

**NUTRITIONAL STATUS OF ADOLESCENT BOYS
AND GIRLS IN COASTAL AREA (COX'S BAZAR)
OF BANGLADESH**



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Roll No.: 0119/23

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**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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Chattogram Veterinary and Animal Sciences University
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JUNE 2022

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June, 2021

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June, 2022

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ABBREVIATIONS

Abbreviation	Meaning
CVASU	Chattogram Veterinary and Animal Sciences University
BBS	Bangladesh Bureau of Statistics
BIRTAN	Bangladesh Institute of Research and Training on Applied Nutrition
BMI	Body Mass Index
BRAC	Bangladesh Rural Advancement Committee
DAE	Department of Agricultural Extension
FAO	Food and Agricultural Organization of the United Nations
FFM	Fat Free Mass
FM	Fat Mass
GO's	Government Organizations
IPH	Institute of Public Health
MUAC	Mid-Upper Arm Circumference
NGO	Non-Government Organization
SAT	Subcutaneous Adipose Tissue
SD	Standard Deviation
SPSS	Statistical Package for social Sciences
UNICEF	United Nations Children's Fund
WHO	World Health Organization

ABSTRACT

The study's goals were to identify the contributing elements to the adolescents' nutritional condition and to determine how those factors related to the traits they had chosen. About 250 respondents provided the information needed for this survey. This research was carried out in the coastal area of COX'S BAZAR district. Researcher conducted his own data collection using the respondents' interview schedules from 10 November to 1 February, 2022. Age, MUAC, respondent's education, respondent's mother's education, family income, food intake, and nutritional understanding all exhibited positive significant correlations with their BMI toward nutritional status, according to correlation analysis. The dietary status of the respondent was inversely correlated with the disease information characteristic. The other five factors of the respondents— gender, religion, family size, father's education, and cleanliness practices—had favorable, non-significant associations with their BMI and nutritional status. Children's age, physical activity, transportation, leisure, and involvement in nutrition programs all had adverse, non-significant correlations with their BMI and nutritional status. Because they consumed few calories, the majority of the participants were inactive. About 89.6% respondents were poor active and only 2.4% respondents were active in calorie intake. Majority of the adolescent were suffering from malnutrition. Most of the respondents were underweight about 79.6%, only 20% respondents were normal weight. Majority of the respondent's mother (63.3%) had primary level of education and 55% of the respondent's father had primary level of education.

According to a multiple linear regression analysis, teenage nutritional status positively correlated with annual family income, food intake, and nutritional awareness. Disease information was substantial and displayed a negative correlation with nutritional status in adolescents. The respondents' parents and their lacked nutritional understanding. Proper intervention programs should be implemented in order to correct the nutritional status nutrient intake and dietary habits of adolescent residing in Cox's Bazar.

Keywords: Adolescent, nutritional status, costal area, BMI, MUAC, hygiene.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Nutrition during adolescence is essential for future longevity (Tamanna et al., 2013). About 20% of the world's population are adolescents that ranges between 10 to 19 years and 23% of Bangladeshi inhabitants. The transition from childhood to adulthood can cause major physiological, psychological and other body changes. Adolescent's health depends on several factors including age, gender, knowledge, families, physical and biological environment, social values and etc. Sex, age and fathers' occupation have substantial effect on nutritional status. Adolescent's nutritional status is significantly impacted by their mothers' literacy and professional position. (Bidu et al., 2016).

Nutritional information and associated factors regarding this larger group may back the achievement of health goal of Bangladesh government. Unfortunately, global adolescent population has been suffering from malnutrition and obesity. These are, in particular, major public health concerns in developing regions, especially in Asia. Almost 1200 million adolescents and 19% of the total population in developing world suffer from malnutrition (Akhter and Sondhiya, 2013). In Bangladesh, specific to gender, 32% of the adolescent girls were underweight (Alam et al., 2010).

With a population of over 150 million and one of the world's densest populations (881/sq km), Bangladesh was one of the poorest nations, with 60 million residents (40%) living below the poverty line. A critical period in their lives is adolescence. Adolescents gain up to 50% of their adult weight at this time, 20% or more of adult height, and 50% of adult bone mass. Maximum calorie and protein requirements are also present, as well as rising demands for other nutrients including iron, calcium, and vitamins. In average, adolescents did not seem to increase their caloric consumption as they got older, according to a US study. 16% of the global population is made up of adolescents, and 85% of them live in poor nations. Adolescents make up about 22% of the population in Bangladesh. Teenagers from Low and Middle Income Countries (LMCs) are more likely to be undernourished, notwithstanding an increase in over nutrition in recent years. The term "individual level double burden of malnutrition" (IDBM) refers to the simultaneous development of two types of malnutrition (Jubayer et al., 2020).

Nutrition plays the crucial role for the advancement of human life. Unfortunately, most of the adolescent boys and girls especially from rural areas in Bangladesh are greatly suffering from chronic malnutrition. Due to rapid growth in adolescent period, they must satisfy the additional nutritional demands. Under nutrition is more prevalent in Bangladesh due to inadequate intake of nutrient rich foods. Factors regarding reproduction also making up girls adolescents more vulnerable than boys (Islam, 2019).

The teenage years are recognized to be one of the most important times for physical growth and development. An individual goes through a variety of distinct changes during this time, in general. Except for the brain and the skull, almost every system and organ of the body experiences growth during adolescence, including the skeleton, muscles, and nearly all other organs. The requirement for energy, protein, and other nutrients rises during adolescence because of the faster pace of growth. It's been established that a protein shortage slows adolescent growth. Teenagers constitute the next generation of any nation, and it is widely acknowledged that they represent a crucial moment in life for societal wellbeing. The dietary needs of adolescents are extremely important and crucial in the majority of poor nations, yet they are also neglected more than other population groups like children and women. Meeting the nutritional needs of adolescents could be a crucial step in ending the cycle of poverty, chronic disease, and intergenerational malnutrition. (Manzoor, 2016).

Bangladesh has seen a significant decline in the prevalence of under nutrition and is likely to meet the MDG for nutrition. The incidence of micronutrient deficiency still remains quite high and is regarded as a serious public health issue despite the fact that numerous efforts have been put in place over the years to address the issue. The study and discussions around the creation of a strategy to address micronutrient deficiencies have provided an opportunity to analyze the achievements and difficulties of current interventions, as well as the current micronutrient status among children and women in the nation (Ahmed et al., 2016).

Chronic malnutrition also lowers physical power and productivity since it is linked to lean body mass. Therefore, it is important to concentrate on the causes of adolescent malnutrition to avoid its negative effects. Previous studies suggested that the nutritional status of adolescents is influenced by a variety of environmental factors, including family, socioeconomic level, and socio demographic characteristics. Age, sex, and the educational level of the mother are specific factors that affect how well-nourished

adolescents are. Additionally, adolescents' nutritional condition was related to their lack of understanding about nutrition and meal skipping (Wolde et al., 2014). Considering the high prevalence of adolescent malnutrition and several setting-specific factors. To reduce variability, the same measurer was used for each anthropometric measurement. Having awareness of the factors that lead to malnutrition in adolescent boys and girls may help to create strategies for improving their nutritional status.

1.2 Research hypothesis

There is a correlation between adolescent traits that have been chosen and their BMI.

Null hypothesis: There is no correlation between the chosen adolescent traits and their BMI score.

1.3 Objectives of the Study

The following particular goals were developed in order to achieve the study's goal:

- To identify variables that affect the nutritional health of adolescents in the study area; and
- To determine the factors influencing the nutritional status and adolescent malnutrition in the research area.

CHAPTER 2

REVIEW OF LITERATURE

This chapter's goal is to review earlier research that has been done in relation to the current subject. The researcher made every effort to find the necessary data by looking up pertinent studies. The researcher made an effort to compile data on the idea of nutrition, nutritional knowledge, and the nutritional state of adolescents.

2.1 Adolescence

Adolescence is the stage of life when growth is finished and people reach sexual maturity. Although adolescence is typically linked with the teenage years, it can start earlier and last longer depending on its physical, psychological, or cultural manifestations. For instance, puberty now frequently starts during preadolescence, especially in females. Cognitive development and physical development can continue until the early twenties, especially in men. According to the World Health Organization (WHO), adolescents are young individuals between the ages of 10 and 19, and adolescence is frequently split into early (10-13 years), middle (14-16 years), and late (17-19 years) adolescence (Sarker et al., 2018). UNICEF (2011) divides the second decade of life as below.

- **Early adolescence-** Early adolescence is defined as 10 to 14 years of age. Physical changes often start at this time, usually with a growth spurt, and continue through the development of the sex organs and secondary sexual traits. The person whose body is undergoing the transition may experience fear, exhilaration, or pride as a result of these exterior changes, which are frequently very visible. Although less obvious, the internal changes in the person are equally significant. Incredibly rapid electrical and physiological development also occurs in the brain. In a year, brain cells can nearly double, and neural networks undergo a significant reorganization that affects one's abilities on the emotional, physical, and mental levels (UNICEF, 2020).
- **Late adolescence-** The period between 15 and 19 years old is known as late adolescence. The body is still growing, although by this time the major physical changes have often taken place. The capacity for critical and reflective cognition is substantially augmented as the brain continues to develop and restructure itself.

Peer-group opinions still tend to be important at the outset, but their hold diminishes as adolescents gain more clarity and confidence in their own identity and opinions (UNICEF, 2020).

2.2 Changes during Adolescence

2.2.1 Physical changes

Growth in physical size during adolescence is second to the growth that occurs in infancy (Ross et al., 2012). Generally, growth spurt begins at the age of ten or eleven for girls and twelve or thirteen for boys. It lasts for about two and a half years (Pandey, 2018). Adolescence is when more than 20% of a person's entire stature growth and up to 50% of their adult bone mass occurs.

- **Body composition:** Boys' shoulders enlarge and their muscle mass grows during adolescence, but girls' body fat levels rise, their hips become rounder, and their waists become smaller. Boys and girls develop their bodies in different ways and at different rates (Shovalet et al., 2014). Boys reach a maximal height growth velocity at 13.5 years of age, which is higher than that for girls and lasts for a longer period of time. Girls reach their peak height growth velocity at a younger age than boys, i.e. at 11.5 years of age (Ross et al., 2012).
- **Sexual maturity:** The sexual development coincided with the growth spurt. Breast development, pubic and auxiliary hair growth, and menarche all occurred in females. The pubertal changes in boys include voice deepening, expansion of the shoulders, development of pubic and auxiliary hair, and growth of the penis and testicles. By assessing pubertal development based on secondary sex characteristics, testicular and penile growth and the appearance of pubic hair in males; breast development and the appearance of pubic hair in girls, the tanner stage rating, it is possible to assess sexual maturation (Ross et al., 2012).

2.2.2 Psycho social changes

Along with social and economic independence, identity development, and physical and sexual maturation, there are other changes that occur, such as the development of abstract reasoning skills and a trend toward social and economic independence. Since adolescence was a step to adulthood, people work to establish their sense of self. Their eating, clothes, and social behavior alter as a result of the desire to fit in with their peer

group. Stress on the mind, heart, and social relationships results from this. A move towards more independence from parents and their values occurred, and peers played a steadily more important role as role models, friends, advisors, and determiners of interests and values. An erotic predisposition toward people of one or more genders, most frequently expressed as sexual or erotic inclinations, has been classified as sexual orientation (Saewyc, 2011).

2.2.3 Growth and development

For a number of reasons, the adolescent stage was thought to represent a special moment of intervention in the life cycle. After the first year of life, early adolescence is crucial since this is the time when physical development, including fast changes to the body's physiology, endocrine system, and growth, occurs. At this age, the skeleton and around 29% of adult height are still present. Mammals' skeletal growth slows down as they get older, in great part because of a condition known as "programmed growth plate senescence" in early life. With cumulative chondrocyte replication over time, there is a gradual decrease in growth plate senescence (Christian et al., 2018). Proteins enhance growth, development, and maturation during adolescence by maintaining and constructing muscular tissues, as well as repairing tissue damage. According to the behavioral decision-making theory, both adults and adolescents should consider the benefits and drawbacks of a course of action. The reproductive, musculoskeletal, neurodevelopmental, endocrine, metabolic, immunological, and cardio-metabolic systems begin a phase of growth and maturation during puberty that lasts into the third decade. Adolescence can be viewed as a sensitive period because of this, in which the quality of the physical, nutritional, and social settings may alter future health and development trajectories (Patton et al., 2018).

2.3 Factors Affecting Adolescent Nutritional Status

The following are some variables that may have an impact on adolescents' nutritional status.

2.3.1 Dietary adequacy

The nutrition that adolescents consumed during their early years and adolescence had a significant impact on their growth and development. A person's ability to eat properly depends on two variables. The first was adequate access to food in terms of both amount and quality, which is influenced by socioeconomic level, dietary habits, cultural

customs, and food distribution. The capacity to digest, absorb, and use the food constituted the second factor. Most rural household diets in developing nations consist primarily of locally farmed starchy staples, with little to no animal products and only seasonally available fruits and vegetables. Many youths chose fast food and convenience foods because they were affordable, easily accessible, and tasty. They also skipped meals and snacked frequently (Pandey, 2018). Undernutrition is a result of monotonous diets that include just a few meals, especially in children from families who struggle with hunger. Fast foods are those that are produced, served, and consumed outside of the home quickly. In other terms, it refers to meals made with a lower nutritional content (Banik et al., 2020).

Due to the preference for sons in several SEAR nations, girls may receive less nourishment and food of lower quality. Girls' and boys' food consumption was restricted in various regions of India out of concern for their rapid growth. The dietary habits and behaviors of adolescents were influenced by sociocultural factors (Pandey, 2018).

Studies on adolescent diets have revealed that while food consumed at home was related to socioeconomic factors, food consumed outside of the home was more influenced by peer pressure and unrelated to family background or social class groupings (Aljaaly, 2012). The main issue with these foods was that they frequently contained more calories, fat, saturated fat, trans-fat, cholesterol, sugar, and sodium than foods prepared at home while having fewer vitamins A, C, folate, calcium, iron, and zinc. In general, adolescents consumed fewer fruits and vegetables than is advised. Families with a single parent or those with low incomes were more likely to skip breakfast. Breakfast eating was linked to decreased BMI or protection against obesity, according to several research (Ross et al, 2012).

Although poverty was once thought to be the main factor influencing food consumption, several researchers now believe that cultural factors—rather than socioeconomic conditions—play a more significant influence in determining food allocation and nutritional sufficiency. The average daily calorie intake of a family member may be insufficient even in areas with ample food supplies.

2.3.2 Physiological condition and lifestyle

Adolescent boys and girls were shown to be more at risk of malnutrition. In adolescence, growth imposes increased dietary requirements. Extreme weight loss

measures may be used by athletes who must maintain a specific weight for competition, which could harm their performance and health. Adolescent athletes who are concerned about their weight and dieting are more likely to develop eating disorders, and low-energy diets are more likely to be deficient in micronutrients such as calcium, iron, magnesium, zinc, and vitamin B6. With an estimated prevalence of 6.5% to 31.0% among adults and 13.4% to 22.9% among children, Bangladesh, the eighth most populous country in the world, has a high burden of mental health disorders. However, these numbers are likely to be higher for caregivers. Approximately 3.4 per 1000 children are estimated to have CP in Bangladesh and severity is notably higher than international norms; 79.6% of children will have spastic type, 68.2% will be unable to walk, 67.6% will have speech impairments, and 23.7% will have epilepsy (Power et al., 2021).

Studies have revealed that during adolescence, physical activity levels tend to decline dramatically. The average American college student, according to studies, does not meet the American College of Sports Medicine's current recommendations for physical activity, which call for doing vigorous cardio-respiratory endurance exercises at least three times per week, doing flexibility exercises at least three times per week, and doing strength- or endurance exercises at least twice per week. Regular physical activity has been demonstrated to lower the risk of coronary heart disease, stroke, diabetes, high blood pressure, colon cancer, breast cancer, and depression. Additionally, since energy expenditure was a major driver of weight management and energy balance, physical exercise was essential. Contrarily, adolescent livelihoods in low-income nations may involve strenuous physical labor, which directly affected their energy needs and weight status. Adolescent physical activity levels predicted later adiposity, and declines in physical activity during the adolescence were linked to rises in body mass index. Physical inactivity has been linked to risk factors for cardiovascular disease in adolescence, such as obesity, hypertension, elevated blood lipids, and cholesterol (Aljaaly, 2012).

2.3.3 Psychosocial factors

Although parents might still serve as good examples, adolescents were typically greatly impacted by their classmates, their own dietary choices, and their own evolving understanding of which foods form a healthy and appropriate diet (Pandey, 2018). The cognitive, physical, social, and lifestyle aspects that affect adolescent eating behaviors

all play a role. In adolescence, issues related to body image and weight management were very important and popular. Serious body image issues can lead to psychological distress and food disorders, which can have negative effects on health (Aljaaly, 2012). Adolescent lifestyle, eating habits, and attitudes may change significantly as a result of the search for identity, the fight for independence and acceptance, and the obsession with beauty. Body image issues and nutritional risk during adolescence, particularly among girls and boys, were significantly influenced by these issues.

2.3.4 Food security

For adequate nutrition, one must have access to food. Food availability, food stability, and food access are the three fundamental elements of food security, while food usage can also be included. Achieving adequate food supplies through domestic production and food imports is known as national food security. For many developing nations, including Bangladesh, achieving food security is the top development objective (Roy et al., 2019). The absence of food, low purchasing capacity, improper distribution, or insufficient usage of food at the home level are all potential causes of food insecurity. The ability of the family to generate and obtain food is a key component of household food security. Additionally, the manner in which food is produced and distributed within the household is given significant consideration. All of those elements have an immediate impact on household nutrition. A proxy indicator of food security was the food consumption score. The food consumption score (FCS), created by WFP, and was used to calculate how frequently food items were consumed. The cut-offs for the 10 FCS indicator, which has been used across regions and livelihood groups, are uniform and well-defined. It was based on a composite score that took into account food frequency, dietary variety, and the relative nutritional value of various food groups. The respondent was questioned regarding how frequently they had consumed various foods throughout a recall period of the previous seven days (Headey, 2012).

2.3.5 Health, water and sanitation

Environment and knowledge were just two of the many variables that influenced practices that support and preserve population health. These practices include access to health services, management of communicable diseases, and getting medical attention from certified professionals when ill. The inability to engage in worthwhile activities that advance society and increased treatment costs at the expense of food items are

typically linked to people's bad health. Nutritional vulnerability and susceptibility to food insecurity are both exacerbated by poor health. The health and nutritional status of teenagers have only slightly improved globally over the past 50 years, and there is little information on the socio-demographic and economic factors that influence their nutritional status in low- and middle-income nations (Leroy et al., 2018).

In metropolitan regions with often packed populations, sanitation was particularly crucial. Disease outbreaks are caused by poor sanitation, which also affects how food is used and consumed. Another crucial indication of food security is water accessibility. Having access to water that is both of sufficient quality and quantity is crucial for nutritional security. For tasks like cooking, washing clothing, and drinking, households need water. The quantity and quality of this water must be adequate and safe for ingestion. Young children who are exposed to inadequate water and sanitation develop diarrhea, which is particularly prevalent in individuals who live in low-income or middle-income nations. A new meta-analysis of the impacts of integrated water, sanitation, and handwashing interventions on anthropometry found little effects on underweight or wasting in children under the age of five and modest improvements in linear growth. Results of observational research have linked diarrhea or other infectious disorders to poor cognitive results (Tofail et al., 2018).

2.3.6 Socio economic condition

The state of the country's politics and economy directly affects the availability of food, the accessibility of healthcare services, and the general development of the nation. Population characteristics, literacy rates, the allocation and use of the natural resources that are available, market circumstances, and the modernization of the agriculture sector are all socioeconomic factors that are present at the national level. Cultural attitudes on what to eat and own, social institutions like family size, caste or ethnicity, and relationships, livelihood systems (occupations), and household features like the percentage of working adults all have an impact on food security at the subnational or regional level. Malnutrition in adolescents was more likely to be linked to low socioeconomic position (Aseefa et al., 2013).

2.3.7 Educational status

Nutritional knowledge was discussed as a part of health programs in low income countries and alternatives suggested in the planning of health education activities, these

are organized on the central level and executed as a vertical program. All children in Bangladesh are entitled to free and compulsory education, according to Article 17 of the constitution. Children between the ages of six and 10 are required by law to attend school. However, education in Bangladesh is often thought to be of inferior quality. Children who are employed, disabled, native children, children who live in distant locations, and children who are extremely poor all still have difficulty getting access to school, according to UNICEF. Only fifty percent of kids in less affluent neighborhoods attend school. Boys are more likely than girls to leave school early or never attend. Repetition rates are high because students frequently fall short of the curriculum's prerequisite abilities. A youngster often needs more time than five years to finish grades one through five. Periodic school closings further cut down on lesson time. Dark and claustrophobic classrooms continue to hinder learning in many institutions. (UNICEF, 2017).

2.3.8 Annual family income

Many people reside in rural locations devoid of amenities like market access, appropriate roads, and facilities for health care and education. According to estimates, 35% of people in rural areas are considered to be poor (Kalansooriya et al., 2016). They experience ongoing food insecurity, lack property and other possessions, are frequently illiterate, and may also experience major illnesses or impairments. Another 29% of rural residents are categorized as moderately poor. They may have a little plot of land, some livestock, and generally enough food to eat, but their diets are not nutrient-rich. They run the risk of falling further into poverty as a result of health issues or natural calamities. Particularly when they are the only heads of their households, women are among the poorest of the rural poor. Strong national efforts to reduce poverty obscure variations between urban and rural Bangladesh in welfare trends. Both rural and urban parts of Bangladesh had a decline in the national poverty rate, although urban Bangladesh saw the rate of decline significantly more slowly, mostly due to slower rates of poverty reduction in Dhaka and rising poverty in Chittagong. The level of extreme poverty in metropolitan areas has not decreased. In urban areas, the percentage of people who were living in extreme poverty was 7.7% in 2010 and 7.6% in 2016. Given that Bangladesh continues to urbanize during this time, more people (3.3 million) today live in extreme poverty in Bangladesh's cities than there did in 2010. (3 million).

2.4 Under Nutrition and Obesity or Overweight in Adolescents

Malnutrition refers to nutritional deficiency issues, including under nutrition and deficits in micronutrients, and malnutrition also applies to nutritional surplus problems deemed nutritional deficiencies. Person become obese when energy intake exceeds energy used. Bangladesh is a South Asian developing country with a large population that is undergoing fast demographic and economic change. In 2050, there will be 218 million people, up from 165 million in 2017. An examination of the prevalence survey data from the Bangladesh Health and Demographic Survey conducted in 2014 revealed that 33% of the country's children were underweight. However, a recent epidemiological survey conducted across the country found that 3.5% of children (6–15 years) were fat, 9.5% were overweight, and 17.6% were underweight. These analyses emphasize the possibility that obesity and overweight in Bangladesh would soon pose a serious threat to the country's public health (Banik and Rahman, 2018).

Increased consumption of nutrient-poor, high-sugar, and saturated-fat meals is linked to obesity and overweight, as does a decline in physical activity. Bangladesh has one of the highest rates of malnutrition in the world, with 6 million children thought to be chronically underweight. Children in Bangladesh are malnourished to a degree of about 36%. Due to factors like rapid urbanization, a constant decline in the number of playgrounds, rising purchasing power, and easy access to new technologies like hand-held computer toys, physical activity has been declining and sedentary activities increasing in recent years. This has contributed to an emerging overweight and obesity problem among young children in urban settings, especially among wealthy families in Dhaka. (Rahman and Islam, 2014).

2.5 Consequences of Under Nutrition or Over Nutrition among Adolescent

Chronic under nutrition in adolescents slows down normal development and has many negative health effects. This is a serious and pervasive issue. Because they may not have fully developed, underweight pregnant teenagers are more likely to experience obstructed labor and other obstetric problems. Children's obesity and overweight rates are rising quickly across the globe. Over 1 billion overweight adults lived in the world, at least 300 million of them were obese. In several emerging nations where the prevalence was previously quite low, obesity is becoming more common. With both under nutrition and over nutrition present in big centers, the nation is currently suffering

from a double burden of malnutrition. Children who are overweight or obese are more likely to grow up to be overweight or obese adults, and overweight adults are more likely to die young or suffer from chronic diseases linked to obesity, which are already a strain on Bangladesh's already-struggling healthcare system. Childhood overweight and obesity is a particular public health concern for Bangladesh (Mirelmanet al., 2012).

2.6 Prevalence of Malnutrition and Associated Factor in Adolescents

Adolescent malnutrition has been a particularly serious issue in South East Asia. Stunting was seen in 32% of adolescents in India, 47% in Nepal, and 36% in Bangladesh. 36% in Nepal, 53% in Bangladesh, and 53% in India have low body mass indices (BMI). In Bangladesh, rural adolescent girls consume an average of 81% of the RDA for their age in terms of energy. There is, however, a dearth of published information about the dietary habits, anthropometric measurements, and energy intake of teenage Bangladeshi girls from low-income families in both urban and rural areas. According to the BMI category, 66% of adolescent girls in rural and urban areas were underweight, 0.9% were overweight, and just 0.2% were obese (Hossen et al., 2016). Healthy behaviors and health-consciousness among female adolescents can be very important for preserving current and future family nutrition and health (Alam et al., 2010).

2.7 Meal Skipping Habits of Adolescent

Adolescents typically skip meals in an effort to slim down but do not think about eating healthily. In a cross-sectional research conducted at a Nigerian school, the predominant eating behaviors were meal skipping, consuming fast food and soft drinks, and eating little fruit and vegetables. Adolescents' understanding of health and nutrition and their healthy behaviors will be essential for preserving future family health and nutrition (Alam et al., 2010). Two-thirds of the adolescents were aware of the necessity of consuming additional nutrients during adolescence in order to develop. The burden of illness is one factor that contributes to adolescents' undernutrition in poor nations (Alam et al., 2010).

2.8 Physical Activity and Lifestyle

In Bangladesh, 2989 adolescents between the ages of 13 and 17 participated in a recent WHO study that was the first to evaluate adherence to recommended PA recommendations. The survey found that 58% of boys and 60% of girls were not engaging in enough physical activity. Therefore, the purpose of this study was to investigate the trends and correlates of PA in Bangladeshi adolescent populations. This finding is particularly significant given that physical inactivity is one of the main NCD-related avoidable risk factors in Bangladesh (Khan et al., 2017).

Although four out of every five school-aged adolescents do not reach the World Health Organization's recommendation of 60 minutes per day of moderate-to-vigorous PA, this represents a considerable fraction of the population (Fan et al., 2021). A national strategy for adolescent health was created by the government of Bangladesh to prioritize initiatives aimed at enhancing adolescent health from 2017 to 2030. There is a lack of data on the prevalence of mental health issues among adolescents in Bangladesh, as noted by the policymakers and program managers in Bangladesh throughout the formulation of this plan. They also emphasized how difficult it was to create effective treatments to enhance adolescents' mental health due to a lack of knowledge. According to UN Population Fund projections, Bangladesh's share of adolescents would keep rising. Therefore, achieving sustainable development goals in Bangladesh requires focusing on the physical and mental health of adolescents (Mridha et al., 2021).

2.9 Conceptual Framework of the Study

The foregoing review revealed that there was a great need for research work on nutritional status. The concepts of nutritional status of adolescent is a basic requirement for maintaining nutritional food value, hygiene practice, disease information and nutritional knowledge of adolescent. The conceptual framework, which directs the investigation, is the researcher's own hypothesis regarding the issue. It can be an adaptation of a model used in a prior research that has been modified to fit the investigation. Through the conceptual framework, the researcher may demonstrate the correlations between the many factors he intends to analyze in addition to indicating the direction of the investigation. However, a conceptual model for the present investigation was offered in Figure 2.1 for a clearer understanding.

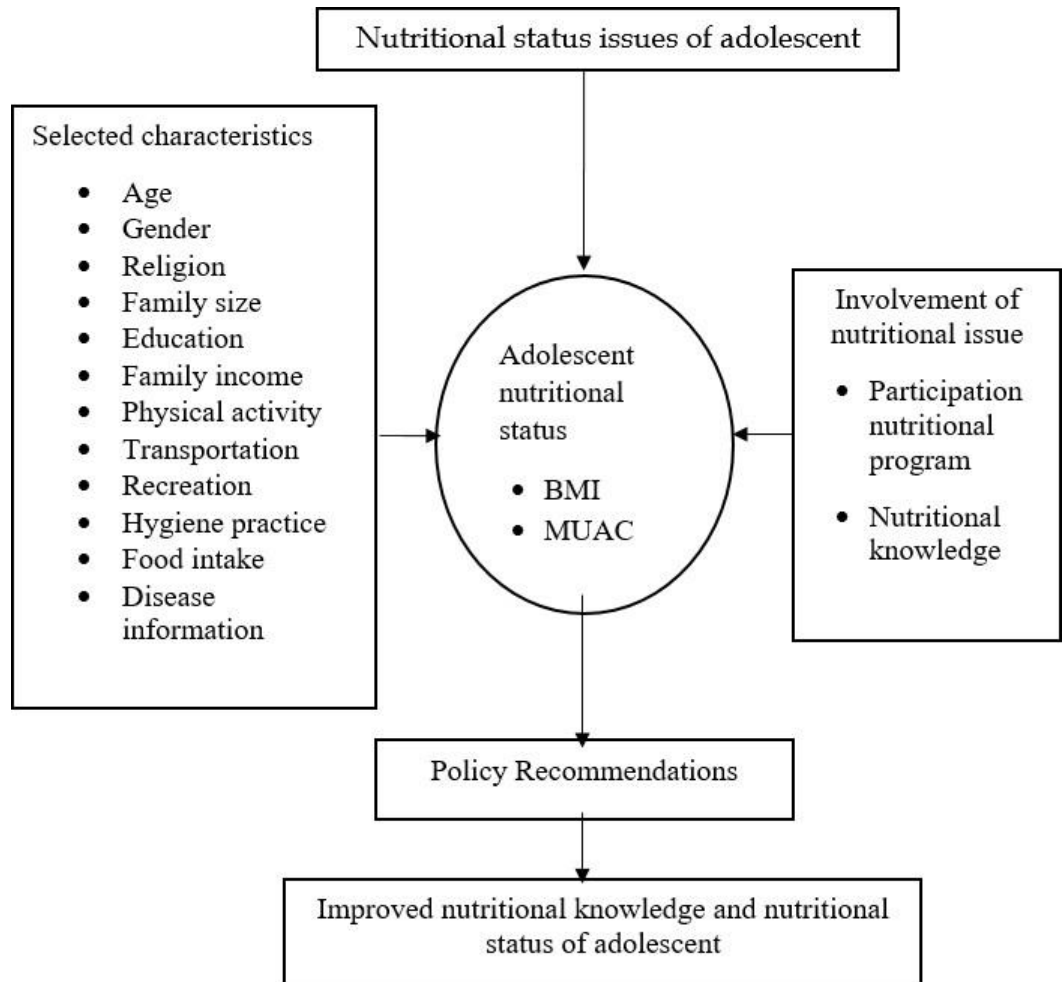


Figure 2.1 Study's Conceptual Framework

CHAPTER 3

METHODOLOGY

Data collection and analysis, which are crucial to any form of study, are done using methodology. It is a necessary and crucial component of carrying out any scientific inquiry or research. This is why the study should be done with great attention and sincerity. By assessing the facts to make the best conclusion, the researcher can acquire genuine and trustworthy data with the aid of an appropriate approach. These chapters describe the methodological approach and study design, including the study area, sampling strategy, data collection techniques, methodologies for different variables, research instruments, and data processing techniques.

3.1 Research Design of the Study

Dramatic physical, cognitive, and social changes occur between the ages of 10 and 14 years, which have been referred to here as early adolescence. Over the course of these five years, a teen's body changes, evolving from a prepubescent kid with infantile characteristics to a person with an adult aspect (Blum et al., 2014).

The study is designed with 250 early adolescent selected for the investigation to provide the most objective, accurate, and cost-effective answers to the research questions. It creates a framework for evaluating the relationships between variables and aids in steering the study in the right direction. Mixed method studies which combine the qualitative and quantitative approaches were used in this research for more robust result than using a single approach and it contributes to the validity of the results through cross checking. The broad approach taken to conduct research is referred to as the research design. That describes a clear and logical strategy for answering well-established research questions by gathering, interpreting, analyzing, and presenting data.

A structure developed to identify solutions to research issues is known as a research design. A mixed methodological framework for the study has been developed, which was diagrammatically shown in the Figure 3.1

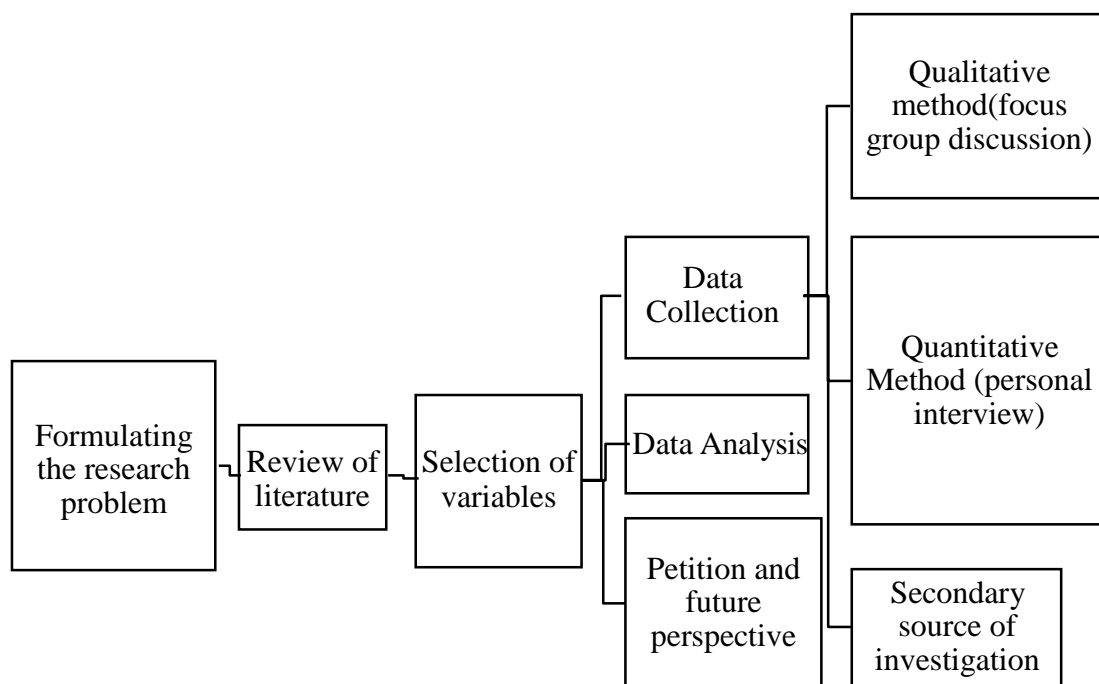


Figure 3.1 Mixed method research design of the study

3.2 Variables of the Study

All of the variables are presented in the interview schedule Appendix-A.

- Educational level was measured on the basis of adolescent years of schooling in educational institutions which was determined by his/her response. A score of one was given for each year of schooling.
- A household's total financial earnings from both agricultural (crops, cattle, poultry, and fish) and non-agricultural sources were referred to as income (service, business, labor, remittance). It was expressed in 1000 taka (Khalak, 2016) and (Shovo, 2017).
- A measuring tape was used to measure height in meter on a wall. The adolescents were measured against the wall without wearing footwear and the wood scale was brought down to the top of their heads, and their heads were positioned such that their eyes were straight forward and their line of vision was parallel to the body. The height was measured to the closest 0.1 cm. To avoid variation, the same measurer was employed for each anthropometric measurement (Wolde et al., 2014).
- MUAC was calculated by placing a marker halfway between the lateral and medial surfaces of the arm, between the acromion (shoulder), the olecranon (elbow), and the vertical axis of the upper arm. MUAC was assessed according to age.

- 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. (Sirardet al., 2010). This variable was determined on the basis of time per day.
- Respondent participation in the nutrition program was BIRTAN, IPH, UNICEF, save the children, FAO, BRAC. This variable was determined on the basis of participation.
- 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 (Ruelet al., 2010). Respondent intake food was converted into calorie. This variable was determined on the basis of calorie.
- Respondent answered nutritional related question. Nutrition education was a combination of arts and science not only contributes nutritional information but also it help to understand people to maintain their good health, good sanitary practices, introduction of better food hygiene, more efficient use of food resources etc. Nutrition education is an effective gauge to improve healthy dietary habits and food choices (Sachithananthan et al., 2012).

Table 3.1 List of study variables

Characteristics	Variable Type
1. Age 2. Gender 3. Religion 4. Family size	Socio Demographic
5. Respondent's, Mother's education, father's education 6. Family income	Socio Economic
7. Height, 8. Weight, 9. MUAC, 10. BMI	Anthropometric measurements
11. Nutritional knowledge 12. Physical activity. 13. Participation in nutrition program 14. Hygiene practice 15. Food intake 16. Disease information.	Others

3.3 Study Location

Adolescent boys and girls from the local villages in the coastal region of the COX'S BAZAR district participated in a descriptive and cross-sectional research. It is a district in the Chittagong Division in Bangladesh's southern region.

Coastal regions are constantly evolving. Waves, wind, erosion, and fluctuations in the environment constantly influence the nature and character of these zones, which geologists refer to as "the interface between the land and the ocean."

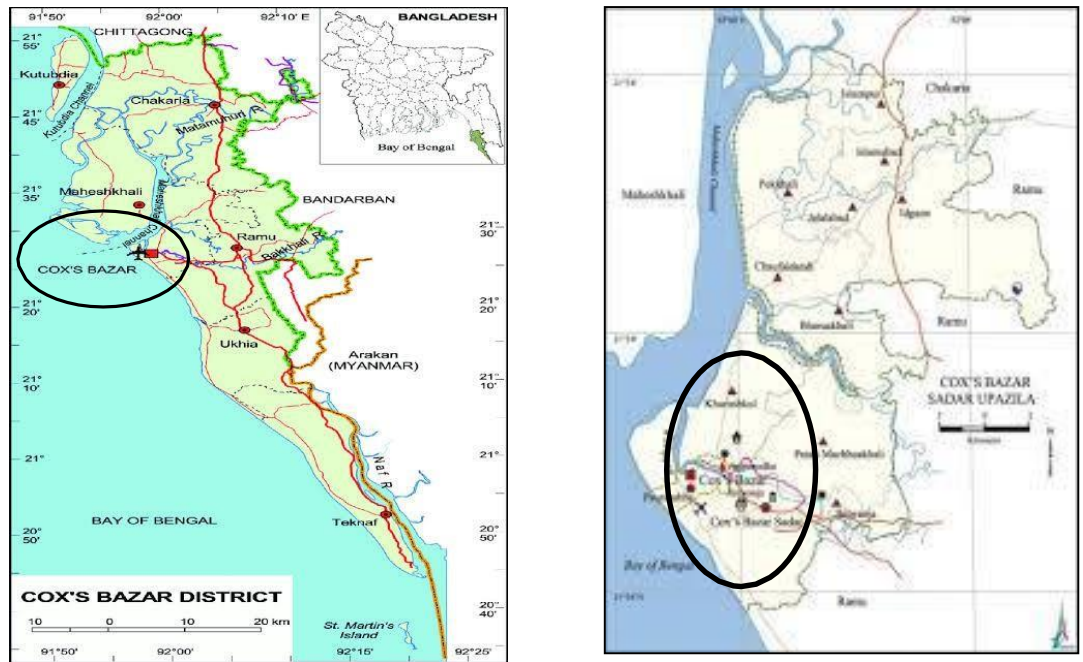


Figure 3.2 Map of study area [COX'S BAZAR District (in left) and COX'S BAZAR sadar (in right)]

3.4 Population and Sample of the Study

Himchari, Kolatoli, Doria Nagar, are the villages under COX'S BAZAR District. About 700 adolescents were lived in 3 villages under these three villages. All adolescent boys and girls in the selected communities were the study population. Two hundred and fifty participants with ages ranging from 10 to 14 were chosen for this research by using Yamane sample size formula. Simple random sampling method used in this study. No boys and girls denied taking part in this investigation.

Sample size, $n = \frac{N}{1+N * e^2}$; Where, N= Population size; e= acceptable sampling error.

3.5 Collection of Data

Following preliminary observations and a review of the literature, a questionnaire was created, the majority of which was taken from earlier, related studies (Abdkhalil et al., 2015), with the author's own modifications. Different people translated the questionnaire into Bangla and back into English to assess its validity before the adolescent of the chosen village took part in a scheduled personal interview. The respondents were each individually interviewed with permission from their separate families or homes. The parents of the respondents were also questioned.

A personal interview was done to collect information on adolescent nutrition knowledge. In several instances, the researcher's initial attempt to meet the respondents at their homes for interviews was unsuccessful. The researcher made numerous visits in some instances in an effort to get in touch with them. The researcher encountered no significant challenges in gathering the data; instead, he received excellent assistance from the respondents in a variety of ways, including information sharing, preparation for interviews, locating the homes of other respondents, etc.

3.6 Data Processing and Statistical Tests

Male and female enumerators performed household interviews with the male and female respondents of each chosen household. Prior to the start of the fieldwork, enumerators received comprehensive training. Information on the survey methodology and sampling have been published elsewhere (Ahmed et al., 2013). 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 adolescent nutritional status and BMI. 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).

All of the responses from the interview schedule were given numerical coded values of the data collection from the respondents in table 3.2.

Table 3.2: List of the parameters in numerical value

Parameters	Segment	Score
Education	Primary	1
	Secondary	2
	Higher secondary	3
	Honors /above	4

Parameters	Segment	Score
Income/year	Poor income (<70000 taka)	1
	Normal income (70000-150000 taka),	2
	Fair income (>150000 taka)	3
BMI	<18.5 Underweight	1
	18.5-24.9 Normal	2
	Overweight 25-29.9	3
	Obesity grade 1 30.0-34.99	4
	Obesity grade 2 35.0-39.995	5
MUAC	SAM: <16 cm	1
	MAM: 16-18 cm	2
	NORMAL: >18 cm	3
Organization Participation	Not Participation	0
	Participation 1 Time	1
	Participation 2 Times	2
	Participation 3 Or More Times	3
Hygiene Practice Frequency	Not yet	0
	Rare	1
	Occasionally	2
	Frequently	3
Food intake	Low active (<1600 calorie)	1
	Moderately active (1601-1900 calorie)	2
	Active (1901-2200 calorie),	3
	Very active (>2200 calorie)	4
No of right question answered	(1-3 question)	1
	(4-6 question)	2
	(7-10 question)	3

CHAPTER 4

RESULTS

4.1 Socio-Demographic and Other Characteristics of Adolescents in Cox's bazar Sadar of COX'S BAZAR District (n=250)

There were various characteristics of adolescents that might influence their nutritional status. In the present study sixteen characteristics of adolescents were selected which included their age, gender, religion, family size, number of child. Table 4.1 provides a summary of the key traits of the respondents' characteristics.

Table 4.1 Selected personal characteristics of adolescents (n=250)

Determinants	Frequency	Percentage (%)	Mean	SD
Age (Years)				
10.00	48	17.5	11.7	1.18
11.00	67	26.8		
12.00	64	25.6		
13.00	57	22.8		
14.00	14	5.6		
Gender				
Male	179	71.6	1.28	0.45
Female	71	28.4		
Religion				
Muslim	111	92.5	1.13	0.34
Hindu	9	7.5		
Family size				
Small (<4)	2	1.7	4.9	0.84
Medium (4-6)	114	95.0		
Large (>6)	4	3.3		
Number of child				
No child	115	46	0.73	0.76
One child	87	34.8		
Two child	48	19.2		

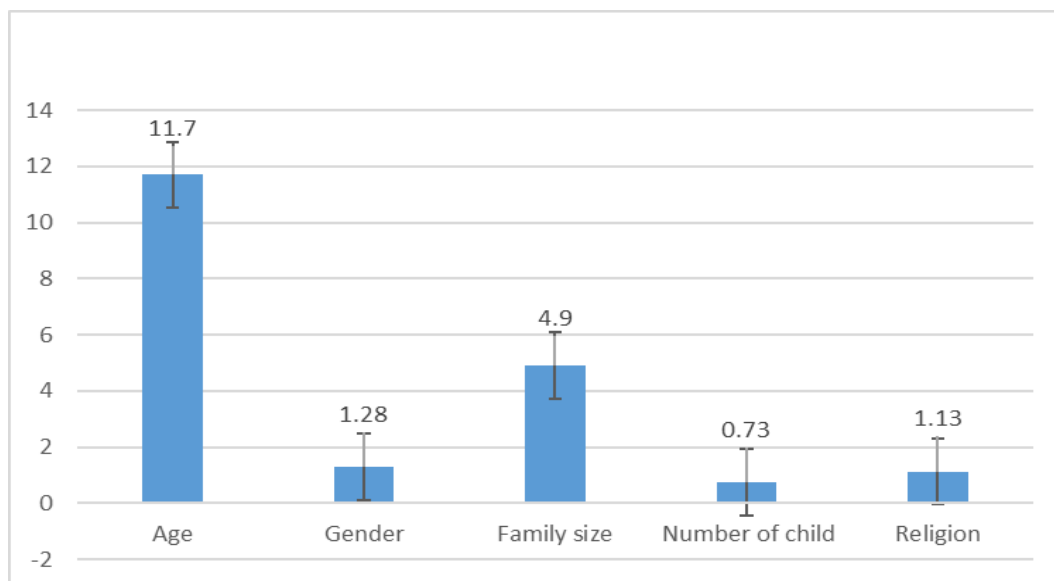


Fig 4.1: Mean & SD graph for personal characteristics of adolescents

4.2 Socio-economic Characteristics of the Adolescents

Socio economic characteristics of the participants represents in Table 4.2. Socio economic characteristics of adolescents were selected which included their annual family income, respondent education, mother's education and father's education. The selected characteristics of adolescent mostly related to nutritional status. Respondent's education and parent's education also influenced of adolescent nutritional knowledge, nutritional information and nutritional status.

Table 4.2 Socio-economic status of adolescents (n=250)

Determinants	Frequency	Percentage	Mean	SD
Annual family income (000'TK)				
Poor(<70)	50	20	99.66	38.43
Normal(70-150)	177	70.8		
Fair(>150)	23	9.2		
Respondent education				
Primary	86	34.4	1.66	0.48
Secondary	164	65.6		
Mothers education				
Illiterate	60	24.0	1.02	0.71
Primary	126	50.4		
Secondary	64	25.6		

Determinants	Frequency	Percentage	Mean	SD
Father's education				
Illiterate	66	26.4	1.06	0.77
Primary	103	41.2		
Secondary	81	32.4		

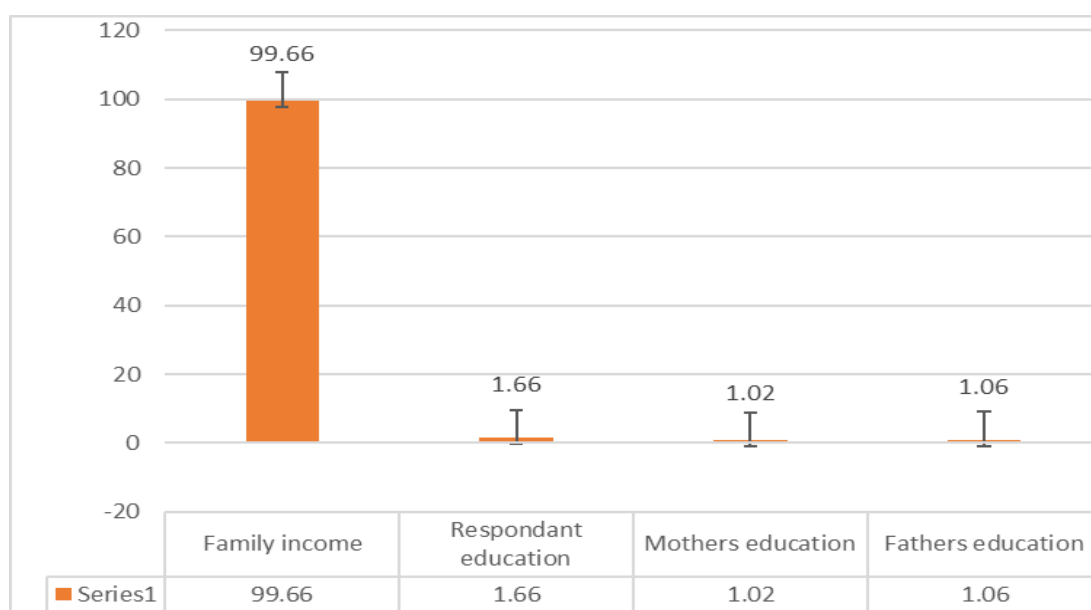


Fig 4.2: Graphical representation on Mean and SD of socio economic traits

4.2.1 Annual Family Income

The respondents' annual household income ranged from 50 to 200 thousand taka. with a mean of 99.66 thousands and a standard deviation of 38.43 thousand.

Majority of the adolescent annual family income (000'tk) was (70-150) thousands. That -was (70.8%). Poor (<70) thousands family income was 20% and fair (>150) thousands family income was only (9.2%). Result revealed that most (70.8%) of the respondents had normal annual family income which had positive relationship with nutritional status.

4.2.2 Respondent Education

The respondent's education level ranged from 10 to 14 years of formal education, with a mean of 11.7 years and a standard deviation of 1.18 years. The respondents were divided into primary (1–5) and secondary (6–10) categories based on their degree of education, which are shown in Table 4.2. According to data, the respondents'

educational levels ranged from primary (34.4%) to secondary (65.6%). Data showed that 65.6% of respondents had a secondary degree.

4.3 Body Mass Index (BMI) Value

BMI ranged from 12.33 to 28.67 for the respondents, with a mean of 16.73 and a standard deviation of 2.24. (Table 4.3). The respondents were divided into five categories based on their BMI values: underweight, normal weight, overweight, obesity grade 1 and obesity grade 2.

Table 4.3: Distribution of respondents based on their BMI

Categories	Frequency	Percentage	Mean	SD
Under weight(<18.49)	199	79.6	16.73	2.24
Normal (18.5-24.99)	50	20.0		
Over weight (25-29.99)	1	0.4		
Obesity grade 1 (30.0-34.99)	0	0		
Obesity grade 2 (35.0-39.99)	0	0		

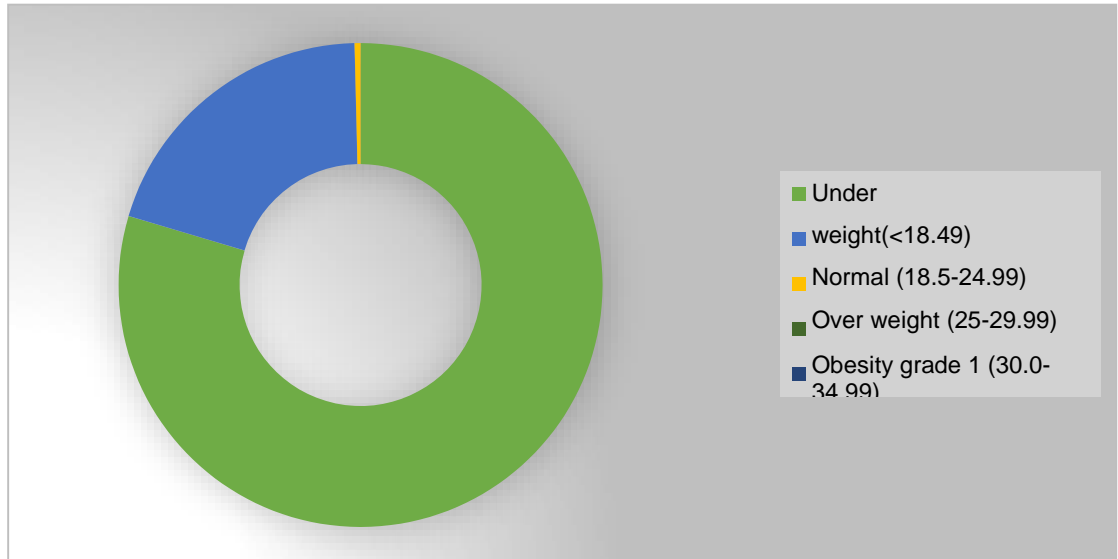


Fig 4.3: Pie chart of Distribution of respondents based on their BMI

Data presented in the Table 4.3 reveals that majority (79.6%) of the respondents was underweight, 20% had normal body weight and 0.4% had overweight. Obesity grade 1 and obesity grade 2 respondents had not found.

4.4 Physical activity

Physical activity was divided into two categories indoor game and outdoor game. Indoor game was included ludo, carom board and chess. Outdoor game was included football, cricket, and badminton. Every respondent attended minimum 1 hour per day and maximum 5 hours per day.

4.5 Nutritional Issue

Adolescent participation in nutritional programs and nutritional knowledge was included nutritional issue.

Table 4.4: Participation in nutrition programs and nutritional knowledge of adolescent

Characteristic	Minimum	Maximum	Mean	SD
Participation in nutrition programs	0.00	1.00	.05	0.22
Nutritional knowledge	2.00	8.00	4.78	1.38

4.5.1 Participation in nutrition programs

Respondent Participated in nutrition program ranged from 0 to 28 against the possible scores ranged from 0 to 1. This distribution is shown in Table 4.4 Data shows that majority of the respondent had not participated in nutrition programs. The mean and standard deviation of data distribution were found 0.05 and 0.22 respectively.

4.5.2 Nutritional knowledge

Respondent answered the nutritional related question score of nutritional knowledge ranged from 0 to 10 against the possible scores ranged from 2 to 8. Majority of the respondent had medium nutritional knowledge that was 64.5%. Poor nutritional knowledge was 30% and high nutritional knowledge was 7.5%. The mean and standard

deviation of data distribution were found 4.78 and 1.38 respectively. Respondent better nutritional knowledge was affected in positive sign to their nutritional status.

4.6 Hygiene Practice and Disease Information of Adolescent

4.6.1 Hygiene practice

Hygiene practice score ranged from 1 to 18 against the possible scores ranged from 15 to 18. Respondent minimum hygiene practice was 15 and maximum hygiene practice was 18. The mean and standard deviation of data distribution were found 16.64 and 1.07 respectively. All respondent were very active in their hygiene practice. Highly hygiene practice of respondent was less infected to diseases.

4.6.2 Disease information

Disease information score ranged from 1 to 24 against the possible score ranged from 1 to 9. Respondent was minimum disease infected 1 and maximum disease infected 9. The mean was 5.17 and standard deviation was 1.52. Disease information was negative impacted on the respondent nutritional status.

Table 4.5: Hygiene practice and disease information of adolescent

Characteristic	Minimum	Maximum	Mean	SD
Hygiene practice	15.00	18	16.64	1.07
Disease information	1.00	9.00	5.17	1.52

4.7 Food Intake Last 24 Hours Recall

Consumption of non-staple food such as egg, meat, fish, dal, milk, biscuit, paratha, bread, puri, ice cream was not frequent in the study area. Respondent intake average biscuit 2.72 %, paratha 1.44%, bread 1.12%, rice 47.04%, egg 2.67%, fish 9.24%, meat 6.96%, dal 14.71%, dry fish 0.91%, milk 10.14%, ice cream 0.93%, cold drinks 1.44%, puri 0.67%. Respondent's intake high Percentage carbohydrate, low Percentage protein and others. A similar result was found by Alamet al., (2010).

Table 4.6: Food intake from different sources

Name of foods	Mean(g/d)	Percentage
Biscuit	27.60	2.72
Paratha	14.60	1.44
Bread	11.40	1.12
Rice	477.00	47.04
Egg	27.12	2.67
Fish	93.72	9.24
Meat	70.60	6.96
Dal	149.20	14.71
Dry fish	9.20	0.91
Milk	102.80	10.14
Ice cream	9.38	0.93
Cold drinks	14.60	1.44
Puri	6.80	0.67

Fig 4.4: Graphical representation of food intake

4.8 Consumption of Calorie

Data shows that highest proportion (89.6%) of the respondent were in low active, moderately active was 7.6%, only active was 2.4% and very active was 0.4%. The mean was 1323.55 calorie and standard deviation was 234.59

Table 4.7: Calorie intake of adolescent

Determinants	Frequency	Percentage	Mean	SD
Low active (<1600 cal)	224	89.6	1323.55	234.59
Moderately active (1601-1900 cal)	19	7.6		
Active (1901-2200 cal)	6	2.4		
Very active (>2200 cal)	1	0.4		

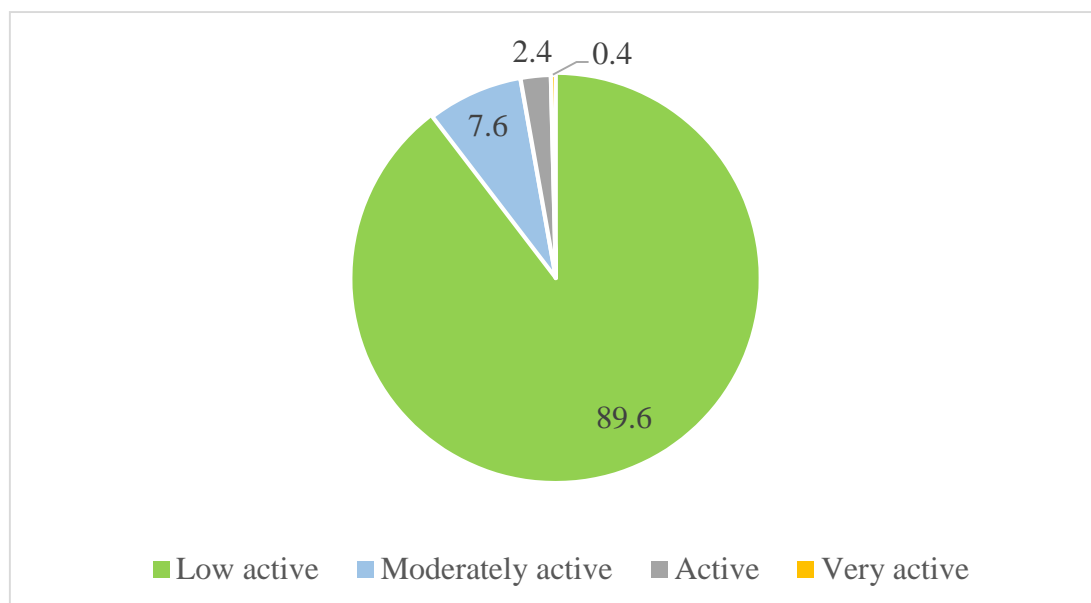


Fig 4.5: Pie chart of Calorie intake of adolescent

Mean calorie was in low active, respondent were not intake proper food item. They were intake low calorie of food that why negative impact on their health or nutritional status.

4.9 Relationship between the selected characteristics of adolescents and BMI

Pearson's product moment coefficient of correlation (r) was compute in order to explore relationship between the selected characteristics of adolescents and BMI (shown in Table 4.8).

Table 4.8: Relationship between the selected characteristics of adolescents**BMI**

Adolescent BMI	Correlation co-efficient (r)	Remarks
Age	0.14*	Moderate Relation
Gender	-0.02	No Relation
Religion	0.09	No Relation
MUAC	0.30**	Strong Relation
Child	0.10	No Relation
Family size	0.06	No Relation
Respondents education	-0.01	No Relation
Mother education	0.09	No Relation
Father's education	0.04	No Relation
Income	0.15*	Moderate Relation
Physical activity	-0.01	No Relation
Participation nutrition program	-0.08	No Relation
Hygiene practice	-0.05	No Relation
Food intake	0.22**	Strong Relation
Disease information	-0.06	No Relation
Nutritional knowledge	0.20*	Moderate Relation

The relationship between the two issues under consideration was tested using the coefficient of correlation (r). Table 4.8 shows the coefficient of correlation (r) between the chosen adolescent traits and adolescent BMI. However, Pearson's product moment coefficient of correlation has also been used to calculate the interrelationships between the various variables (Appendix-B1) & (Appendix-B2).

4.9.1 Adolescent age and adolescent BMI

According to Table 4.8, the correlation between an adolescent's age and BMI level was 0.14*. The relationship between adolescent age and BMI was significant based on the computed (r) value. Hence, the concerned null hypothesis could be rejected. Thus, it

may be concluded that there was significant relationship between adolescent age and their BMI. Again, adolescent age was positively linked with BMI (Appendix-B1) (Appendix-B1).

4.9.2 Adolescent MUAC and adolescent BMI

Table 4.8 shows that in case of overall adolescent, MUAC of adolescent and their BMI was significantly positive (0.30*) which is larger than the Table value at 1% level of probability. Hence the concerned null hypothesis could be rejected. Again, MUAC of adolescent was positively correlated with adolescent BMI (Appendix-B1).

4.9.3 Adolescent family income and adolescent BMI

The correlation coefficient between education of adolescent family income and their BMI level was 0.15* as shown in Table 4.8. Based on the computed (r) value the relationship between adolescent family income and their BMI was significantly positive. Hence, the concerned null hypothesis could be rejected. Thus, it may be concluded that there was significant and positive relationship between adolescent family income and their BMI. Again, adolescent family income was positively correlated with BMI (Appendix-B2). A similar result was found by Alam et al., (2018).

4.9.4 Adolescent physical activity and adolescent BMI

The relationship between adolescent physical activity and their BMI has been shown in Table 4.8, the compute the (r) value was (-0.01). Computed (r) value notified negatively non-significant relationship between adolescent physical activity and their BMI. So, the concerned null hypothesis could be accepted. Thus, it could be said that adolescent physical activity did not show any significant relationship to their BMI. Again it is found that adolescent physical activity was negatively correlated with their BMI (Appendix-B2).

4.9.5 Adolescent participation nutrition program and adolescent BMI

The correlation coefficient between participation nutrition program of adolescent and their BMI level was -0.08 as shown in Table 4.8. Based on the computed (r) value the relationship between adolescent participation nutrition program and their BMI was negatively non-significant. Hence, the concerned null hypothesis could be accepted. Thus, it may be concluded that there was not shown any significant relationship

between adolescent participation nutrition program and their BMI. Again, adolescent participation nutrition program was negatively correlated with BMI (Appendix-B2).

4.9.6 Adolescent hygiene practice and adolescent BMI

The relationship between adolescent hygiene practice and their BMI has been shown in Table 4.8, the compute the (r) value was (-0.05). Computed (r) value notified non-significant relationship between adolescent hygiene practice and their BMI. So, the concerned null hypothesis could be accepted. Thus, it could be said that adolescent hygiene practice did not show any significant relationship to their BMI. Again it is found that adolescent hygiene practice was positive correlated with their BMI (Appendix-B2).A similar result was found by Roy et al.,(2019).

4.9.7 Adolescent food intake and adolescent BMI

The correlation coefficient between adolescent food intake and their BMI level was 0.22* as shown in Table 4.8. Based on the computed (r) value the relationship between adolescent food intake and their BMI was significantly positive. Hence, the concerned null hypothesis could be rejected. Thus, it may be concluded that there was significant and positive relationship between adolescent food intake and their BMI. Again, adolescent food intake was positively correlated with BMI (Appendix-B1

4.9.8 Adolescent nutritional knowledge and adolescent BMI

The correlation coefficient between nutritional knowledge of adolescent and their BMI level was 0.20* as shown in Table 4.8. Based on the computed (r) value the relationship between adolescent nutritional knowledge and their BMI was significantly positive. Hence, the concerned null hypothesis could be rejected. Thus, it may be concluded that there was significant and positive relationship between adolescent nutritional knowledge and their BMI. Again, adolescent nutritional knowledge was positively correlated with BMI (Appendix-B1).

4.10 Linear Multiple Regression Analysis of Nutritional Status of Adolescent

To determine the factors associated with adolescent BMI of nutritional status of adolescent, multiple regression analysis (enter method) was conducted.

Annual family income (X1), Physical activity (X2), Participate nutrition program (X3), Hygiene practice (X4), Food intake (X5), Disease information (X6), Nutritional Knowledge (X7), Education (X8) were considered as independent variables of the regression analysis.

The value of adjusted R^2 values found in the multiple regressions was 0.094, while the corresponding F-value was 3.597 and also significant at 0.05 levels. The findings of multiple regression analysis indicated that the determinant factors of adolescent nutritional status were level of respondent education, mother education, hygiene practice, Annual family income, food intake, nutritional knowledge and disease information. A similar result was found by (Alam et al., 2019).

Multiple linear regression analysis indicated that Participate nutrition program was significant and showed a negative trend with BMI. It implies that BMI decreases with the decreasing of Participate nutrition program. A similar result was found by (Moonajilinet al., 2020).

Table 4.9 Summary of multiple regression analysis.

Explanatory variable	Unstandardized Co-efficient		Standardized Co-efficient	t-value	Sig.
	B	Std. Error	B		
(Constant)	14.456	2.481		5.827	0.000
Annual family income	0.009	0.004	0.149	2.354	0.019*
Physical activity	-0.153	0.180	-0.053	-0.849	0.039*
Participate nutrition program	-1.282	0.644	-0.127	-1.991	0.048*
Hygiene practice	0.142	0.133	0.067	1.063	0.028*
Food intake	0.002	0.001	0.216	3.332	0.001*
Disease information	0.074	0.096	0.050	0.774	0.440
Nutritional Knowledge	0.306	0.105	0.188	2.901	0.004*
Education	0.038	0.181	0.013	0.212	0.832
Adjusted R ² = 0.094		F-value = 3.597			

The findings of the multiple linear regression analysis also indicated that food intake was significant and showed a positive trend with BMI.

It implies that BMI decreases with the decreasing of adolescent food intake.

Multiple linear regression analysis indicated that adolescent nutritional knowledge was significant and showed a negative trend with BMI. It implies that BMI increases with the decreasing of adolescent nutritional knowledge.

4.11 Step-Wise Multiple Regression Analysis

A step-wise multiple regression analysis was applied to identify significant explanatory variables that was effected on nutritional status of adolescent. The results of the step-wise multiple regression analysis was shown in Table 4.10. The variable-wise effect was explained below. The results of the multiple regression analysis shown that among the explanatory variables, two variables such as food intake (X₅) and nutritional knowledge (X₇) had significant influences on nutritional status of adolescent.

Table 4.10 Summary of the step-wise multiple regression analysis

Model	Variables entered	Multiple R	Multiple R²	Variation explained (%)	F value	Significance level
Constant +X ₅	Food intake (X ₅)	0.224	0.05	50	13.128	.000
Constant + X ₅ +X ₇	Nutritional knowledge (X ₇)	0.284	0.081	3.1	8.205	.005

These two variables were finally entered into the model and the contribution of these variables accounted for 53.1% of the total variation in BMI of adolescent. However, between these two variables food intake alone could explain 50% variations in BMI of the adolescent. Nutritional knowledge could explain 3.1% variations in BMI of adolescent.

CHAPTER 5

DISCUSSION

5.1.1 Selected individual characteristics of the respondents

The respondents who were in their early adolescent years ranged in age from 10 to 14. The mean and standard deviation were 11.76 and 1.26 respectively. A score of one was assigned for each year of their age (Kuri, 2013). The respondents were (71.6%) male and (28.4%) female. Religion of the respondent were (92.5%) Muslim and (7.5%) Hindu.

BMI ranged from 12.33 to 28.67 for the respondents, with a mean of 16.73. According to BMI values, (79.6%) of the population was underweight, (20%) was of normal weight, and (0.4%) was overweight. The majority of respondents were underweight. They had a terrible nutritional state. In Bangladesh, up to 31 percent of adolescent girls (15–19 years old) were undernourished (body mass index (BMI) <18.5) (National Institute of Population Research, 2017).

Annual family income of the respondents ranged from (000'TK) 50 to (000' TK) 200. The mean and standard deviation of data distribution were found 99.66 and 38.43 respectively. Poor family income was (20%), normal family income was (70.8%) and fair family income was (9.2%). Majority of the respondent was normal family income. A similar result was found by Islam et al., (2015).

Respondent physical activity ranged from 1 hour to 5 hours. The mean and standard deviation of data distribution were found 3.13 and 0.78 respectively. Majority of the respondent were physically active. All respondent were active in physical activity that was the positive sign to nutritional status (Alam et al., 2021).

Respondent were participated in nutrition program maximum 1 time. The mean and standard deviation of data distribution were found 0.05 and 0.22 respectively. Not

participation (91.7%) and one time participation (8.3%). Majority of the respondent were not participated in nutrition program.

Respondent nutritional knowledge ranged from 2 to 8 right answered nutrition related out of 10 questions. The mean and standard deviation of data distribution were found 4.78 and 1.38 respectively. Majority of the respondent had not good nutritional knowledge.

Respondent disease information score ranged from 1 to 9. The mean and standard deviation of data distribution were found 5.52 and 1.55 respectively. Majority of the respondent were affected in various diseases. A similar result was found by Hakim and Kamruzzaman, (2015).

Non-staple foods including eggs, beef, fish, dal, milk, paratha, bread, puris, and ice cream were not often consumed in the research region. The average respondent's food consumption was puri 0.67%, milk 10.14%, ice cream 0.93%, paratha 1.44%, bread 1.12%, rice 47.04%, egg 2.67%, fish 9.24%, meat 6.96%, dal 14.71%, dried fish 0.91%, and biscuits 2.72%. High percentage of carbohydrates and low percentage of protein were consumed by the respondents. A similar result was found by Alamet al., (2010).

5.1.2 Relationship between the selected characteristics of adolescent and their BMI

Pearson's product moment Coefficient of Correlation (r) was computed in order to explore relationship between the selected characteristics of adolescent and their BMI level. Among characteristics of the respondents, characteristics namely age, MUAC, respondent education, income, food intake, and nutritional knowledge showed positively significant relationships with their BMI. Rest of the characteristics number of child, physical activity, participation in nutrition program were non-significant relationships with their BMI.

5.2 Limitation of the Study

Every study is, in general, more or less, but there are always timing, financial, and staffing constraints, along with a number of additional shortcomings relating to the nature, scope, and goals of the research. There were certain restrictions on how this study was conducted in the present. The following are this study's drawbacks.

- During the interview, the rural adolescents provided information from their memories.

- Only for a chosen community in the area of COX'S BAZAR, the study was carried out.
- Only a few of the numerous and constantly changing features of adolescents were chosen for the study.
- The researcher relied on the information provided by the randomly chosen respondents during interviews with them for information about the study.

CHAPTER 6

CONCLUSION

On the basis of the findings, discussion and logical interpretation, the researcher drew the following conclusions:

Most of the respondents were low active due to low calorie intake. About 89.6% respondents were low active and only 2.4% respondents were active in calorie intake. Again most of the respondent family income was normal but not fair. About 95% respondent family size was medium. Respondent food intake and family income had positive and significant relationship with their BMI and it was calorie correlated with their nutritional status. The findings indicate that most of the respondents were underweight about 79.6%, only 20% respondents were normal weight.

CHAPTER 7

RECOMMENDATIONS

Recommendations for policy implication

These suggestions could be made in light of the study's results and recommendations:

- Adolescents should be advised not to skip meals and to eat more frequently in order to meet their nutritional and energy needs and promote healthier weight gain. They should be encouraged to eat a variety of fruits, green leafy vegetables, pulses and legumes, meat, fish, poultry, milk, and their byproducts, which are foods that are high in nutrients and contain a lot of energy.
- Adolescent nutrition should be improved by increasing their training exposure and media contract length. In order to fulfill its obligations, the government cannot do it all by itself. The government may receive assistance from NGOs and others. In order to help adolescents improve their nutritional knowledge and nutritional status, government 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.
- Government and non-government organizations may take appropriate initiatives to create diversified income generating activities at household level so that the women engage them in such activities to increase their annual family income.
- Age, respondent education, mother education, family income, food intake, disease information and nutritional knowledge were some the personal characteristics of adolescent found to be significantly linked to their nutritional status. In formulating any action plan for the adolescent regarding such activities, at least these variables might be considered on priority basis.

Recommendations for further research

The researcher's limited investigation did not provide all the data necessary for an accurate assessment of the nutritional status of adolescents. Consequently, the following suggestions for future research projects could be made:

- The present study was conducted in three villages namely COX'S BAZAR Sadar under COX'S BAZAR district. It will help to achieve a comparative picture of

adolescent nutritional status of the whole country's coastal area which will be helpful for effective policy making.

- The study was undertaken to explore the relationships of selected characteristics of adolescent with their BMI towards nutritional status as focus variable. Therefore, it could be recommended that further studies should be conducted with other independent and dependent variables.
- In the present study, among characteristics ten of them namely age, height, weight, MUAC, respondent education, mother education, family income, food intake, disease information and nutritional knowledge showed significant relationships with their BMI towards nutritional knowledge. Hence, further studies are necessary to find out nature of the relationship between the other concerned issues to make the present findings valid.
- Research should be undertaken particularly to identify the further problems that adolescent face in managing their nutritional status and to explore their potentialities to overcome the problem.

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APPENDIX A

Chattogram Veterinary and Animal Sciences University Applied Human Nutrition & Dietetics Khulshi, Chattogram

An Interview Schedule On

Study on Nutritional Status of the Adolescents in Cox's Bazar Area under
COX'S BAZAR District

Name of the respondent: Serial no:
.....
Father's/Husband's name: Date:
.....
Village: Union:
.....
upazila: District:
.....

(Please furnish the information of the following items)

1. Age:

What is your present age? Years

2. Gender:

3. Religion:

4. Height in meter:

5. Weight in kg:

6. BMI in kg/m²:

7. MUAC in cm:

8. Family size:

How many members are there in your family?

Male.....Female.....Child.....Total.....

9. Education: Please state your literacy level

Educational qualification					
	Academic	Literacy			
	Illiterate	Primary	Secondary	Higher secondary	Above
Respondents					
Mothers education					
Fathers education					

10. Annual Family Income:

	Source	Income (000'TK)
Agricultural	Agricultural sources (crop/vegetable)	
	Fisheries	
	Poultry	
	Forestry	
	Livestock	
	Others(if any)	
Non Agricultural	Service	
	Business	
	Remittance	
	Labor wage	
	Fixed deposit	
	Others (if any)	
Total		

11. Participation in Nutrition Program:

Name of organization	Not Participation	Participation 1 Time	Participation 2 Times	Participation 3 Or More Times
BIRTAN				
IPH				
UNICEF				
WFP				
Save the Children				
FAO				
BRAC				

12. Hygiene Practice:

Personal Hygiene Maintain	Frequently	Occasionally	Rare	Not yet
Do you wash your hand regularly with soap before eating?				
Do you wash your hand regularly with soap after eating?				
Do you wash your hand regularly with soap after toilet?				
Do you cut nail regularly?				

Do brush your teeth regularly?				
Do you take your bath regularly?				

13. Food Intake:

Name Of Foods	Amount/Meal	No Of Meals
Biscuit		
Paratha		
Bread		
Rice		
Egg		
Fish		
Meat		
Dal		
Dry fish		
Milk		
Ice cream		
Cold drinks		
Puri		
Others		

14. Diseases Information:

Disease	At Present	Within Previous 1 Week	Within Previous 1 Month	Within Previous 1 Year
Cold & cough				
Diarrhea				
Eye problem				
Fever				
Skin problem				
Stomach pain				
No disease				

Date:

APPENDIX-B 1

Correlation matrix showing the relationships among the variables (n=250)

	BMI	Age	Height	Weight	MUAC	Respondent education	Mother education	Income	Food intake	Disease information	Nutritional knowledge
BMI	1										
Age	.439	1									
Height	.395	.784	1								
Weight	.887	.685	.766	1							
MUAC	.803	.571	.616	.856	1						
Respondent education	.234	.658	.529	.406	.401	1					
Mother education	.184	.088	.055	.140	.103	-.030*	1				
Income	.396	.219	.306	.408	.329	.155	.131	1			
Food intake	.567	.401	.334	.554	.466	.159	.160	.426	1		
Disease Information	-.227	-.216	-.161	-.229	-.297	-.144	-.197	-.163	-.490	1	
Nutritional Knowledge	.256	.192	.059	.210	.121	-.086	.445	.089	.232	-.249	1

*. Correlation is significant at the 0.05 level (2-tailed).

**.. Correlation is significant at the 0.01 level (2-tailed).

APPENDIX-B 2

	BMI	Gender	Religion	Child	Family size	Father's education	Physical activity	Participation Nutritional program	Hygiene Practice
BMI	1								
Gender	.104	1							
Religion	.018*	.067	1						
Child	-.053	-.040*	.101	1					
Family size	.015*	.027*	-.013*	.352	1				
Father's education	.146	.196	.093	-.116	-.077	1			
Physical activity	-.009**	.000**	.052	-.058	-.047*	.212	1		
Participation Nutritional Program	.256	.083	.095	-.212	.012*	.385	.275	1	
Hygiene Practice	.065	-.232	-.070	-.008**	.043*	.038*	.083	-.150	1

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

APPENDIX C
PHOTO GALLERY



Height Measurement



Weight Measurement



Height Measurement



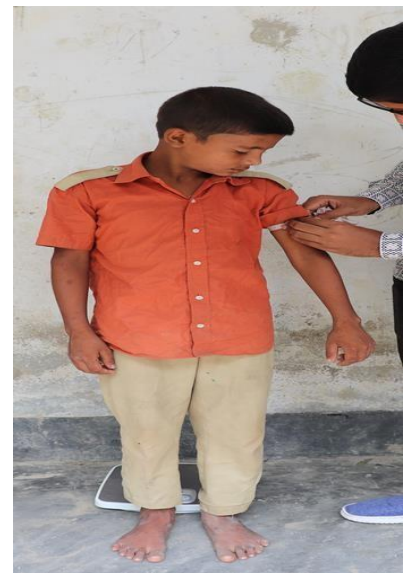
Height measurement



Weight measurement



Data Collection on questionnaire



MUAC measurement

BRIEF BIOGRAPHY

Al Hasnat Rezae Rabby passed the Secondary School Certificate Examination in 2011 from Cox's Bazar Government High School, Cox's Bazar and then Higher Secondary Certificate Examination in 2013 from Cox's Bazar Government College, Cox's Bazar. He obtained his B.Sc. (Hons.) 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 Masters 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.