30	
	Thrice or more in a week	29(21.0)	44(31.9)	33(23.9)	24(17.2)	8(5.8)	138	
Egg	Zero Intake	4(44.4)	2(22.2)	2(22.2)	1(11.1)	0(0.0)	9	0.734
	Once a week	7(19.4)	14(38.9)	10(27.8)	4(11.1)	1(2.8)	36	

	Twice a week	2(9.5)	8(38.1)	7(33.3)	3(14.3)	1(4.8)	21	
	Thrice or more in a week	26(19.4)	40(29.9)	33(24.6)	26(19.4)	9(6.7)	134	
Vegetables	Zero Intake	1(5.9)	10(58.8)	2(11.8)	4(23.5)	0(0.0)	17	0.363
	Once a week	7(28.0)	8(32.0)	5(20.0)	3(12.0)	2(8.0)	25	
	Twice a week	1(12.5)	1(12.5)	3(37.5)	2(25.0)	1(12.5)	8	
	Thrice or more in a week	30(20.0)	45(30.0)	42(28.0)	25(16.7)	8(5.3)	150	
Pulse	Zero Intake	1(16.7)	3(50.0)	2(33.3)	0(0.0)	0(0.0)	6	0.948
	Once a week	4(22.2)	6(33.3)	4(22.2)	4(22.2)	0(0.0)	18	
	Twice a week	1(10.0)	4(40.0)	3(30.0)	1(10.0)	1(10.0)	10	
	Thrice or more in a week	28(16.9)	51(30.7)	49(29.5)	28(16.9)	10(6.0)	166	

* Data frequency percentage of each group & $p < 0.1$ was considered statistically significant

4.4 MUAC Status and Associated factors
4.4.1 MUAC and Demographic factors

Table 4.6 illustrates BMI among various factors and nutritional status of the under privileged Children. No significant association was found the age range, family size, gender, location, and family member, occupation of father, activity level and source of drinking water. Among the children under five years all are normal in MUAC. Female who are having normal MUAC status are 97.7% and 2.3% are moderate acute malnourished. Accordingly, 98.6% of the male have normal BMI status and 1.4% are severely acute malnourished. From the study 97.5% children located at Sholoshahar are normal and 4.0% from Agrabad are severely acute malnourished. Families having 1 to 5 members 97.2% are normal, 2.1% are moderate acute malnourished and 0.7% are severe acute malnourished. Furthermore, the fathers who are rickshaw puller have 94.1% normal, 2.9% moderate acute malnourished and 2.9% severe acute malnourished children in their families.

Table 4.6 Association between MUAC and other variables among the under privileged children of Chittagong metropolitan area.

Variable	Category	MUAC Status			Total	P-value
		Normal n(%)	MAM n(%)	SAM n(%)		
Age Range	Less than 5 years	34(100.0)	0(0.0)	0(0.0)	34	0.625
	5 to 10 years	118(96.7)	3(2.5)	1(0.8)	122	
	More than 10 years	44(100.0)	0(0.0)	0(0.0)	44	
Gender	Female	126(97.7)	3(2.3)	0(0.0)	129	0.176
	Male	70(98.6)	0(0.0)	1(1.4)	71	
Location	CRB	48(97.9)	1(2.1)	0(0.0)	49	0.190
	Agrabad	24(96.0)	0(0.0)	1(4.0)	25	
	Cantonment	46(100.0)	0(0.0)	0(0.0)	46	
	Sholoshahar	78(97.5)	2(2.5)	0(0.0)	80	
Family Member	1 to 5 members	141(97.2)	3(2.1)	1(0.7)	145	0.461
	More than 5 members	55(100.0)	0(0.0)	0(0.0)	55	
Activity Level	Sedentary	74(98.7)	1(1.3)	0(0.0)	75	0.731
	Moderate Active	122(97.6)	2(1.6)	1(0.8)	125	
Occupation of father	Rickshaw Puller	32(94.1)	1(2.9)	1(2.9)	34	0.739
	Worker	72(98.6)	1(1.4)	0(0.0)	73	
	Driver	31(100.0)	0(0.0)	0(0.0)	31	
	Business	14(100.0)	0(0.0)	0(0.0)	14	
	Jobless	17(100.0)	0(0.0)	0(0.0)	17	
	Public Service	13(100.0)	0(0.0)	0(0.0)	13	
	Others	17(94.4)	1(5.6)	0(0.0)	18	
Source of drinking water	Tap	4(100.0)	0(0.0)	0(0.0)	4	0.405
	Boiled	61(96.8)	1(1.6)	1(1.6)	63	
	Tube well	78(98.7)	1(1.3)	0(0.0)	79	
	WASA	42(100.0)	0(0.0)	0(0.0)	42	
	Pump	3(100.0)	0(0.0)	0(0.0)	3	
	Mineral Water	2(100.0)	0(0.0)	0(0.0)	2	
	Filter Water	2(100.0)	0(0.0)	0(0.0)	2	
	Others	4(80.0)	1(20.0)	0(0.0)	5	

* Data frequency percentage of each group & p < 0.1 was considered statistically significant

4.4.2 MUAC and 24 hours dietary pattern

Table 4.7 illustrates BMI with 24 hour dietary history. No significant association was found with breakfast and dinner. Statistical positive significance was found between the MUAC status and lunch. According to the study, children taking only carbohydrate on lunch are 92.3% normal according to the MUAC range and 7.7% are moderately malnourished. Again, 99.1% are normal and 0.9% are severely acute malnourished from the children who consume both carbohydrate and protein during lunch and all the children taking balanced diet at lunch have normal MUAC status.

Table 4.7 Association between MUAC and 24 hours dietary pattern among the under privileged children of Chittagong metropolitan area.

Variable	Category	MUAC Status			Total	P-value
		Normal n(%)	MAM n(%)	SAM n(%)		
Breakfast	Zero Intake	6(100.0)	0(0.0)	0(0.0)	6	0.999
	Carbohydrate	98(97.0)	2(1.9)	1(1.0)	101	
	Carbohydrate, Protein	44(97.8)	1(2.2)	0(0.0)	45	
	Carbohydrate, Fat	1(100.0)	0(0.0)	0(0.0)	1	
	Carbohydrate, Protein, Fat	1(100.0)	0(0.0)	0(0.0)	1	
	Carbohydrate, Vitamins, Minerals	23(100.0)	0(0.0)	0(0.0)	23	
	Balanced diet	23(100.0)	0(0.0)	0(0.0)	23	
Lunch	Zero Intake	7(87.5)	1(12.5)	0(0.0)	8	0.035*
	Carbohydrate	12(92.3)	1(7.7)	0(0.0)	13	
	Carbohydrate, Protein	114(99.1)	0(0.0)	1(0.9)	115	
	Carbohydrate, Vitamins, Minerals	12(92.3)	1(7.7)	0(0.0)	13	
	Balanced diet	51(100.0)	0(0.0)	0(0.0)	51	
Dinner	Zero Intake	20(90.9)	2(9.1)	0(0.0)	22	0.225
	Carbohydrate	3(100.0)	0(0.0)	0(0.0)	3	
	Carbohydrate, Protein	112(98.2)	1(0.9)	1(0.9)	114	
	Carbohydrate, Vitamins, Minerals	19(100.0)	0(0.0)	0(0.0)	19	
	Balanced diet	42(100.0)	0(0.0)	0(0.0)	42	

* Data frequency percentage of each group & p < 0.1 was considered statistically significant

4.4.3 MUAC and weekly dietary pattern

Table 4.8 illustrates BMI with weekly dietary pattern. No significant association was found with fruits, meat or fish, egg, vegetables and pulses. Statistical positive significance was found between the MUAC status and milk consumption in weekly dietary history. The study shows that about 97.6% children who drink milk once a week

are normal in MUAC status and 2.4% are severely acute malnourished. On the other hand children drinking milk twice a week have 9.0% normal and 10% moderate acute malnourished in MUAC status. And as to the analysis 99.1% children are normal and 0.9% are moderately acute malnourished among the children who drink milk thrice or more within a week.

Table 4.8 Association between MUAC and weekly dietary pattern among the under privileged children of Chittagong metropolitan area.

Variables	Category	MUAC Status			Total	P-value
		Normal n(%)	MAM n(%)	SAM n(%)		
Fruits	Zero Intake	11(100.0)	0(0.0)	0(0.0)	11	0.836
	Once a week	60(98.4)	1(1.6)	0(0.0)	61	
	Twice a week	20(95.2)	1(4.8)	0(0.0)	21	
	Thrice or more in a week	105(98.1)	1(0.9)	1(0.9)	107	
Milk	Zero Intake	34(100.0)	0(0.0)	0(0.0)	34	0.020*
	Once a week	40(97.6)	0(0.0)	1(2.4)	41	
	Twice a week	18(90.0)	2(10.0)	0(0.0)	20	
	Thrice or more in a week	104(99.1)	1(0.9)	0(0.0)	105	
Meat	Zero Intake	1(100.0)	0(0.0)	0(0.0)	1	0.951
	Once a week	31(100.0)	0(0.0)	0(0.0)	31	
	Twice a week	29(96.7)	1(3.3)	0(0.0)	30	
	Thrice or more in a week	135(97.8)	2(1.5)	1(0.7)	138	
Egg	Zero Intake	9(100.0)	0(0.0)	0(0.0)	9	0.969
	Once a week	35(97.2)	1(2.8)	0(0.0)	36	
	Twice a week	21(100.0)	0(0.0)	0(0.0)	21	
	Thrice or more in a week	131(97.7)	2(1.5)	1(0.8)	134	
Vegetables	Zero Intake	17(100.0)	0(0.0)	0(0.0)	17	0.237
	Once a week	24(96.0)	0(0.0)	1(4.0)	25	
	Twice a week	8(100.0)	0(0.0)	0(0.0)	8	
	Thrice or more in a week	147(98.0)	3(2.0)	0(0.0)	150	
Pulse	Zero Intake	6(100.0)	0(0.0)	0(0.0)	6	0.991
	Once a week	18(100.0)	0(0.0)	0(0.0)	18	
	Twice a week	10(100.0)	0(0.0)	0(0.0)	10	
	Thrice or more in a week	162(97.6)	3(1.8)	1(0.6)	166	

* Data frequency percentage of each group & p < 0.1 was considered statistically significant

Chapter-5. Discussion

Information was submitted by 200 respondents from the selected Chattogram metropolitan region. Between 18 May and 4 August 2022, data were collected from the respondents using a planned interview schedule. The coefficient of correlation test was used to look at how closely related the variables were. The key findings of the research are outlined below.

The age range of the respondents who were in their early childhood years was 3 to 16. Children between the ages of 5 and 10 made up the largest age group. The percentages for the age categories under 5, between 5, and 10, and above 10, respectively, are 17.0%, 61.0%, and 22.0%. Each of their years of age received a score of one (Kumar Kuri et al., 2014). There were 64.5 percent women and 35.5% men among the responders. The majority of respondents (40.0%) hailed from the Cantonment region, and the locations of the respondents were CRB (23.0%), Agrabad (24.5%), Sholoshohor (12.5%), and Cantonment (40.0%).

According to this survey, 2.0% of homes use tap water for drinking, 31.5% of households use boiling water, and 39.5% of households use water from tube wells. More than half of the respondents reported drinking water straight from the water supply (55.0%), while 45.0% said they purified the water by boiling it (Rahman et al., 2021). Again, the Bangladesh National Nutrition Council report (2019–2020) claimed that, higher than our research report, 99.0% of Bangladeshi households, 100.0% of Chattogram district families, and 97.0% of Chattogram division families utilize improved drinking water sources. This result comes in below all of the criteria. The availability of water sources and family health education may be to blame for this. This may be addressed by raising awareness and educating the family caregivers about health-related issues.

BMI measurements show that 19.5% of the population is extremely underweight, 32.5% is wasted, 25.5% is normal weight, 17.5% is overweight, and 5.0% is obese. Most of the replies were useless. They were in poor nutritional condition. However, according to the district nutrition profile of the Bangladesh National Nutrition Council (2019–2020), Chattogram district has no incidence of childhood obesity or overweight. According to the NFHS-3 report's findings, 20.0% of children under the age of 5 were wasted, or abnormally short for their height. In India, one out of every five children

under the age of five is wasted. Children under the age of five who were underweight made up about 43.0% of the population. A combination indicator of chronic or acute malnutrition is underweight status (Yadav and Dubey., 2017). Children and adolescents in the study population were overweight or obese at 7.7% and 10.0%, respectively, by Chinese standards. After correcting for age, sex, and location, the study population's standardized prevalence of obesity was 8.05%; in Nigeria, the prevalence of underweight among children under the age of five was 19.4% (Umeokonkwo et al., 2020). According to my research, children that are overweight, wasting, or obese have percentages that are greater than all other parameters—29.4%, 11.8%, and 11.8%, respectively. When compared to other children living in the city, CMA's disadvantaged children under the age of five who are malnourished are more susceptible. Children who are malnourished need greater attention and support from the caregiver as well as correct nutritional practice. This is because irregular feeding practices and uneven living conditions contribute to their malnutrition.

According to BMI, 33.6% of children aged 5 to 10 were overweight and 17.2% were determined to be underweight. Children older than 10 years old who were overweight or wasted were determined to be 29.6% of the population. This conclusion is more significant than that of Shrestha, et al. (2020), who discovered a prevalence rate of 31.9% wasting among children aged 6 to 10 in a few Gorkha district, Nepal, earthquake-affected districts. Pernitez-Agan, et al. (2019) and Ahmed, et al. (2018) revealed that the prevalence of overweight among teenage boys and girls in Bangladesh was 10.6% and 5.2%, respectively. In our investigation, we discovered that the rates of wasting and overweight were greater than usual. Regularly consuming too many carbohydrates and leading an erratic lifestyle are the major causes of the rate's rise.

According to this research, 0.5% of the poor children had severe acute malnutrition and 1.5% have moderate acute malnutrition. However, according to the Bangladesh National Nutrition Council report (2019–2020), 58.0% of children in December 2019 and 54.0% in November 2019 had severe acute malnutrition. We found a decreased incidence of severe acute malnutrition from our research. Dietary habits, family wealth, and other demographic characteristics may have an impact on attaining a reduced risk of severe acute malnutrition.

Chapter-6: Conclusions

The researcher came to the following conclusions as a result of the research's results, analysis, and logical interpretation:

The majority of responders were female, and the youngest children were typically between the ages of 5 and 10. Up to five family members make up around 72.5% of families. The father is the primary breadwinner in the majority of the children's lower-income families. Drivers (36.5%) and rickshaw pullers (17.0%) make up the majority of fathers. Despite belonging from a lower-income household, the majority of families get their drinking water via tube wells and boiling water. The majority of youngsters (62.5%) are moderately active because they are often engaged in play. However, a significant portion of kids 32.5% are wasted, with 19.5% of them seriously wasted and 98.0% of them having normal MUAC conditions. Anthropometric measurements and related parameters show that malnutrition, which has a significant prevalence among disadvantaged children and practically doubles with age and poor socioeconomic status. To restore linear development, normalize weight, improve health, and improve quality of life, it is important to pay attention to the nutritional state of poor children and youth. One of the most important factors in their care must be the golden rule of resisting and avoiding the potential and actual negative consequences of malnutrition by offering an optimum diet. According to the study's findings, the Chattogram metropolitan region in Bangladesh has quiet rooms that may improve the nutritional quality of disadvantaged children. A cooperative effort by the government and other organizations is required in an equitable way to enhance the nutritional condition of impoverished children in order to lessen the burden of malnutrition among such youngsters.

Chapter 7: Recommendation

Conclusive evaluations of food supplementation programs in developing countries are generally unavailable. Most such programs have been implemented without attention to the requirements that must be met in order to derive a robust conclusion from program evaluation. Given the findings and recommendations of the research, the following proposals might be made:

- Children and youths should be motivated to eat more regularly and not skip meals in order to fulfill their metabolic and dietary needs and promote a positive weight gain. They have to be urged to consume a wide range of fruits, green leafy vegetables, pulses and legumes, meat, fish, poultry, milk, and their byproducts, which are foods rich in nutrients and high in energy.

- The duration of their media contracts and training exposure should be increased in order to promote child nutrition. The government cannot do it all by itself to satisfy its commitments. NGOs and other organizations may provide support to the government. Governmental organizations like the Ministry of Health and other Non-Governmental Organizations may take the appropriate initiative to provide motivational videos, information about nourishing food, hygiene practices, food intake patterns, and periodic campaigns on food safety issues in order to assist children in improving their nutritional knowledge and nutritional status.

- Government and non-government institutions may implement the necessary measures to develop various household income-generating activities so that the women participate in them to raise the yearly family income.

- The nutritional condition of children was shown to be highly correlated with their age, household income, and food consumption, 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 is, in general, more or less, but there are usually constraints in terms of scheduling, finances, and personnel, as well as a variety of other issues pertaining to the nature, scope, and objectives of the research. There were limitations on how this research could be carried out right now. The shortcomings of this research are as follows.

- The underprivileged children from CMA shared details from their memories during the interviews.
- The research was conducted just for particular community in the Cattogram metropolitan region.
- Only a couple of the many and ever-evolving characteristics of children were selected for the research.
- For information regarding the study, the investigation is based on the data provided by the respondents selected at random during conversations with them.

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:

- The metropolitan region of Chattogram in Bangladesh served as the study's location. It will contribute to the development of a comparative picture of the nutritional state of all the nation's underprivileged children, which will be useful for the formulation of effective policies.
- The goal of the research was to determine how several child features related to the target variable—nutritional status—and their BMI. Therefore, it can be advised that more research be done using other independent and dependent variables.
- Nine characteristics—age, gender, location, MUAC, family members, activity level, father's occupation, food consumption and source of drinking water—showed significant connections with their BMI toward nutritional understanding 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 Questionnaires

Assalamuwalikum, I'm a student at Chattogram Veterinary and Animal Sciences University and am known by the name of Md. Borhan Uddin. On "Dietary Pattern and Nutritional Status of Underprivileged Children in Different Parts of Chattogram Metropolitan Area, Bangladesh," I am undertaking a qualitative study. The goals of this research are to ascertain the nutritional condition of disadvantaged children in Bangladesh's Chattogram Metropolitan Area and the variables that influence nutritional status. A 15 to 20 minute interview will be required of you in order to participate in the research. Participants in this trial run little to no risk. In order to protect anonymity, I will try to avoid using your real name in the research itself. You are free to leave the study whenever you like.

You acknowledge that you have read, understood, and are interested in taking part in this research by signing below.

Date-   Signature/Thumb

Nutritional Survey

Location of the Survey to take place?
◯ Sholosahar ◯ Agrabad ◯ Cantonment ◯ CRB

Name of the Child?
~

Age of the child?
~

Gender?
◯ Male ◯ Female

Address?
~

Number of members in the family?
~

Occupation of father?
~

Occupation of mother?
~

Any form of physical or mental disability?

◯ Yes   ◯ No

Height?

~

Weight?

~

Nutritional Status:

Anthropometric Measurements	Value/Result
BMI	
MUAC	
Head Circumference	
Chest Circumference	
Waist Circumference	
Hip Circumference	
Body Fat	
Weight for age (underweight)	
Height for age (stunting)	
Weight for Height (wasting)	

Any sign of PEM?
◯ YES   ◯ NO
If present, then which kind?
◯ Marasmus ◯ Kwashiorkor ◯ Marasmic-Kwashiorkor
Any sign of obesity present?
◯ YES   ◯ NO

24-hour recall data:

Meal	Description	Amount
Breakfast		
Lunch		
Dinner		
Snacks		

Weekly Dietary habit:

Food Items	More than twice a day	Twice a day	Once a day	Once a week	Once a fortnight	Once a month
Fruits (1 svg)						
Milk (240ml)						
Meat/Fish (30 gm)						
Egg (1 whole)						
Vegetables (1 svg)						
Pulse & Legumes (1 svg)						

What type of fruit is consumed?

◯ Citrus fruit   ◯ Sweet fruit

Source of drinking water?

~

Level of activity?

◯ Sedentary ◯ Moderately active ◯ Extremely Active

Amount of Kcal consumed?

~

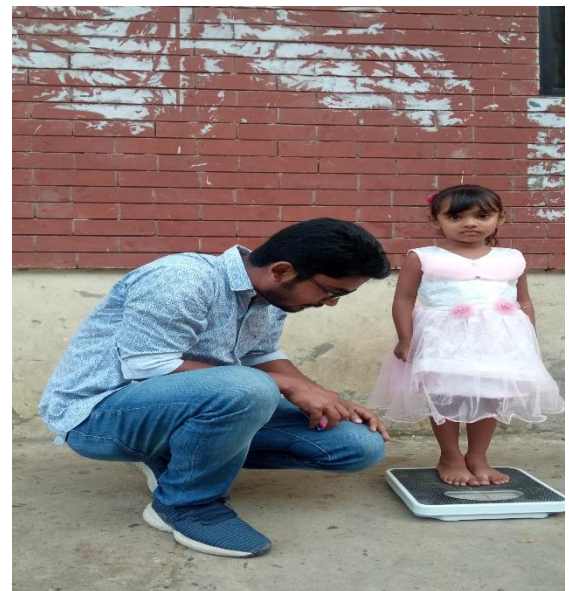Total energy requirement?

~

Preferred Weight range?

~

Preferred Height Range?

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COMMENT:

APPENDIX B: Photo Gallery

Figure: Weight Measurement

Figure: Height Measurement

Figure: MUAC Measurement

Brief Biography

Md. Borhan Uddin passed the Secondary School Certificate Examination in 2011 from Barkal S Z High School, Chandanaish, Chattogram Bangladesh and also Higher Secondary Certificate Examination in 2013 from Govt. City College, Chattogram, Bangladesh. He obtained his B.Sc. (Honors) degree in Food Science and Technology from the Faculty of Food Science and Technology at Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh. Now, he is a candidate for the degree of Master of Science in Applied Human Nutrition and Dietetics under the Department of Applied Food Science and Nutrition, Chattogram Veterinary and Animal Sciences University (CVASU). He has an immense interest to work in improving the health status of people through proper guidance and suggestions and to create awareness among people about food safety and nutrition.