# Chapter-1: Introduction

Nutrition in adolescence time plays an important role for future lifespan (Tamanna *et al.,* 2013; WHO, 2005). Adolescents, belong to age 10-19 years, makes up 20% of world population (WHO, 2005) and, 23 % of Bangladesh inhabitants (BBS, 2001). 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 (Cole *et al.*, 2007). These are, in particular, major public health concerns in developing regions, especially in Asia (FAO, 1999). Almost 1200 million adolescents and 19% of the total population in developing world suffer from malnutrition (Akhter and Sondhiya, 2013). Research showed the low body mass index (BMI) was 53% in India and 36% in Nepal (Bhandari *et al.,* 2014). In Bangladesh, specific to gender, 32% of the adolescent girls were underweight (Alam *et al.,* 2010). Rates of both types of malnutrition need to know as obesity also considered a risk morbidity among young girls.

Malnourished adolescent girl may enter in poor pregnancy and subsequently give birth of low weight babies (Kumar, 2012). In addition, chronic malnutrition, associated with lean body mass and, reduces muscular strength and work capacity (WHO, 1995). So, determinants of malnutrition in adolescent girls should be focused to prevent its bad outcome. Previous research indicated that several environmental factors, including family, socio economic status, socio demographic factors are connected to nutritional status of adolescents (Kamble, 2003). Specifically, age, sex, mother educational status, also contributes in the nutritional status of the adolescents (Elena and Luminita, 2007; Doustmohammadian *et al.*, 2009). Also, poor knowledge on nutrition, skipping meal were associated with nutritional status of the adolescents (Wolde *et al*., 2014).

Given the high prevalence of adolescent malnutrition and different factor across setting. The same measurer was employed for a given anthropometric measurement to avoid variability (FAO, 1999, Kambal, 2003). This study was undertaken to know the nutritional status and causes of malnutrition in three selective areas. Achieving the knowledge on predictors of malnutrition of adolescent girl may give an idea to frame the strategies to improve the nutritional condition of adolescent girls.

## 1.1 Objectives

- To know the rates of underweight and obesity among the adolescents and
- To determine the associated factors of malnutrition of adolescent girls in the study area.

# Chapter-2: Review of Literature

Many boys and girls in developing countries enter adolescence undernourished, making them more vulnerable to disease and early death. For obtaining a good health in the later stage i.e. in adulthood proper nutrition and healthy eating habits are foundations during this age period. But for a long period of time, their health has been neglected because they were considered to be less vulnerable to disease than the young children or the very old. In the last decade only, their nutritional health was getting attention. The health and nutritional status of adolescents is an index of their future manpower. Inadequate nutrition during adolescence can have serious consequences throughout reproductive years and beyond. A window of opportunity is represented by adolescent to prepare a nutritionally healthy adult life (Kaur *et al.*, 2007).

## 2.1. Growth and development during adolescent period

A unique intervention point in the life-cycle is considered to be the adolescence period for a number of reasons (World Bank, 2003). Early adolescence after the first year of life is important where physical growth and changes occurs rapidly in body composition, physiology, and endocrine. About 29% of adult height and 50 % of adult skeleton is maintained at this age. During adolescence, proteins help to maintain and build muscles tissues and repair tissue to support growth, development and maturation (Petrie *et al*., 2004).

## 2.2. Under-nutrition and obesity/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 (Hall *et al*., 2011). Overweight and obesity are attributed to increased consumption of energy dense, nutrient poor foods with high levels of sugar and saturated fats combined with reduced physical activity (WHO, 2003).

## 2.3. Consequences of under-nutrition/over-nutrition among adolescent girls

Chronic under-nutrition in adolescents delays normal maturation and with numerous adverse health consequences it is a significant and widespread problem. Underweight pregnant adolescents are particularly susceptible to obstructed labor and other obstetric complications as they may not have matured yet (Justin *et al*., 2000). Globally, overweight and obesity in children are rising rapidly. There were more than

1 billion overweight adults globally, at least 300 million of them obese (WHO, 2003). The prevalence of obesity is increasing worldwide and in some developing countries where the prevalence was previously very low (Hoffman, 2001).

### 2.4. Prevalence of malnutrition and associated factor in adolescents

Malnutrition among the adolescent girls in the South East Asia has been an exceptionally a big problem. Among adolescent, 32% stunting was found in India, 47% in Nepal and 36% in Bangladesh. Low body mass index (BMI) is 53% in India, 36% in Nepal and 50% in Bangladesh. The average energy intake by rural adolescent girls in Bangladesh is 81% of the recommended dietary allowance (RDA) for age. However, little published data exits on dietary intake, anthropometric measurement and energy intake of Bangladeshi low income family's adolescent girls in the urban and rural groups. Considering both rural and urban, according to the BMI category, about 66% adolescent girls were found under-weight, 0.9% over-weight and only 0.2% obese (Hossen *et al*., 2016). Female adolescent health and nutrition awareness and healthy habits can play a critical role in sustaining future family health and nutrition (Alam *et al*., 2010).

### 2.5. Socio-economic status

Adequate availability of food depends on the socioeconomic status, food practices and cultural traditions (WHO, 2006). Family income other important factor in the determination of health and nutritional status of adolescents (Nilsen *et al*., 2009). Low income families tend to either purchase less nutritious cheap food items which affects the nutritional needs of the vulnerable such as adolescents where nutrient is high to support their physiological growth and development. Low economic status was more likely to be associated with adolescents' malnutrition (Aseefa *et al*., 2013).

### 2.6. Meal skipping habits of adolescent girls

Girls frequently skip meal due to get them thin but not consider healthy eating (Shaw, 1998; Neumark-Sztainer, 2004). Meal skipping, consumption of fast foods along with soft drinks and low consumption of fruits and vegetables were the main eating habits in a school-based cross-sectional study of Onyiriuka *et al*. (2013) in Nigeria. Health and nutrition knowledge and healthy habits of female adolescents will have critical roles to play in maintaining future family health and nutrition (Alam *et al*., 2010). Two-thirds (64%) of the girls were aware of the need to take extra nutrients during adolescence to develop. In developing countries, one of the factors associated with

undernutrition of adolescents is burden of disease. Alam *et al*., (2010) estimates the burden of disease, consisting of general and reproductive morbidity and its nutritional consequences, in addition to other factors.

### 2.7. General and reproductive health of the adolescent girls

Adolescence is a period of physical and psychological preparation for healthy maternity. Adolescent girls' influences on their own health and future generation. A large majority of adolescent girls in India suffer from morbidities in reproductive health (Agrawal *et al*., 2007; Sharma *et al*., 2008). Reproductive morbidities such as dysmenorrhoea, pre-menstrual syndrome, irregular menses, excessive bleeding during menstruation etc. are common in adolescent girls. In spite of this, health care seeking for reproductive morbidities is very low. Most of the adolescent girls remain silent without seeking medical attention. If these are not treated early, the resulted can be various reproductive disabilities (Kulkarni *et al*., 2011).

In a study the burden of disease measured with self-reported morbidity was quit high; 33% of the girls had one or more morbidity symptoms in the last two weeks. Morbidity symptoms in order of prevalence were: fever (17%), followed by cough and cold (8%), stomachache (4%), diarrhoeal diseases (3%), and skin problems (1%) (Alam *et al.*, 2010).

# Chapter-3: Materials and Methods

## 3.1. Study setting and design

Descriptive and cross-sectional study was conducted among adolescent girls in local communities of Chattogram and Cox's Bazar district and, three camps of Rohingya refugee in Cox's Bazar district. Chattogram district is situated between 21º54' and 22º59' north latitude and between 91º17' and 92º13' east longitude and 211 kilometers (km) from capital Dhaka (BBS, 2013). Cox's Bazar lies between 20º43' and 21º56' north latitudes and between 91º50' and 92º23' east longitudes and, 306 km away from capital. The population of Chattogram, Cox's Bazar district and Rohingya community are 2592439, 459082 and around 1000000, respectively (BBS, 2013).

## 3.2. Study population and study duration

All adolescent girls in the selected communities were the study population. A total of 360 participants aged between 10 to 19 years old were selected for this study. No girls denied taking part in this investigation. Data was collected from March to May 2019.

## 3.3. Sample size estimation

The total sample size was calculated from the following equation to consider 5% level of significance and achieve 80% power of the analysis:

$$n = \left(\frac{Z_{\alpha/2}}{m}\right)^2 \times \hat{P} \times \left(1 - \hat{P}\right) \dots\dots\dots (1)$$

Here,

n is the sample size; Z is the z-score which is equivalent to 1.96 at 5% level of significant; m is the margin of error; $\hat{P}$ is the proportion which is 0.65 obtained from previous study of Hossen *et al.* (2013).

The margin of error of equation (1) can be calculated as

m= critical value x standard error.

Where, critical value of z-score is 1.96 and standard error is 0.025.

Putting all the value in equation (1) finally we get the sample size is 345.

## 3.4. Sampling procedure

Two stage stratified random sampling with equal allocation method was applied for data collection. At the first stage household was randomly selected and at second

stage participants were selected randomly from household. Three locations were selected from each three areas (Chattogram, Cox's Bazar and Rohingya community) and equally 40 girls were enrolled from each location.

### 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 girls were interviewed to collect the necessary information.

### 3.6. Study variables

The questionnaire was divided into socio-demographic variable, socio-economic variable, anthropometric measurements and other factors. 1) Socio-demographic characteristics includes age, marital status, family size and place of residence; 2) Socio-economic variables includes education of respondent, mother education, father education and family income; 3) Anthropometric measurements were height, weight, mid-upper arm circumference (MUAC), and body mass index (BMI); and, 4) Other variables were menstruation status, premenstrual syndrome, knowledge on nutrition, meal frequency, dietary diversity, skipping tendency of meal, source of drinking water, and mass media exposure. Premenstrual syndromes were bron, fatigue, abdominal bloating, anxiety, irritation, headache, pain in lower abdominal area before menstruation.

#### 3.6.1. Assessment of anthropometric measurements

##### 3.6.1.1. Mid-upper arm circumference (MUAC)

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 (WHO 2008) MUAC distribution was as follows:

| **Category** | **MUAC according to age** | |
|---|---|---|
| | **10-14.9 years** | **15-19 years** |
| Severe acute malnutrition (SAM) | < 16cm | < 18cm |
| Moderate acute malnutrition (MAM) | 16-18cm | 18-21cm |
| Normal | > 18cm | > 21cm |

### 3.6.1.2. Body mass index (BMI)

**Height measurement:** A measuring tape was used to measure height in cm on a wall. The girls were measured against the wall without wearing footwear and with heels together and their heads positioned with their eyes looking straight ahead (frankfert plane) so that the line of vision was parallel to the body and the wood scale 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).

**Weight measurement:** A digital balance operated by battery was used to record the weight of the girls. 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 formula of $\frac{Weight\ (in\ kg)}{(Height\ in\ meter)^2}$

According to CDC guideline BMI was categorized as:

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

### 3.6.2. Food frequency and dietary recall

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.

### 3.6.3. Nutritional knowledge and morbidity pattern

To assess their dietary knowledge, a checklist of food items (rice/wheat, meat, fish, milk, eggs, vegetables, and fruits) was used. Girls were asked to name the check-listed foods that provide mainly energy, protein, vitamin, and minerals. They were asked if they were aware of the importance of taking extra nutrients during adolescence and use of iron supplements to assess their dietary knowledge and intake. A checklist was used for recording general morbidity symptoms they had experienced in the preceding two weeks. The checklist included fever, cough/cold, diarrhea/dysentery, stomachache, respiratory problems, ear and eye problems, skin problems, and others. The girls were asked privately about menstrual irregularities, avoidance of any food during last menstruation, and passage of white discharge with

foul smell. Self-reported morbidity symptoms were taken at face value (Alam *et al.*, 2010).

### 3.7. Statistical analysis

#### 3.7.1. Exploration of data

Descriptive analysis of mean, median, percentage, range, standard deviation was used. Chi-square test was done to see the association between response and co-variants. All analysis was done using the statistical packages SAS9.3, SPSS 16.0 and 5% level of significance was considered.

#### 3.7.2 Multi-category logit model: Baseline category logit model

This an extension of binary logistic regression model when the response variable has more than two categories. Baseline-category logit model is the most popular way to model data when the set of the response categories are unordered (Agresti, 2002). It gives a simultaneous representations of the odds of being in one category relative to being in another category (baseline category). When the last category (J) is the baseline, the baseline category logits are

$log\frac{\pi_j}{\pi_J}$, j = 1, 2, …….. J – 1

Given that the response falls in the category j or category J, this is the log odds that the response is j.

For J = 3, the model uses $\log\left(\frac{\pi_1}{\pi_3}\right)$ and $\left(\frac{\pi_2}{\pi_3}\right)$,

The baseline category logit model with a predictor x is

$\log\left(\frac{\pi_j}{\pi_J}\right) = \alpha_j + \beta_J x$ , j = 1,2, ……., J-1 ……... (2)

This equation 2 for these pairs of categories determines equations for all other pairs of categories. The choice of the baseline category is arbitrary.

# Chapter-4: Results

## 4.1. Socio-demographic and other characteristics of adolescent girls in Chattogram, Cox's Bazar and Rohingya camp area (n=360)

The average age of the participants was 15.43 years (SD 2.43 years). **Table 1** demonstrates that, majority (62.8%) adolescent girls were in 15-19 years' age group, and, 37.2% in 10-14.9 years. Islam accounted for 91.6% respondents and 7.8% followed Hindu religion. Most of them were unmarried 86.4% while rest 13.6% were married. Majority (90.5%) used tube well water for drinking. Majority (50.6%) girls came from medium size family.

**Table1: Socio-demographic characteristics of adolescent girls (n=360)**

| Determinants | Frequency | Percentage |
|---|---|---|
| **Age** | | |
| 10-14.9 | 134 | 37.2 |
| 15-19 | 226 | 62.8 |
| **Religion** | | |
| Islam | 330 | 91.6 |
| Hindu | 28 | 7.8 |
| Buddhism | 2 | 0.6 |
| **Marital status** | | |
| Unmarried | 311 | 86.4 |
| Married | 49 | 13.6 |
| **Frequency of radio and television** | | |
| Daily | 64 | 17.8 |
| Never | 118 | 32.8 |
| Sometimes | 126 | 35.0 |
| Very rare | 52 | 14.4 |
| **Drinking water Source** | | |
| Pond | 5 | 1.4 |
| Tube well | 326 | 90.5 |
| Wasa | 29 | 8.1 |
| **Family size** | | |
| Small ($\leq 4$) | 113 | 31.4 |
| Medium (5 to 7) | 182 | 50.6 |
| Large ($\geq 8$) | 65 | 18.0 |

### 4.2. Socio-economic characteristics of the adolescent girls

Socio-economic characteristics of the participants represents in **table 2.** The average family income was 23,998 BDT (SD 18,065 BDT). One in ten (10%) participants were illiterate and majority (46.7%) completed the secondary education. Majority of mothers (38.9%) were illiterate and maximum (37.5%) fathers had higher secondary and above education. Majority (43.6%) families had monthly income of over 20000 BDT.

**Table 2: Socio-economic characteristics of adolescent girls**

| Determinants | Frequency | Percentage |
|---|---|---|
| **Monthly Family income (Tk)** | | |
| <10000 | 123 | 34.2 |
| 10001-20000 | 80 | 22.2 |
| >20000 | 157 | 43.6 |
| **Education** | | |
| Illiterate | 36 | 10.0 |
| Primary | 115 | 31.9 |
| Secondary school | 168 | 46.7 |
| Higher secondary | 41 | 11.4 |
| **Mother's education** | | |
| Illiterate | 140 | 38.9 |
| Primary | 73 | 20.3 |
| Secondary school | 44 | 12.2 |
| Higher Secondary and above | 103 | 28.6 |
| **Father's education** | | |
| Illiterate | 98 | 27.2 |
| Primary | 40 | 11.1 |
| High School | 87 | 24.2 |
| Higher Secondary and above | 135 | 37.5 |

### 4.3. Morbidity pattern of adolescent girl

#### 4.3.1. Disease prevalence of adolescent girls within last two weeks

**Figure 1** depicts the general pattern of morbidity among the adolescent girls. Fever was the (14.7%) common morbidity found among the girls. Others common diseases and symptoms were cold and cough (9.4%), diarrhea (11.1%) and stomach pain (5%).

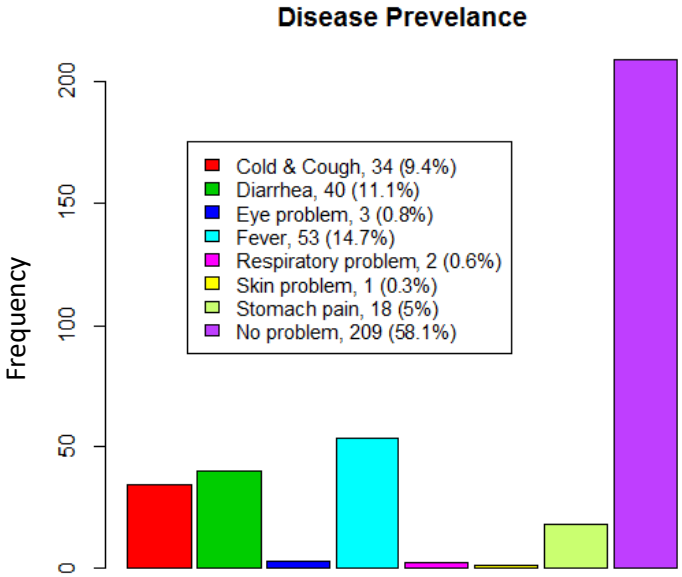


**Figure 1: Self-reported overall general morbidity among adolescent girls.**

**Table 3** shows prevalence of diseases and symptoms in three areas based on the nutritional status. In Chattogram, cold and cough was higher (68.8%) in normal weighted participants, followed by 25.0% among underweight and 6.2% in overweight. Higher prevalence of diarrhea (83%) was observed among the normal adolescent of Rohingya camp and, it was 6% in underweight and 11% in overweight. The incidence of fever was higher in normal girls of Chattogram (69%) while 25% among underweight girls and 6% in overweight girls. For stomach problem, a higher rate (87%) was observed in normal weight followed by 13% in underweight in Chattogram.

**Table 3: Disease prevalence in different area**

| Sickness | Chattogram (n, %) | | | Cox's Bazar (n, %) | | | Rohingya camp (n, %) | | |
|---|---|---|---|---|---|---|---|---|---|
| | Under | Normal | Over | Under | Normal | Over | Under | Normal | Over |
| Cold & cough | 4 (25) | 11(68.8) | 1(6.2) | 4(30.8) | 8(61.5) | 1(7.7) | 1(20) | 4(80) | - |
| Diarrhea | 2(17) | 9(75) | 1(8) | 3(30) | 6(60) | 1(10) | 1(6) | 15(83) | 2(11) |
| Eye problem | 2(67) | 1(33) | - | - | - | - | - | - | - |
| Fever | 4(25) | 11(69) | 1(6) | 7(35) | 10(50) | 3(15) | 7(41) | 10(59) | - |
| Respiratory problem | - | 1(100) | - | - | - | 1(100) | - | - | - |
| Skin problem | - | - | - | 1(100) | - | - | - | - | - |
| Stomach pain | 1(13) | 7(87) | - | 1(15) | 6(85) | - | 1(34) | 2(66) | - |
| No Disease | 14(22) | 41(64) | 9(14) | 30 (45) | 33(48) | 5(7) | 11(15) | 65(84) | 1(1) |

### 4.3.2. Premenstrual syndrome occurrence

**Figure 2** indicates the rates of premenstrual syndrome (PMS) among the girls. More than three fourth (79%) of the girls suffer from PMS during their menstrual period. Bron, fatigue, abdominal bloating, anxiety, irritation, headache, pain in lower abdominal portion prior to menstruation were the typical premenstrual syndromes.

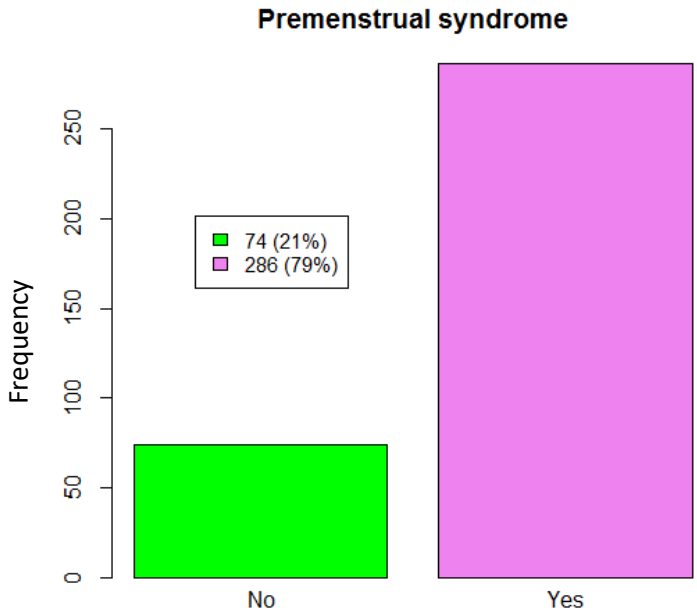


**Figure 2: Occurrences of premenstrual syndrome among the participants.**

### 4.4. Dietary patterns of adolescent girls

#### 4.4.1. Types of food intake in last 24 hours' recall

We observed from **table 4** that the intake of staple food (Rice) among adolescent girls was uniform in the selected areas. Consumption of non-staple food such as egg, meat, fish, dal, vegetables, fruits, milk were not frequent in the selected areas. About three quarter (77.2%) of the participant had no leafy vegetables at all. There was also a low rate of fruits and milk intake, which was 12.8% and 6.7% respectively. For one day, 62.5% consumed fish, 42.8% meat, 41.4% egg, and 83.1% ate vegetables.

**Table 4: Food stuffs consumption in a day by adolescent girl**

| Foods Stuff | Yes (n, %) | No (n, %) |
|---|---|---|
| Rooti / Bread | 153 (42.5) | 207(57.5) |
| Tea | 232 (64.4) | 128 (35.6) |
| Egg | 149 (41.4) | 211 (586) |
| Rice | 359 (99.7) | 1 (0.3) |
| Fish | 225 (62.5) | 225 (62.5) |
| Meat | 154 (42.8) | 206 (57.2) |
| Vegetables | 299 (83.1) | 61 (16.9) |
| Fruits | 46 (12.8) | 314 (87.2) |
| Dal | 231 (64.2) | 129 (35.8) |
| Leafy Vegetables | 82 (22.8) | 278 (77.2) |
| Milk | 24 (6.7) | 336 (93.3) |
| Dry Fish | 43 (11.9) | 317 (88.1) |

### 4.4.2. Frequency of taking meal per day

**Figure 3** represents the habit of intake meal in a day among the participants. Highest meal intake (52%) was three times a day followed by 36% participants took meal at least 4 times a day. Participants seemed to take meal twice and 5 times in a day were similar 6%.

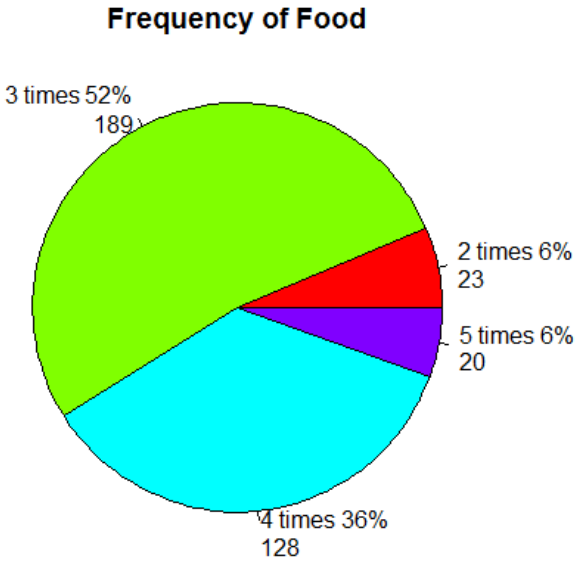


**Figure 3: Frequency of food intake by adolescents per day**

### 4.4.3. Tendency of skipping meal among adolescents in the covered area (n=360)

**Figure 4** reflects the trend in meal skipping among adolescent girls. Half (51%) of the respondents had skipping meal habit.

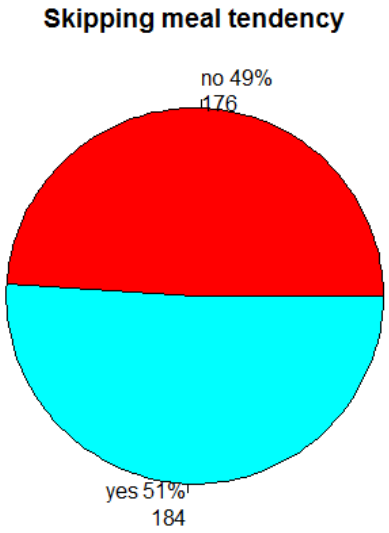


**Figure 4: Overall tendency of skipping meal among the adolescent**

According to area, the custom of skipping meal among adolescent girl is depicted in **Table 5**. We can note from the table that the tendency to skipping meal is higher in the adolescent of Chattogram (80%) followed by 65.8 in Cox's Bazar. In Rohingya Camp it was quite low (7.5%).

**Table5: Practice of skipping meal among the adolescent girls according to area**

| Area | Skip meal | |
|---|---|---|
| | Yes (n, %) | No (n, %) |
| Chattogram | 96 (80) | 24 (20) |
| Cox's Bazar | 79 (65.8) | 41 (34.2) |
| Rohingya Camp | 9 (7.5) | 111 (92.5) |

### 4.5. Adolescent girls' nutritional status in the observed areas

#### 4.5.1. Nutritional status according to MUAC

**Figure 5** displays the MUAC status of 10-14.9 years and 15-19 years old adolescents. In 10-14.9 years' age group, the prevalence of severe acute malnutrition (SAM) was 2%, moderate acute malnutrition (MAM) was 14% and, MUAC was normal for 84% of the respondents. In 15-19 age groups, 2% participants were SAM, 11% were MAM and, MUAC considered normal for 87% girls.

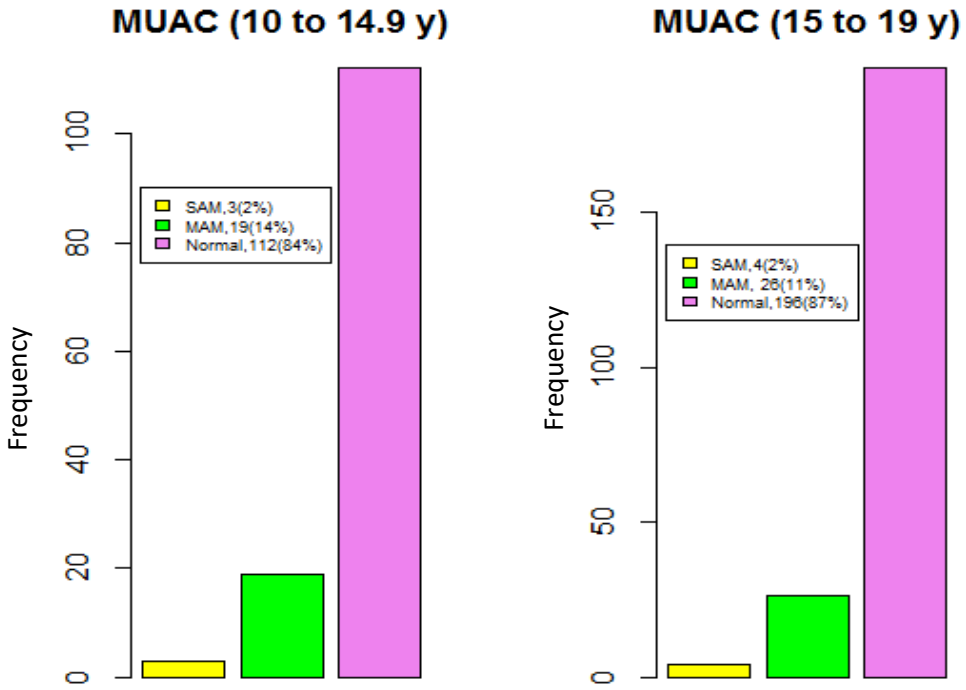


**Figure 5: MUAC status according to 10 to 14.9 years and 15 to 19 years old adolescent girls**

The average MUAC among the 10-14.9 aged participants was 21.70 cm (SD 2.9cm) in Chattogram district and 20.90 cm (SD 3.83cm) in Cox's Bazar and 21.65cm (SD 3.48cm) in the camp. And among the participants of 15-19 years, average MUAC was found 23.74 (SD 2.4cm) in Chattogram, 24.92cm (SD 2.76) in Cox's Bazar; and 22.60cm (SD 2.26cm) in camp. **Table 6** indicates that the SAM rate in the Rohingya camp is 6.5% among the age group of 10-14.9 which is higher from the other two areas. In this age group, the MAM percentage was higher (24.1%) in the Cox's Bazar. Within the age group of 15-19 years, SAM was found 4.5% in Rohingya camp. Also prevalence of MAM was found higher (14.6%) in the Rohingya camp than that of the other two areas.

**Table 6: SAM and MAM prevalence among adolescent girls' area wise**

| Area | MUAC Category | 10-14.9 Y | 15-19 Y |
|---|---|---|---|
| **Chattogram** | SAM | 1(2.0) | - |
| | MAM | 2 (4.1) | 8 (11.3) |
| | Normal | 46 (93.9) | 63 (88.7) |
| **Cox's Bazar** | SAM | - | - |
| | MAM | 13 (24.1) | 5 (7.6) |
| | Normal | 41(75.9) | 61(92.4) |
| **Rohingya Camp** | SAM | 2(6.5) | 4(4.5) |
| | MAM | 4 (12.9) | 13 (14.6) |
| | Normal | 25 (80.6) | 72 (80.9) |

### 4.5.2. Nutritional status of the respondents according to BMI

Average body mass index for overall participants was 20.38 kg/m$^2$ (SD 3.35). Prevalence of underweight, overweight and normal nutritional status has been shown in the **figure 6.** Among the 360 participants, prevalence of underweight seems to be 26.1%. Overweight prevalence was 7.2%.

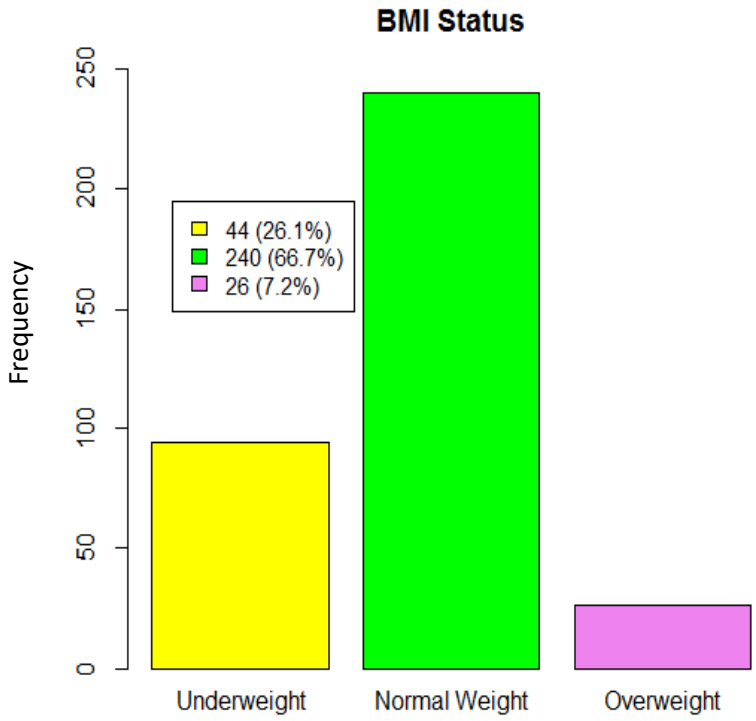


**Figure 6: Overall BMI status of adolescent girls**

From the study, the average BMI found in Chattogram was 20.63 kg/$m^2$ (SD 3.34 kg/$m^2$); and for Cox's Bazar and Camp level the average BMI was 20.26kg/$m^2$ (SD 4.18kg/$m^2$) and 20.24kg/$m^2$ (SD 2.26 kg/$m^2$) respectively. T**able 7** describes that underweight prevalence was higher (38.3%) in Cox's Bazar district. This prevalence in Chattogram and Rohingya camp was 22.5% and 17.5% respectively. Overweight prevalence found higher (10%) in the Chattogram followed by Cox's Bazar and Rohingya community made up 9.2% and 2.5% separately. In this three different areas and culture, normal nutritional status was higher in Rohingya community. 80% participants were found to be normal in this community whereas in Chattogram and Cox's Bazar area 67.5% and 52.5% participants fall in the normal range of BMI, respectively.

**Table7: Adolescent girls' nutritional status by BMI**

| BMI | Chattogram, n (%) | Cox's Bazar, n (%) | Camp, n (%) | Total , n (%) |
|---|---|---|---|---|
| Underweight | 27 (22.5) | 46 (38.3) | 21 (17.5) | 94 (26.1) |
| 95% CI | (15.38-31.02) | (29.61-47.64) | (11.17-25.5) | (21.65-30.97) |
| Normal | 81 (67.5) | 63 (52.5) | 96 (80) | 240 (66.7) |
| 95% CI | (58.34-75.77) | (43.19-61.69) | (71.72-86.75) | (61.54-71.52) |
| Overweight | 12 (10) | 11 (9.2) | 3 (2.5) | 26 (7.2) |
| 95% CI | (5.27-16.82) | (4.67-15.81) | (0.52-7.13) | (4.77-10.40) |

CI= Confidence Interval

### 4.6. Univariate analysis of nutritional status of BMI and other covariates

**Table 8** illustrates amalgamation among various factors and nutritional status of the adolescent girls. No significant association was found the family size and the sickness within two weeks with nutritional status. Statistical positive significance was found between the nutritional status and area, age, marital status, education of the respondents, father's education, mother's education, drinking water source, family income, frequency of meal, skipping meal, premenstrual syndrome. Where the cell frequency was less than 5 we used fisher exact test.

**Table 8: Association between nutritional status and other variables among the adolescent girls of Chattogram, Cox's Bazar and Rohingya Camp.**

| Parameters | Nutritional status by BMI in kg/m$^2$ | | | $\chi^2$/FET | P- value |
|---|---|---|---|---|---|
| | Under weight | Normal weight | Over weight | | |
| **Area** | | | | | |
| Chattogram | 27 (22.5) | 81 (67.5) | 12 (10) | | <0.001$^{FET}$ |
| Cox's Bazar | 46 (38.3) | 63 (52.5) | 11 (9.2 ) | 23.48 | |
| Camp | 21 (17.5) | 96 (80) | 3 (2.5) | | |
| **Age in years** | | | | | |
| 10 – 14.9 | 64 (47.8) | 63(47.0) | 7(5.2) | 51.862 | <0.001 |
| 15 – 19 | 30(13.3) | 177(78.3) | 19(8.4) | | |
| **Marital status** | | | | | |
| Married | 0(0.0) | 44(91.7) | 4(8.3) | 27.922 | <0.001$^{FET}$ |
| Unmarried | 94(30.1) | 196(62.8) | 22(7.1) | | |
| **Education** | | | | | |
| Illiterate | 6(16.7) | 30(83.3) | 0(.0) | 20.168 | 0.002$^{FET}$ |
| Primary | 37(32.2) | 72(62.6) | 6(5.2) | | |
| High School | 48(28.6) | 107(63.7) | 13(7.7) | | |
| Higher Secondary | 3(7.3) | 31(75.6) | 7(17.1) | | |
| **Father's Education** | | | | | |
| Illiterate | 35(35.7) | 61(62.2) | 2(2.0) | 14.084 | 0.027$^{FET}$ |
| Primary | 11(27.5) | 27(67.5) | 2(5.0) | | |
| High School | 22(25.3) | 59(67.8) | 6(6.9) | | |
| Higher Secondary & above | 26(19.3) | 93(68.9) | 16(11.9) | | |
| **Mother's education** | | | | | |
| Illiterate | 48(34.3) | 86(61.4) | 6(4.3) | 18.440 | 0.004$^{FET}$ |
| Primary | 13(17.8) | 58(79.5) | 2(2.7) | | |
| High School | 11(25.0) | 30(68.2) | 3(6.8) | | |
| Higher Secondary & above | 22(21.4) | 66(64.1) | 15(14.6) | | |
| **Family size** | | | | | |
| Small | 29 (25.7) | 69(61.1) | 15(13.3) | 9.146 | 0.055$^{FET}$ |
| Medium | 45(24.7) | 128(70.3) | 9(4.9) | | |
| Large | 20(30.8) | 43(66.2) | 2(3.1) | | |
| **Drinking Water Source** | | | | | |
| Pond | 4(80.0) | 0 (.0) | 1(20.0) | 18.173 | .001$^{FET}$ |
| Tube well | 82(25.2) | 225(69.0) | 19(5.8) | | |

| | | | | | |
|---|---|---|---|---|---|
| Wasa | 8(27.6) | 15(51.7) | 6(20.7) | | |
| **Family Income** | | | | | |
| <10000 | 32(26.0) | 88(71.5) | 3(2.4) | 14.553 | 0.005[FET] |
| 10001-20000 | 27(23.8) | 50(72.5) | 3(3.8) | | |
| >20000 | 35(22.3) | 102(65.0) | 20(12.7) | | |
| **Frequency of meal** | | | | | |
| 2 times | 15 (65.2) | 8(34.8) | 0(.0) | 22.678 | 0.001[FET] |
| 3 times | 44(23.3) | 135(71.4) | 10(5.3) | | |
| 4 times | 33(25.8) | 81(63.3) | 14(10.9) | | |
| 5 times | 2(10.0) | 16(80.0) | 2(10.0) | | |
| **Skip meal** | | | | | |
| Yes | 64(34.8) | 104(56.5) | 16(8.7) | 17.780 | <0.001 |
| No | 30(17.0) | 136(77.3) | 10(5.7) | | |
| **Sickness within two weeks** | | | | | |
| Yes | 39(25.8) | 101(66.9) | 11(7.3) | 7.4 | 0.285 |
| No | 55(26.3) | 139(66.5) | 15(7.2) | | |
| **Premenstrual syndrome** | | | | | |
| Yes | 51(17.8) | 212(74.1) | 23(8.0) | 49.429 | <0.001[FET] |
| No | 43(58.1) | 28(37.8) | 3(4.1) | | |

**FET= Fisher Exact Test; * Significant at p < 0.05; **Significant at p < 0.01**

### 4.7. Multi-category logit model: Baseline category logit model

Area, age, premenstrual syndrome, skip meal and knowledge about nutrition were the significant parameters of BMI. In case of area, the probability of underweight and overweight was 1.86 times and 1.73 times higher for Chattogram (area1) than Rohingya community (area3) compared to normal weight. The likelihood of underweight and overweight was 1.78 times and 2.28 times higher for Cox's Bazar (area 2) than Rohingya community compared to normal weight. The risk of underweight was 2.35 times higher for 10 to 14.9 years old than 15 to 19 years old compared to normal weight. The risk of underweight was 2.21 times higher who had premenstrual syndrome (PMS) than no PMS compared to normal weight. The probability of underweight was 2.14 times higher who skip meal than that of no skip meal compared to normal weight. The probability of underweight and overweight was 1.39 times and 1.80 times higher for no knowledge about nutritional than who have knowledge compared to normal weight.

**Table 9: Parameter estimates (standard error) of baseline category logit model**

| **Parameter** | **BMI category for logit** | | | |
|---|---|---|---|---|
| | **Underweight / Normal** | **OR (95% CI)** | **Overweight / Normal** | **OR (95% CI)** |
| Intercept | -0.828(0.309)* | - | -3.073 (0.617)** | - |
| Area 1 vs 3 | 0.618 (0.251)* | 1.86 (1.19-1.41) | 0.546 (0.343)* | 1.73 (1.47-3.45) |
| Area 2 vs 3 | 0.575 (0.208)* | 1.78 (1.71- 4.10) | 0.825 (0.342)* | 2.28 (1.95-4.49) |
| Age (10-14.9) vs (15-19) | 0.856(0.168)** | 2.35(2.86 -10.72) | -0.225 (0.272) | 0.798 (0.22 -1.85) |
| PMS (yes vs no) | 0.794 (0.178)** | 2.21 (2.24 - 5.83) | 0.135(0.710) | 1.14 (0.18-3.17) |
| Skip meal (yes vs no) | 0.759 (0.184)** | 2.14 (1.11- 4.45) | 0.071 (0.259) | 1.07 (0.31-2.40) |
| Knowledge about Nutrition (no vs yes) | 0.326 (0.175)* | 1.39 (1.03-1.26) | 0.586 (0.283)* | 1.80 (1.06-9.81) |

**OR=Odds Ratio; *Significant at p <0.05; **Significant at p < 0.01; CI= confidence Interval**

# Chapter-5: Discussion

This study was performed to find out the nutritional status of the adolescent girls, their general morbidity pattern, food habit and predominant factors that contribute to malnutrition among the adolescent. The overall underweight prevalence was found 26.1%. This finding is similar with the study of Wolde *et al.* (2014) who found 28.0% underweight prevalence rate. The prevalence of overweight found in this study was 7.2%, which is similar that of Wolde *et al*. (2014), who found obesity rate was 5.2%. Ahmed *et al* (2010) found that the prevalence of malnutrition among the adolescent in Bangladesh was 16%. In our study we found the rate higher than this.

Disease burden was measured by self-reported morbidity within last two weeks. Prevalence of morbidity was found overall 25.8% among the underweight within two weeks of the study which was similar (27.0%) with the findings obtain by the study by Alam *et al.* (2010).

In our study, age was found to be associated with nutritional status of the adolescent girls. Undernutrition was found more among the younger age group than the older age group. Similar association with the nutritional status was also revealed in the study of Joshi *et al*. (2014). An opposite findings found in Sarkar *et al.* (2015) and stated undernutrition prevalence was higher among the younger age girls then the older one.

Education had a significant effect on the nutritional status. In this study, we observed that with the increase level of education, the status of the nutritional health of the participants are tends to be increase. This result shows the similarities with the observation of the study carried out by Mulugeta *et al.* (2009). This could be due to the understanding of knowledge obtained about nutrition and implementing it in their practical life. This observation also represented that receiving a minimal education makes the adolescent more aware than those who have received no education.

Fathers' education and mothers' education was also found to contribute in the nutritional status of the respondent. Underweight prevalence was higher among the girls whose parents were illiterate. And overweight prevalence was higher among the adolescent girls whose parents received higher education. The result of the study of Assefa *et al.* (2013) also agreed with this finding. Most of adolescent girls reported that they got to know about nutrition from their parents, which proves the validity of the association.

Another determinant for nutritional status was the income of the family. Underweight prevalence was higher in the low income family and overweight prevalence was higher in family having high income. Tendency towards an increase nutritional status of the adolescent girls with an increase in the family income was observed in the current study which was also revealed in the findings of Hossain *et al.* (2013).

Eating having of adolescent studies has come to the spotlight and several studies have claimed that adolescent girls have poor dietary habit. Meal frequency is an important determinant to maintain a healthy life. The current study found the association with the frequency of meal with nutritional status as like as the findings of Wolde *et al.* (2015). The adolescent girls who takes less than two meals per day are more likely to be underweight than the girls who takes more than three meals per day.

This study reveals the association between the tendency of skipping meals and nutritional status which was also observed in the study of Wolde *et al*. (2014). Skipping meal tendency was higher among the participants of Chattogram area and least percentage of this practice was seen among the girls of Rohingya camp. This malpractice may contribute to the higher prevalence of underweight among the respondent of Chattogram. This association was also found in the observation of Sarkar *et al*. (2015). The association might be due to skipping meals leads to inadequate dietary intake.

Knowledge on nutrition is one of the important predictors that contribute in the status of the nutrition. Girls having good knowledge on nutrition are more likely to have normal weight than the girls possess less knowledge. In the observation of Melaku *et al.* (2017) reveals the same relationship. But the finding of the study conducted by Alam *et al*. (2010) shows negative association between the nutritional knowledge and status. Most of them reported that they have heard about anemia but they don't know the reason behind this deficiency. Even they are less concern about iodine deficiency disorder and Vitamin A deficiency disorders. In this study, PMS occurrences were found significantly associated with nutritional status of the adolescent girls which was similar findings observed by Samanta *et al*. (2019).

# Chapter-6: Conclusion

This study was to find out the rates of malnutrition among adolescents. Adolescence is crucial regarding nutrition for future mothers as her future child. Different authorities have been taken it into concern to maintain good health in this stage of life. Because, adolescence is transition to adulthood and, proper nutrition in this stage has positive impact on nutritional status in further life. In addition, proper nutrition in adolescence make the girl prepared good pregnancy and subsequent give birth of healthy babies. This study found considerable rates of malnutrition among the adolescents. And area, age, skipping meal, knowledge on nutrition and premenstrual syndrome were associated with nutritional status.

## Chapter-7: Recommendation and Future perspective

Regular intake of meal can reduce the deterioration of nutritional status among the adolescent. Community based adolescent friendly health and nutrition education can contribute to improve the knowledge and status regarding nutrition. Awareness program on meal skipping and knowledge on malnutrition among parents may also minimize the burden of nutritional morbidity in this study area. This study included only three areas of the country and small size data. It is suggested that future work should include a greater geographical area for more authentication of findings. Larger sample for research may give more accurate results on prevalence and associated factors of malnutrition in adolescent girls. Community health extension work should be strengthening with nutritional health educators to minimize the rates of malnutrition among the adolescent girls in the study areas.

## Limitations of the study

This study had some limitations. Findings of this small sample may lower its generalizations. For having a meaningful conclusion, the sample size needs to be large. It was a cross sectional study which deal with only one-time nutritional status. Follow up data could be given a clear image of context. This study only looked at the young girls, which may not translate to opposite gender or other age groups. Finally, self-reporting of some variable might contribute some information bias. All girls present at the study time was considered for the study rather than picking data from similar socioeconomic status which may lead to unequal comparison among study areas. However, proper sampling method and statistically justified sample size may validate the findings of the study.

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# Annex 1: Questionnaire

Date:

Name of the respondent:

Religion:

Height in cm:

Weight in kg:

BMI in $kg/m^2$:

MUAC in cm:

**Demographic Data:**

Age of the respondent: For fraction write down the age in the right corner of the table

| | |
|---|---|
| 10 | |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |

Living area:

Time of living in the area:

Family member:

**Socio-economic conditions:**

| 1. Educational qualifications | | | | | |
|---|---|---|---|---|---|
| | Academic literacy | | | | |
| | Illiterate | Primary | Secondary | Higher secondary | Above |
| Respondents | | | | | |
| Mothers education | | | | | |
| Fathers education | | | | | |

2. What is the main income source of the family?
   …….....
3. What is monthly income of the family?
   ……
4. Who is the main incoming person of the family?
   …….....
5. What is the mothers' occupation? Housewife/ Job holder/ Others ……

**Marital condition:**

1. What is your marital status? Single/ Married/ Divorced/ Others ……
2. How is your marital life going on? Very good/ Somehow going/ Not well
3. Do you have any children? Yes/ No
4. If yes, then how many? ……
5. Are you pregnant? Yes / No

**Food intake, nutritional knowledge and hygiene practice:**

1. How many times do you eat? 2/ 3/ 4/ 5
2. What have you eaten for the last 24 hours?

| | |
|---|---|
| Rooti / Bread | |
| Tea | |
| Egg | |
| Rice | |
| Fish | |
| Meat | |
| Vegetables | |
| Fruits | |
| Dal | |
| Leafy Vegetables | |
| Milk | |
| Dry Fish | |

3. Do you know about extra supplement intake during this period? Yes/ No
4. If yes, then where did you learn it? …….
5. Do you know the six food group and their sources? Yes/ No
6. Do you skip meal? Yes/ No
7. If yes, then when do you skip meal usually? ……
8. Why did you skip meal? ……..
9. What is the source of your drinking water? Tubewell/ Wasa/ Others ……...
10. Do you filter water before drinking? Yes / No
11. How frequent do you watch television or listen to radio? Daily/ Sometimes/ Very Rare/ Never
12. Do you wash your hand regularly with soap before eating? Yes / No

13. Do you wash your hand regularly after toilet? Yes/ No

**Morbidity related information:**

1. Did you experience any diseases in last two weeks? Yes/ No
2. If yes then, which disease was that?

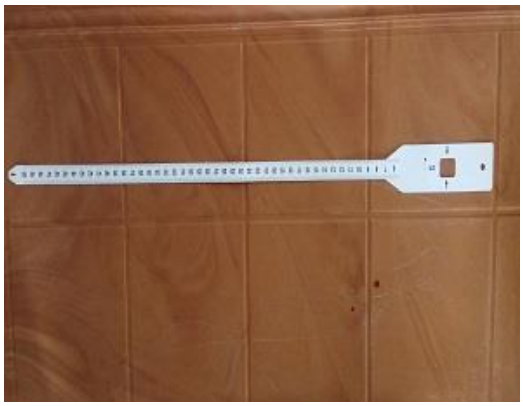
| | |
|---|---|
| Cold & cough | |
| Diarrhea | |
| Eye problem | |
| Fever | |
| Respiratory problem | |
| Skin problem | |
| Stomach pain | |
| No Disease | |

3. Have you experienced menstruation? Yes/ No
4. Is your menstruation cycle regular? Yes/No
5. Do you experience any premenstrual syndrome? Yes/ No
6. If yes, then what are those?
   Bron/ fatigue/ abdominal bloating/ anxiety/ irritation/ headache/ pain in lower abdominal portion prior to period.

I gave answers to all these questions willingly.

**Signature/ Thumbprint**

## Annex 2: Photo gallery



MUAC Tape for Adults


Digital Weight Machine

Height measurement

Weight Measurement

MUAC measurement

Verbal Data Collection

## Brief Biography

This is Kazi Jannatul Wakeya, Daughter of Kazi Kamal Uddin and JoynabAkter. She had passed the Secondary School Certificate Examination in 2008 and then Higher Secondary Certificate Examination in 2010. She received Bachelor of Food Science and Technology (BFST) degree from Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University, Khulshi, Chattogram. Now, she is a candidate for MS in Applied Human Nutrition and Dietetics under the Department of Applied Food Science and Nutrition, Faculty of Food Science and Technology, CVASU. She is keen to do further research in the Applied Nutrition and Clinical Nutrition sector and contributes her knowledge in improving the nutritional status of the people throughout the world.