Chapter-01:- Introduction

The COVID-19 pandemic in Bangladesh is a part of the worldwide pandemic of coronavirus disease 2019(COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).The outbreak of novel coronavirus disease 2019 has emerged in China, which rapidly spread the all over the world, and WHO declared it as a pandemic. The pandemic has been escalating and threatening the welfare of human beings globally and already transmitted to 112,752,364 people around the globe with at least 2,498,659 deaths as of February 24, 2021 (World Health Organization, 2021). In Bangladesh, Out of the total 544,544 COVID-19 cases registered as of 24 February 2021, & 493,798 recovered, and 8,379 died and 47,289 were active cases. In the week ending on 24 February, new cases in Chattogram division 66,036 are affected and 1,482 are death.

The COVID-19 situation in Bangladesh is queering day by day. The Government of Bangladesh closed all educational institutions and both public and private offices on 16 March 2020 in an effort to control the outbreak. In Bangladesh, it is currently caught in a dilemma between life and livelihood. It is essential to save lives as well as ensure livelihood in the foreseeable future. It is uncertain how long the COVID-19 pandemic is going to longer. As much as it is necessary to save lives and ensuring availability food and basic services for the population is imperative. The COVID-19 has caused gigantic negative effects on populace wellbeing, society, education, and the economy in Bangladesh. The pandemic has seriously affected educational systems, nutritional status of the children, decrease the mental health condition of the people, food insecurity and also affected banking site, ready-made garment, remittances, etc.

Nutrition plays the important role for the development 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 need additional nutritional demands. Undernutrition is more prevalent in Bangladesh due to inadequate intake of nutrient rich foods. Adolescence is the period between 10-19 years of age is one of the most crucial stages of life for all human being. Adolescent's health depends on several factors such as age, gender, knowledge, families, physical and biological environment, social values etc. (WHO,

2014). Malnutrition can result from a number of factors, including poor socio-economic status, mental state, social status, health conditions, and other multinational issues. A study showed that, age gender and father's occupation have substantial effect on nutritional status (Bidu et al., 2016). Mother's education and professional status also have a considerable impact on the nutritional status of adolescent school children (Selvaraj et al., 2016). But the COVID-19 pandemic is expected to increase the risk of all forms of malnutrition. In the absence of proper nutritional knowledge, people may take in some nutritional misjudgment that would not help cure the COVID-19 infection. In order to have effective quarantine measures, at-risk individuals need to follow appropriate and strict infection-control measures. The nutritional status of the adolescence would be improved with the improved of food systems, incomes, and social protection, health care services for women and children.

COVID-19 pandemic poses a significant mental health threat among adolescence in Bangladesh. Poor economic conditions, poor personal hygiene practices, and high density of population make the majority of the population particularly vulnerable to this virus. Fear of becoming sick, to stay home for extended periods due to lockdown and educational institution closure, decreased the opportunities for exploration and physical activity, the isolation of lockdown, the financial necessity to work, may negatively impact adolescence mental health condition and welfare, leading to a wide variety of mental health disorders, such as stress, anxiety, depression etc. Another study reported that, pandemic stressors such as fear of infection, dissatisfaction and monotony, lack of knowledge, lack of personal space at home, and poor family's financial condition enduring impacts on adolescence mental health (Brooks et al., 2020).Recent study suggest mental health during COVID-19 pandemic is associated with gender, socioeconomic status, occupation, having COVID-19- like symptoms, perceptions of COVID-19 impacts (Wang et al. 2020). All of these factors adversely associated with adolescence mental health and nutritional status. Mental health disorder causes digestive disorders of adolescence. Stress and anxiety may cause a decrease in blood flow and oxygen to the stomach; some of the hormones and chemicals released by body and enter digestive tract, where they interfere with digestion. Improvement in house-hold financial conditions, literacy of parents, taking care of adolescence, implementation of psychological intervention strategies and job

security and flexibility of parents may help to reduce the mental health problem of the adolescence boys and girls.

There is no information yet on mental health and nutritional status associations with or during the COVID-19 pandemic in the general people of Bangladesh. Empirical study of nutritional status and mental health conditions and associated factors during this time is essential to mitigate future negative nutritional status and mental health outcomes. It is not possible to mitigate the effects of pandemic individually but the integrated effort from the state authority as well as concern people of all sectors need to come forward. This study estimates the prevalence of nutritional status and mental health condition of the adolescence boys and girls during COVID-19 pandemic also relates the association between nutritional status and socio-demographic, dietary diversity, and mental health condition of the adolescence boys and girls.

1.1 Aims and Objectives:

This main objective of this study is to identify the impacts of COVID-19 on nutritional status and mental health issues of the adolescence boys and girls. Further aims of this study are to define the association between nutritional status (BMI) of the adolescence and various factor such socio-demographic factors, mental health condition (Stress. Depression, and Anxiety) and dietary diversity.

Chapter 2:- Review of Literature

2.1 History of COVID-19:

The COVID-19 pandemic, also known as the coronavirus pandemic, is an ongoing pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It was first identified in December 2019 in Wuhan, China. The World Health Organization declared the outbreak a Public Health Emergency of International Concern in January 2020 and a pandemic in March 2020. As of 28 February 2021, more than 113 million cases have been confirmed, with more than 2.52 million deaths attributed to COVID-19, making it one of the deadliest pandemics in history.

2.2 Global impacts of COVID-19:

The COVID-19 pandemic has led to a dramatic loss of human life worldwide and presents an unprecedented challenge to public health, food systems and the world of work. The economic and social disruption caused by the pandemic is devastating: tens of millions of people are at risk of falling into extreme poverty.

2.2.1 Impacts of the COVID-19 on Economy:

The outbreak is a major destabilizing threat to the global economy. This pandemic has severe adverse effects on the employees, customers, supply chains and financial markets, in brief, most probably it will cause a global economic recession (Omer A & Ash G, 2020). According to a United Nations Economic Commission for Latin America estimate, the pandemic-induced recession could leave 14–22 million more people in extreme poverty in Latin America than would have been in that situation without the pandemic. According to the World Bank, up to 100 million more people globally could fall into extreme poverty due to the shutdowns. The International Labour Organization (ILO) informed that the income generated in the first nine months of 2020 from work across the world dropped by 10.7 per cent, or $3.5 trillion, amidst the coronavirus outbreak.

2.2.2 Impacts of the COVID-19 on Food and Agricultural system:

The COVID-19 pandemic has disrupted agricultural and food systems worldwide. COVID-19 hit at a time when hunger or undernourishment was once again on the rise in the world, with an estimated 690 million people already going hungry in 2019. Based on the latest UN estimates, the economic recession triggered by the pandemic may lead to another 83 million people, and possibly as many as 132 million, going hungry in 2020. This is mainly due to a lack of access to food – linked to falling incomes, lost remittances and, in some cases, a rise in food prices. In countries that already suffer from high levels of acute food insecurity, it is no longer an issue of access to food alone, but increasingly also one of food production (The Guardian, 2020).

2.2.3 Impacts of the COVID-19 on Education:

The pandemic has severely impacted educational systems globally. Most governments have temporarily closed educational institutions, with many switching to online education. As of 30 September 2020, approximately 1.077 billion learners are currently affected due to school closures in response to the pandemic. According to UNICEF monitoring, 53 countries are currently implementing nationwide closures and 27 are implementing local closures, impacting about 61.6 percent of the world's student population. 72 countries' schools are currently open (UNESCO, 2020).

School closures impact not only students, teachers, and families but have far-reaching economic and societal consequences. School closures in response to the pandemic have shed light on various social and economic issues, including student debt, digital learning, food insecurity, and homelessness, as well as access to childcare, health care, housing, internet, and disability services. The impact has been more severe for disadvantaged children and their families.

2.3 Impacts of COVID-19 in Bangladesh:

Bangladesh is a densely populated country with 170 million people. The majority (85%) of the 60.83 million employed workers in the country work in the informal sector. Out of this number, an overwhelming 92% are women. The Bangladeshi economy is being significantly impacted by the Covid-19 pandemic, which has led to a decline in national and global demand for manufactured goods, particularly in the garment sector. This will increase unemployment and deepen poverty.

People in the lower income groups have been the most affected by the coronavirus pandemic and the lockdown. According to the Bangladesh Bureau of Statistics, of the 25 million workers who work on wages and salary, at least 10 million are dependent on their daily incomes. The loss of income earning opportunities has affected people's ability to purchase foodstuffs, travel restrictions have had an impact on the availability of fresh food and the strict implementation of the regulations has had a substantial cost for many. 53.6 million people living in extreme poverty, including those pushed into extreme poverty by Covid19, and that amongst these 47.3 million people are facing high economic risk (Concern Worldwide, 2020).

2.4 Nutritional status of adolescent

In Bangladesh, according to Global Alliance for Improved Nutrition (GAIN, 2018), shows differences in stunting, underweight, overweight, and obesity in adolescent girls in 2011 through 2014 nationally in Bangladesh. Stunting reduced from 32% in 2011 to 26% in 2014. Underweight remained roughly constant at around 11-12% from 2011 to 2014. Overweight/obesity more than doubled from 3% in 2011 to 7% in 2014.

A research conducted in Bangladesh showed that, according to the BMI category, about 66% adolescent girls were found under-weight, 0.9% over-weight and only 0.2% obese. The prevalence of under-weight was found very much similar in both urban and rural area. The proportions were, 65.3% and 64.8% in rural and urban area respectively (Hossen et al., 2017).

A study conducted in Matlab, Bangladesh showed that, 66% of the adolescent boys and 46% of the adolescent girls were severely underweight whereas 36% and 28% of the adolescent boys and girls were respectively severely stunted. This study also

identified that, girls were more likely than boys to be stunted in childhood, whereas boys were more likely than girls to be stunted and underweight in adolescence (Alinda et al. 2008).

Another study conducted in Ethiopia showed that, the percentage of underweight and normal of boys respectively 29.8% and 66.4% is higher than the girls 24.6% and 70.5%. The nutritional status among the adolescents in this study was similar to those found in rural Benin, India, and Nepal (Yetubie et al., 2010).

Further study conducted in rural area of Wardha showed that, 53.8% of the adolescents were thin, 44% were normal and 2.2% were overweight (Deshmukh et al., 2006).

2.5 Effects of socio-demographic factors on nutritional status of adolescent

A study investigated the correlation between socio-demographic factors and nutritional status of the adolescence boys and girls. Socio-demographic factors such as gender, age, parent's education, family size is the determinant of nutritional status of the adolescence (Zumin et al., 2005).

Research conducted in Bangladesh showed that, the household income and family size is the determinant of nutritional status of adolescent girls. A study conducted in Chattogram hill tracts, khagrachhari showed that, a tendency towards an increase nutritional status in adolescent girls with an increase in the family income. When increase in family size, decrease in nutritional status in adolescent girls (Hossain et al., 2013). Another study showed that, the same result which is conducted the rural areas of the nine States in India (Venkaiah et al. 2002). Parent's occupation is another determinant of nutritional status of the adolescence. The high level of jobs ensured that the higher percentage of nutritional status (Acharya et al., 2014).

Further study conducted in rural area of India showed that, age is the another determinant of nutritional status of the adolescence. The prevalence of undernutrition is higher (53.1%) in boys than in girls (39.5%). The extent of undernutrition increased from 41.6 to 68.6% in boys with increasing age. Among the various socio-economic factors, type of house and family size are found to be significantly contributing factors in explaining nutritional status. In adolescents who belong to family size > 4, the risk of undernutrition is slightly higher (Venkaiah et al. 2002).

Research in Bangladesh showed that the prevalence of underweight was 28% and 33% times higher among children whose mothers had no education and primary

education compared to children whose mothers had higher education (Siddiqi et al., 2011). Other studies in context of Bangladesh showed that maternal education has a strong significant effect on underweight (Das and Rahman, 2011; Siddiqi et al., 2011; Ahmed et al., 2012).

Recent study suggests mental health during COVID-19 pandemic is associated with gender, socioeconomic status, occupation, having COVID-19- like symptoms, perceptions of COVID-19 impacts (Wang et al. 2020).

2.6 Impacts of mental health on nutritional status of adolescent

Stress and worry are also increasing in the household and community. Eighty percent of adolescents report that household stress increased since the onset of COVID-19 with over 75 percent of adolescents reporting either those they are at least moderately scared about COVID-19 or worried about it (Baird et al., 2020).

Another recent study reported that, 59.7% suffered from stress symptoms, however, mild (28%) and moderate (22%). 33.7% of the participants reported symptoms of anxiety, among them 11.6% had moderate anxiety and 11.6% had severe anxiety. 57.9% of the respondents experienced depressive symptoms, including mild (14.5%), moderate (21.2%) and severe (13.2%) (Banna et al., 2020).

The overall prevalence of normal, mild, moderate, severe and extreme severe depression was 75.5%, 17.9%, 5,4%, 1.1% and 0.1%, respectively. The prevalence of any depression was higher among adolescent girls. In both sexes, depression was associated with higher age, higher maternal education, paternal occupation and household size ≤4 were also associated with depression (Mridhaet al. 2021).

Fear of infection, financial uncertainty, inadequate food supply, and absence of physical exercise had significant association with stress, anxiety, depression and post-traumatic symptoms. Studies conducted in Bangladesh showed that the 28.5 % of the respondents had stress, 33.3% anxiety, 46.92 % depression from mild to extremely severe, according to DASS 21 (Khan et al., 2020).

A research conducted in India claimed that, females have a greater level of stress, anxiety, and depression compared to males. This was attributed to quarantine where all family members are at home which can be both mentally and physically demanding (Suseela, 2020).

A study conducted in various university students of Bangladesh investigates the prevalence of depression and anxiety. Around 15% of the students reportedly had

moderately severe depression, whereas 18.1% were severely suffering from anxiety (Islam et al., 2020).

2.7 Dietary diversity related with nutritional status of adolescent

A study revealed that, according to the BMI level 41.33% of adolescent girls were underweight, 35.00% normal, 8.33% overweight and 6.67% obese. Their nutritional statuses were very poor because 65% adolescent girls intake low food (Hossain et al., 2013).

Another study showed that, girls had a lower height, but a higher BMI, and were less likely to be thin than boys (17% of girls were thin compared to 22% of boys). Adolescent girls were significantly more likely to have inadequate energy and iron intakes than boys; boys were more likely to have inadequate zinc intakes (Leroy et al. 2018).

The prevalence of undernutrition among the participants assessed as stunting was 10% overall with younger girls being less stunted (2%) than older girls (16%), whereas 16% were thin with relatively more of the younger girls (21%) being thin than of the older girls (12%), based on the usual pattern of food intake. The girls from families with less educated parents were more likely to be thin and short for their age. Those girls from families with lower incomes and less educated parents had a dietary pattern which tended to be poor with regard to egg, milk, meat and fruit, with lower intakes of protein, fat and riboflavin (Ahmed et al. 1997).

A study conducted in different slum area of Dhaka city in Bangladesh studies that, about 61.3% of the adolescent consumed medium dietary diversified food, 30% of the respondent consumed lowest dietary diversified food where 8.7% girls consumed highly diversified food. About 3.3% of the girls were severely thin, 10% of the girls were moderately thin, 6.7% were overweight and 80% had normal weight (Alam et al., 2018).

Chapter-3:- Materials and Methods

3.1 Participants and setting

This study was conducted among adolescence boys and girls in Chattogram metropolitan area through an online survey from 5th October to 28th December 2020 following lockdown declaration on 26th March 2020 by the government of Bangladesh (World Health Organization, 2020). The sample size was calculated by using "Raosoft software ". Hence, the required sample size was 383. However, 250 samples were taken for the final analysis. It was not possible to take an expected amount of data due to COVID-19 pandemic situation.

3.2 Data collection procedure

The data was collected via an online questionnaire as the face-to-face interview had to be avoided due to ongoing pandemic situation. The questionnaire was designed by Google form and sent the link to the adolescence boys and girls through various social media such as facebook, whatsapp, etc. The questionnaire consisting of several parts such as (i) socio-demographic information (gender, age, parents educational status, parents occupation, household income, present condition of the income), (ii) mental health related information of adolescence boys and girls, (iii) dietary diversity related information of the adolescence. First of all, asking the contest of participating in the survey and also notified that at any time, participants could revoke from the survey without giving any justification.

3.3 Anthropometric measurements

The data height and weight was collected from the respondents of the survey by the given online questionnaire. BMI for age according to WHO standard BMI classification were used for assessing the nutritional status of the adolescence boys and girls. The association between BMI for age and various factors for nutritional status was also observed.

3.4 Mental health assessment of adolescent

The Depression, Anxiety, and Stress scale (DASS-21) was used to measure the mental health condition of the participants (Le et al.2019; Alim et al.2014). The DASS-21 contains three self-report scales with a total of 21-items designed to assess the

negative effects of depressive symptoms, anxiety symptoms, and stress levels (Lovibond SH &Lovibond PF, 1995). The DASS-21 scales are evaluated at 4 points (0= never, 1= sometimes, 2=often, and 3= almost always) which gives a total score of 21. The DASS-21 score was multiplied by 2 to calculate the final score. The range of the score for normal condition - depression (0-9), anxiety (0-7), and stress (0-14), for mild condition- depression (10-13), anxiety (8-9), and stress (15-18), for moderate condition - depression (14-20), anxiety (10-14) and stress (19-25), for severe condition -depression (21-27), anxiety (15-19) and stress (26-33).The DASS has proven to be reliable and relevant for assessing mental health in the Bangladeshi population (Alim et al., 2015; Sadiq et al., 2019).The DASS-21 has been used for assessing mental health in several studies.

3.5 Dietary Diversity Score

Dietary diversity score was calculated based on 24 h recall of adolescence consumption of 12 food groups within the past 24 h (Food and Agriculture Organization, 2007). The food groups included were based on FAO recommendations, as follows: (i) cereals, (ii) Vitamin A rich vegetables and tubers, (iii) White tubers and roots (iv)Dark green leafy vegetables (v) eggs, (vi) fish and other sea foods, (vii) Others vegetables (tomato, onion etc), (viii) milk and milk products, (ix) Vitamin A rich fruits, (x) Flesh meat, (xi) egg, and (xii) Organ meat . Commonly consumed foods in the area were incorporated into each food group. The response option of "yes" was scored one point if at least two food items in each food group were consumed by the adolescence. For food groups not consumed at all, with a response option of "no", zero (0) points were given. Dietary diversity scores (DDS) was summed up by counting each of the 12-food groups, and classified as low ($\leq$3), medium (4–6) and high (above 6).

3.6 Statistical analysis

Data was analyzed by using statistical package for social science (SPSS) version 17.0. Chi- square test was employed to understand the statistical significance between associated factors of nutritional status. Level of significance was set at $p<0.05$.

Chapter-4:- Results

This section describes the findings of the study. The nutritional status of adolescence boys and girls of Chattogram metropolitan area are presented firstly. Then socio-demographic, nutritional status, mental health condition, and food diversity characteristics were explained. Finally, the associations between different variables and nutritional status were described using Chi square test.

4.1 Nutritional status of adolescent boys and girls

This study showed that, about 34.8 % of the adolescence was underweight, 54.8% of the adolescence was normal, 8.4% of the adolescence was overweight and 2% of the adolescence was obese and these are shown in table-4.1.

Table-4.1:- Nutritional status of adolescence using classification of BMI

Variable	Nutritional status criteria	Frequency of adolescence	Percentage (%)
BMI (Kg/m^2)	< 18.5/Underweight	87	34.8
	18.5-22.9/ Normal	137	54.8
	2327.49/Overweight	21	8.4
	>27.5/ Obese	5	2

4.2 Socio- demographic characteristics of the respondents

In this study among 250 adolescence, about 165 (66%) were boys and 85 (34%) were girls. About 6% of father had completed education upto 10th class, 37.2% of father had completed education above 10th class and 56.8% of father had completed degree. About 16% of mother had completed education upto 10th class, 68% mother had completed education above 10th class and 16% of mother had completed degree. About 10% of father were day labor, 17.6% of father worked in abroad, 40.4% of father had business, and 32% of father were job holder. About 92% of mother was housewife, and 8 % were job holder. About 10% of families total monthly lies upto 15000 tk, 34.8% of the family's monthly income between 15000-30000 tk, 45.6% of the family's income between 31000-40000, and 9.6% of the families income above 40000 tk. About 18.8% of the family's income is stable during COVID-19, and 81.2% of the family's income gradually decreases during COVID-19. These are shown in table-4.2.

Table 4.2: Socio- demographic characteristics of respondents

Variables	Group by variables	Frequency (%)	Total
Gender	Boys	165(66)	250
	Girls	85(34)	
Family members	Upto-4	141(56.4)	250
	Above -4	109(43.6)	
Father's Education	Upto-10	15(6)	250
	Above-10	93(37.2)	
	Degree	142(56.8)	
Mather's education	Upto-10	40(16)	250
	Above-10	170(68)	
	Degree	40(16)	
Father's Occupation	Day Labor	25(10)	250
	Abroad	44(17.6)	
	Business	101(40.4)	
	Job holder	80(32)	
Mather's Occupation	Housewife	230(92)	250
	Job holder	20(8)	
Household income	Upto -15000	25(10)	250
	15000-30000	87(34.8)	
	31000-40000	114(45.6)	
	Above 40000	24(9.6)	
Present status of income	Stable	47(28.6)	250
	Increase	0(0)	
	Decrease	203(71.4)	

4.3 Dietary diversity of the respondents:-

In this study showed that, about 9.2% of the adolescence were in low food diversity, 66.4% of the adolescence were in medium food diversity and 24.4% of the adolescence were in high food diversity and these are shown in table-4.3.

Table-4.3:- Dietary diversity of the respondents

Variables	Group by variables	Frequency (%)	Total
	Low dietary diversity	23 (9.2)	
Dietary Diversity	Medium dietary diversity	166 (66.4)	250
	High dietary diversity	61 (24.4)	

4.4 Mental health condition of the respondents

In this study, three types of mental health condition of the adolescence boys and girls, such as depression, anxiety and stress were divided into four group, normal, mild, moderate and severe. The percentage of the depression in normal (54.4%), mild (16%), moderate (22.4%), and severe condition (7.2%) of the total respondents. The percentage of the anxiety in normal (65.2%), mild (16%), moderate (13.6%) and severe condition (5.2%) of the respondents. The percentage of the stress in normal (54.4%), mild (23.2%), moderate (20.4%) and severe condition (2%) of the total respondents and these are shown in table-4.4.

Table-4.4:- Mental health condition of the respondents

Variables	Group by variables	Frequency (%)	Total
Stress	Normal	136 (54.4)	
	Mild	58 (23.2)	
	Moderate	51 (20.4)	250
	Severe	5 (2)	
Depression	Normal	136 (54.4)	
	Mild	40 (16)	
	Moderate	56 (22.4)	250
	Severe	18 (7.2)	
Anxiety	Normal	163 (65.2)	
	Mild	40 (16)	
	Moderate	34 (13.6)	250
	Severe	13 (5.2)	

4.5 Association of BMI and socio-demographic factors:-

The results exposed that, the mother's education, household income, and present status of the income had statistically significant association with BMI.Table-4.5 illustrates these associations.

Table-4.5:- Association between BMI and Socio- demographic factors

Variable	Group by variable	BMI				Total	P value
		Underweight (%)	Normal (%)	Overweight (%)	Obese (%)		
Gender	Boys	59 (35.8)	92 (55.8)	11 (6.7)	3 (1.8)	165	0.567
	Girls	28 (32.9)	45 (52.9)	10 (11.8)	2 (2.4)	85	
Family members	Upto -4	53 (37.6)	76 (53.6)	9 (6.4)	3 (2.1)	141	0.501
	Above- 4	34 (31.2)	61 (56)	12 (11)	2 (1.8)	109	
Father's education	Upto-10	8 (53.3)	7 (46.7)	0 (0)	0 (0)	15	0.563
	Above-10	29 (31.2)	54 (58.1)	9 (9.7)	1 (1.1)	93	
	Degree	50 (35.2)	76 (53.5)	12 (8.5)	4 (2.8)	142	
Mother's education	Upto-10	23 (57.5)	15 (37.5)	2 (5)	0 (0)	40	0.007*
	Above-10	45 (26.5)	105 (61.7)	16 (9.4)	4 (2.4)	170	
	Degree	19 (47.5)	17 (42.5)	3 (7.5)	1 (2.5)	40	
Father's occupation	Day labor	11 (44)	12 (48)	2 (8)	0 (0)	25	0.895
	Abroad	13 (29.5)	28 (63.6)	3 (6.8)	0 (0)	44	
	Business	35 (34.7)	55 (54.5)	8 (7.9)	3 (3)	101	
	Job holder	28 (35)	42 (52.5)	8 (10)	2 (2.5)	80	
Mother's education	Housewife	80 (34.8)	127 (55.2)	18 (7.8)	5 (2.2)	230	0.647
	Job holder	7 (35)	10 (50)	3 (15)	0 (0)	20	
Household income	Upto 15000	15 (60)	7 (28)	3 (12)	0 (0)	25	0.001*
	15000-30000	35 (40.2)	37 (42.5)	10 (11.5)	5 (5.7)	87	
	31000-40000	34 (29.8)	75 (65.8)	5 (4.4)	0 (0)	114	
	Above 40000	3 (12.5)	18 (75)	3 (12.5)	0 (0)	24	
Present status of income	Stable	9 (19.1)	32 (68.1)	6 (12.8)	0 (0)	47	0.038*
	Increase	0 (0)	0 (0)	0 (0)	0 (0)	0	
	Decrease	78 (38.4)	105 (51.7)	15 (7.4)	5 (2.5)	203	

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

4.6 Association of BMI and mental health condition of adolescence:-

The results revealed that BMI was significantly associated with stress and anxiety condition of the adolescence boys and girls. Table-4.6 illustrates this association.

Table-4.6:- Association between BMI and mental health condition of adolescence

Variable	Group by variable	BMI				Total	P value
		Underweight (%)	Normal (%)	Overweight (%)	Obese (%)		
Stress	Normal	56 (41.2)	57(41.9)	19 (14)	4(2.9)	136	
	Mild	21 (36.2)	35(60.3)	2 (3.4)	0 (0)	58	0.001*
	Moderate	9 (17.6)	41(80.4)	0 (0)	1 (2)	51	
	Severe	1 (20)	4 (80)	0 (0)	0 (0)	5	
Depression	Normal	31 (22.8)	100(73.5)	2 (1.5)	3(2.2)	136	
	Mild	10 (25)	22 (55)	8 (20)	0 (0)	40	0.001*
	Moderate	34 (60.7)	14 (25)	6 (10.7)	2(3.6)	56	
	Severe	12 (66.7)	1 (25.9)	5 (10.7)	0 (0)	18	
Anxiety	Normal	55 (33.7)	90 (55.2)	15 (9.2)	3(1.8)	163	
	Mild	12 (30)	22 (55)	4 (10)	2 (5)	40	0.781
	Moderate	14 (41.2)	18 (52.9)	2 (5.9)	0 (0)	34	
	Severe	6 (46.2)	7 (53.8)	0 (0)	0 (0)	13	

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

4.7 Association of BMI and dietary diversity of adolescence:-

The results exposed that, there was no significant association between BMI and dietary diversity of the adolescence of boys and girls, and these are shown in table-4.7.

Table-4.7:- Association between BMI and dietary diversity of adolescence

Variable	Group by variable	BMI				Total	P value
		Underweight (%)	Normal (%)	Overweight (%)	Obese (%)		
Dietary diversity	Low dietary diversity	3 (13)	16(69.6)	4 (17.4)	0 (0)	23	
	Medium dietary diversity	61 (36.7)	88 (53)	14 (8.4)	3(1.8)	166	0.200
	High dietary diversity	23 (37.7)	33(54.1)	3 (4.9)	2(3.3)	61	

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

Chapter -5:- Discussion

The COVID-19 situation in Bangladesh is worsening day by day. In this pandemic situation its effects on the nutritional status, mental health condition, and food diversity of the adolescence boys and girls. It's also hampered the socioeconomic condition of the people. COVID-19 has pushed millions of household income were decrease and reduced limited financial resources. COVID-19 interrupted educational facilities for children and adults including primary, secondary and university. Overall, the COVID-19 pandemic seriously hampered our economy and creates many problems.

Malnutrition is a common problem in Bangladesh. In Bangladesh millions of adolescent suffer from one or more forms of malnutrition. Less of adequate nutritious food or sometimes excess food intake can cause malnutrition. In this online based survey, about 66% of the boys and 34% of the girls participated. The result of this survey, when general BMI classification was used about 34.8% adolescence boys and girls were underweight, 54.8% adolescence were normal, 8.4% were overweight, and 2% were obese, which were related with socio demographic information, mental health condition, and food diversity of the adolescence. In this present study, boys and girls showed almost similar prevalence of underweight. Although the classification of BMI for age (percentile) was not used in this survey but a study showed that the prevalence of thinness was found among 53.8% adolescents when percentile classification was employed (Deshmukh et al., 2006). Another study carried out in rural area in Bangladesh reported 67% thinness in adolescents (Shahabuddin et al., 2012). A study carried out in Ethiopia showed only 13.68% underweight (<18.5 kg/m^2) adolescents (Mohammed and Tefera, 2015). However, prevalence of overweight was found higher among girls at 11.8% than that of boys at 6.7% in the study. Another study carried out in Fatehabad District of Haryana finds the similar results that, the prevalence of overweight at 3% and 14% for boys and girls (Rani and Rani 2016).

Parent's educational status has a significant relationship with nutritional status of children (Col and Col, 2002). In this study showed that, mother's education was significantly associated with nutritional status of the adolescents and the lower prevalence of underweight among adolescents of graduate mothers at 7.6% than the

whose adolescents mothers completed upto 10th class at 9.2% of the total 34.8% adolescents respondents. Similar findings was observed in the another study showed that, 12.4% adolescents of graduate mothers were found underweight. Research in Bangladesh showed that the prevalence of underweight was 28% and 33% times higher among children whose mothers had no education and primary education compared to children whose mothers had higher education (Siddiqi et al., 2011). Other studies in context of Bangladesh showed that maternal education has a strong significant effect on underweight (Das and Rahman, 2011; Siddiqi et al., 2011; Ahmed et al., 2012).

Household monthly income is the determinant of nutritional status of the adolescents. In this study, household monthly income was significantly associated with nutritional status of the adolescents. The prevalence of underweight was higher whose adolescents household monthly income less than 15000 tk compared to whose adolescents household monthly income among 35000-40000 and above 40000, respectively. Similar results were observed in the study conducted by Hossain et al., (2013) shows that, a tendency towards an increase nutritional status in adolescent girls with an increase in the family income. In this study present condition of the household monthly income was significantly associated with nutritional status of adolescents. Only 18.8% of the family's income is stable during COVID-19, and 81.2% of the family's income gradually decreases during COVID-19. When the household monthly income was decrease the prevalence of underweight was found higher at 38.4% compared to whose family's monthly income was stable at 19.1%. Decrease of household income due to loss of jobs, loss of business, and shutdown many private industries. In private sector most of the people lose their jobs during COVID-19. The COVID-19 pandemic has completely derailed the textile industry. According to International Monitory fund (IMF), GDP growth was estimated to have reached 7.9% in 2019 and is forecast to fall to 2% in 2020 due to the outbreak of the COVID-19.

In Bangladesh the percentage of underweight among adolescence boys and girls is 50.7% and 40.2% respectively (Global Nutrition Report, 2020), which is relatively higher with this study at 35.8% and 32.9%. According to Global Nutrition Report, 2020, the level of underweight of boys has declined from 60.4 percent in 2000 to 50.7 percent in 2016 and the level of underweight of girls has declined from 46.5 percent in 2000 to 40.2 percent. In COVID-19 pandemic situation the nutritional status of the

adolescence boys and girls in Chattogram remains constant with the Global Nutrition Report. However, the long duration of this pandemic situation causes serious effects on nutritional status of the adolescence boys and girls.

Mental health is an essential part of any country. Bangladesh is a relatively small and densely populated country, but inadequate mental health care facilities. In this study, 23.2% of the adolescence had higher prevalence of mild stress symptoms, 22.4% had moderate depression symptoms and 16% had mild anxiety symptoms. Similar findings were observed in another study conducted in Bangladesh (Banna et al., 2020). In this study showed that, the stress and depression were significantly associated with nutritional status of the adolescence. Present study shows that, 36.2% of the mild stress adolescence suffered from underweight, 60.7% and 66.7% respectively moderate and severe depressed adolescence suffered from underweight. The high rate of stress, depression and anxiety occurs due to the COVID -19 pandemic situations. The educational background is the needed to reduce this mental health problem. It is possible that those with graduate degrees have more information regarding COVID-19 and are therefore more aware of this situation than those have lower educational level. Similar results founds in a study reported that, those with lowest level of education have the highest rates of increased stress, anxiety and depression symptoms during pandemic (Wang et al., 2020). Unemployment problem is another reason for decrease mental health condition. Unemployed individuals face challenges to earning incomes needed to survive during lockdown. Recent research has suggested that 86.1% of the population believe Bangladesh does not have economic and structural capacity to properly handle COVID-19 (Islam &Siddika, 2020).

Problems related to food intake and malnutrition has been identified as widespread and important concerns for public health in Bangladesh. The present study has to focus on the nutritional status and dietary patterns of adolescent boys and girls in Chattogram. It is noted that, there is no significant association between dietary diversity and nutritional status of the adolescence boys and girls. In this study, about 66.4% of the adolescence is in medium dietary diversity who have consumed at least 4-6 food groups. Lack of a varied diet potentially exposes these adolescents to risk of multiple micronutrient deficiencies. Low fruit and vegetable intake not only increases the risk of nutritional deficits but also deprives these adolescents of the benefit of lowered cardiovascular risk conferred by diets rich in fruits and vegetables

(Mellendick K et al., 2018). Lower consumption of meat, fish, egg, and other fruits is responsible for the underweight of adolescence.

However, this study was not free from limitations, firstly, the snowballing of sample requirement, which may suggest sampling bias unintentionally excluding those who do not have access to internet. Secondly, face-to-face interview was avoided whereas compared to face-to-face interview. The self-reported survey mode may also introduce response bias. Finally, it would be better to have a larger sample size to validate the results but it was not possible to collect larger sample size due to the current pandemic situation.

Chapter-6: Conclusions

The study concluded that adolescence boys and girls are at risk of undernutrition due to COVID-19 pandemic situation. Overweight and obesity were less prevalent. No considerable difference was observed between the nutritional status of boys and girls. Significant association exists between mother's educational status, household monthly income & present condition of income and their children's nutritional status. This study also reveals a high prevalence of mental health symptoms in the adolescence boys and girls of Chattogram. This study observed that, the prevalence of mental health conditions was similar and higher in stress and depression than the anxiety respectively. The prevalence of mental health conditions in the adult was lower in pre-COVID-19, which suggests that the pandemic occurrence may be responsible for decrease mental health conditions. Improvement in house-hold financial conditions, literacy of parents, improve dietary practices, taking care of adolescence, implementation of psychological intervention strategies and job security and flexibility of parents may help to reduce the mental health problem of the adolescence boys and girls. Government should implement the nutritional programmed in the different area, to address the large increase food insecurity, feeding programs may help to mitigate nutritional shortfalls the adolescence which may experienced during the lockdown. Commitment from ministry of health, agriculture, education, rural development and other stakeholders is required for implementing the nutritional programme.

Chapter-7: limitations and Recommendations

7.1 Limitations of the study:-

This study was not free from limitations, firstly, those who do not access the internet were not included in the study. Secondly, face-to-face interview was avoided whereas compared to face-to-face interview. The self-reported survey mode may also introduce response bias. Finally, it would be better to have a larger sample size to validate the results but it was not possible to collect larger sample size due to the current pandemic situation.

7.2 Recommendations:-

- ✓ This study has been done only with Chattogram metropolitan area. If it could be done in rural areas then a distinction could be made between urban and rural areas. If anyone wants to work on this research in the future, they can do in different cities or rural areas of Bangladesh.

- ✓ The ministry of health should involve relevant stakeholders and other ministries like agriculture, water and sanitation and education ministry including community in the planning and implementation of nutrition programme and improvise the mental health services in Bangladesh.

- ✓ Ministry of finance in collaboration with agriculture and relevant stakeholders should implement nutrition sensitive social safety net programme to alleviate poverty, improve household food security.

- ✓ Government should collaborate with other national and international NGOs who are already running some nutrition interventions for better coordinate service provision.

- ✓ Public education and awareness campaigns on mental health conditions may be undertaken by the government to ameliorate misconceptions about this pandemic.

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PART – A :- Socio- demographic Information

1. Name:-……………….……...   4. Height:-…………………….

2. Age:-……………………   5. Weight:-…………………….

3. Gender:-…………………   6. No. of family members:-……

7. Educational status of father:-   8. Educational status of mather:-

☐ Up to 10 ☐Above10 ☐Degree   ☐ Up to 10 ☐ Above10 ☐Degree

9. Father's Occupation:-   10. Mother's Occupation:-

☐ Day labor ☐Abroad ☐ Business ☐Job holder   ☐ Housewife ☐ Job holder

11. Household Income:-

☐ Up to 15000 ☐ 15000-30000   ☐ 31000-40000 ☐ Above 40000

12. Present status of income :-

☐Stable ☐ Increase   ☐ Decrease

PART-B:- Nutritional status

☐ Under- weight   ☐ Normal   ☐ Overweight   ☐ Obese

PART- C :- Food diversity

[Please include the foods that you ate yesterday or past a week during the day and night, whether at home or outside the home]

Question Number	Food group	Examples	Yes=1 No=0
1	Cereals	Rice, wheat or any other grains or foods made from these (bread, noodles etc)	
2	Vitamin A rich vegetables and tubers	Pumpkin, carrots, sweet potatoes or other locally available vitamin A rich vegetables	
3	White tubers and roots	White potatoes, white yams, white cassava or other foods made from roots	
4	Dark green leafy vegetables	Kolmishak, lalshak, puishak, kochushak, mulashak etc.	
5	Other Vegetables	Other vegetables (tomato, onion, eggplant etc)	
6	Vitamin A Rich Fruits	Ripe mangoes, water melon, ripe papaya, dried peaches or other locally available vit-A rich fruits	
7	Other Fruits	Other fruits, including wild fruits	
8	Organ Meat (Iron rich)	Liver , kidney or any other organ meats	
9	Flesh meat	Chicken, duck, goat, beef	
10	Eggs	Eggs from chicken , duck	
11	Fish	Fresh or dried fish	
12	Milk and milk products	Milk, cheese, yoghurt or other milk products	

Part-D:- Mental Health condition

Please read each statement and circle a number 0,1,2 or 3 which indicates how much the statement applied to you over the past week.

The rating scale is as follows:

0 = Did not apply to me all- Never (N)

1 = Applied to me some of the time- Sometimes (S)

2 = Applied to me a good part of time- Often (O)

3 = Applied to me most of the time- Almost always (AA)

Variables	Question	N	S	O	AA	Score
Stress	1. I tended to over- react to situations					
	2. I found it hard to wind down					
	3. I felt that I was using a lot of nervous energy					
	4. I found myself getting agitated					
	5. I found it difficult to relax					
	6. I felt that I was rather touchy					
	7. I was intolerant with what I was doing					
Depression	1. I couldn't seem to experience any positive feeling at all					
	2. I found it difficult to work the initiative to do things					
	3. I felt that I had nothing to look forward to					
	4. I felt down- hearted					
	5. I was unable to become enthusiastic about anything					
	6. I felt I wasn't worth much as a person					
	7. I felt that life was meaningless					
Anxiety	1. I felt scared without any good reason					
	2. I was aware of the action of my heart in the absence of physical exertion (Increase heart rate, heart missing beat)					
	3. I felt I was close to panic					
	4. I was worried about situations					
	5. I experienced trembling					
	6. I experienced breathing difficulty					
	7. I was aware of dryness of my mouth					

Brief Biography

Subrata Dey son of Ashok Dey and Mita Dey passed the Secondary School Certificate Examination in 2009 and then Higher Secondary Certificate Examination in 2011. Subrata dey obtained his B.Sc. (Hons.) in Food Science & Technology in 2017 from Chattogram Veterinary and Animal Sciences University (CVASU), Bangladesh. Now, he is a candidate for the degree of M.S in Applied Human Nutrition and Dietetics under the Department of Applied Food science and Nutrition, Faculty of Food Science and Technology, Chattogram veterinary and Animal Sciences University (CVASU).