

ORIGINAL ARTICLE

Nutritional Status, Dietary Habits and Sanitation Practices of Adolescent Girls in Sunamganj District of Bangladesh

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ABSTRACT

Background: Problems related to nutrition and personal hygiene are widespread among adolescent Bangladeshi girls. This study assessed the nutritional status, dietary habits, and sanitation practices of adolescent girls of Sunamganj District in Bangladesh.

Methods: Totally, 380 adolescent 11-18-year-old girls from 4 different schools and madrasas of Sunamganj District in Bangladesh were randomly enrolled. A structured questionnaire and standard anthropometric methods were used to collect the data.

Results: Totally, 4.2%, 26.6%, 1.3%, 7.8%, 7.5%, 3.2% and 20.1% of girls were 'severely stunted', 'stunted', 'obese', 'overweight', 'thin', 'severely thin' and 'in the risk of being thinness', respectively. Most of girls came from humble socio-economic backgrounds and over two-thirds of their parents were 'below primary' or 'up to primary' educational level. Regarding nutritional knowledge, 32.8% of girls' performance was 'poor', whereas 55.5% were 'average'. The Individual Dietary Diversity (IDD) of 33.8%, 23.4%, and 42.9% of girls were 'poor', 'medium', and 'high', respectively. The Food Consumption Score (FCS) of 0.6%, 11.7%, and 87.7% of girls fell within 'poor', 'borderline', and 'acceptable' categories, respectively. Regarding sanitation practices during the menstrual period, 26.9%, 1.9%, 17.9%, and 39.9% of girls used 'old clothes', 'tissue papers', 'new clothes', and 'napkin pads', respectively, while 86%, 29.5%, and 80.2% of girls habitually washed their hands with soap 'after excretion', 'before preparing food' and 'before eating meals', respectively.

Conclusion: High percentages of girls were still undernourished because of their lower socio-economic conditions and due to lack of knowledge and awareness on personal hygiene.

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Introduction

Problems related to nutrition and personal hygiene are widespread among adolescent girls throughout Bangladesh (1). Adolescents represent 20% of world's population and around 84% are found in developing countries like Bangladesh. During 2011-2014, 26% of Bangladeshi adolescents had stunted growth, 11% were thin and 3-7% were obese (2). More than half of adolescent girls in Bangladesh consume inadequately diverse diets, because of their lack of knowledge in nutrition and a balanced diet (3). The existent well-being and future outcomes of the population of a nation are largely dependent on adolescents' health, especially on adolescent girls' health, because they are the 'future mothers' of a nation (4, 5).

Besides, poor dietary habits and unhygienic sanitation practices cause diarrhea, diseases of reproductive tracts, and other infectious diseases contributing to undernutrition (6). In Sylhet region, 16-17% of 10-18 years old adolescent girls are 'thin', while 31-32% have 'stunted physical growth'(7). In Sunamganj District, 40.9% of children are underweight as the highest across Bangladesh, while 46.1% are stunted, with the highest percentage in Sylhet division (8) as the most underdeveloped and underprivileged districts of Bangladesh (9). Although some studies explored the nutritional status and reproductive health of adolescent girls in other regions of Bangladesh (1-3, 10-15),

the current nutritional condition and sanitation practices of adolescent girls in Sunamganj District remained unknown. Most nutritional data regarding Sunamganj District focus on malnutrition of young children below 5 years (16), but no elaborate and in-depth study investigated nutritional status, dietary habits and sanitation practices of adolescent girls in Sunamganj District of Bangladesh.

Materials and Methods

From March to May 2019, three hundred and eight 11-18 years old adolescent girls studying in 6 to 9 classes at Meruakhola Mominia Fazil Madrasa, Lobjan Chowdhury Girls High School (in urban area), and Dighirpar Dakhil Madrasa (in rural area) in Sunamganj District of Bangladesh, were enrolled. Data regarding family background, religion, age, educational qualification, occupation, and income of their parents were provided by interviewers properly trained by Bangladesh Institute of Research and Training on Applied Nutrition. This study was approved by the Local Ethics Committee. All the study steps were performed in accordance with the Helsinki Declaration. The research design was shown in Figure 1. The height was measured using a vertical measuring rod, and weight through a beam balance scale (17). Mid-upper arm circumference (MUAC) was measured by MUAC tape. Since no special MUAC tape was available for adolescents, MUAC cut off was set as given in Table 1 and

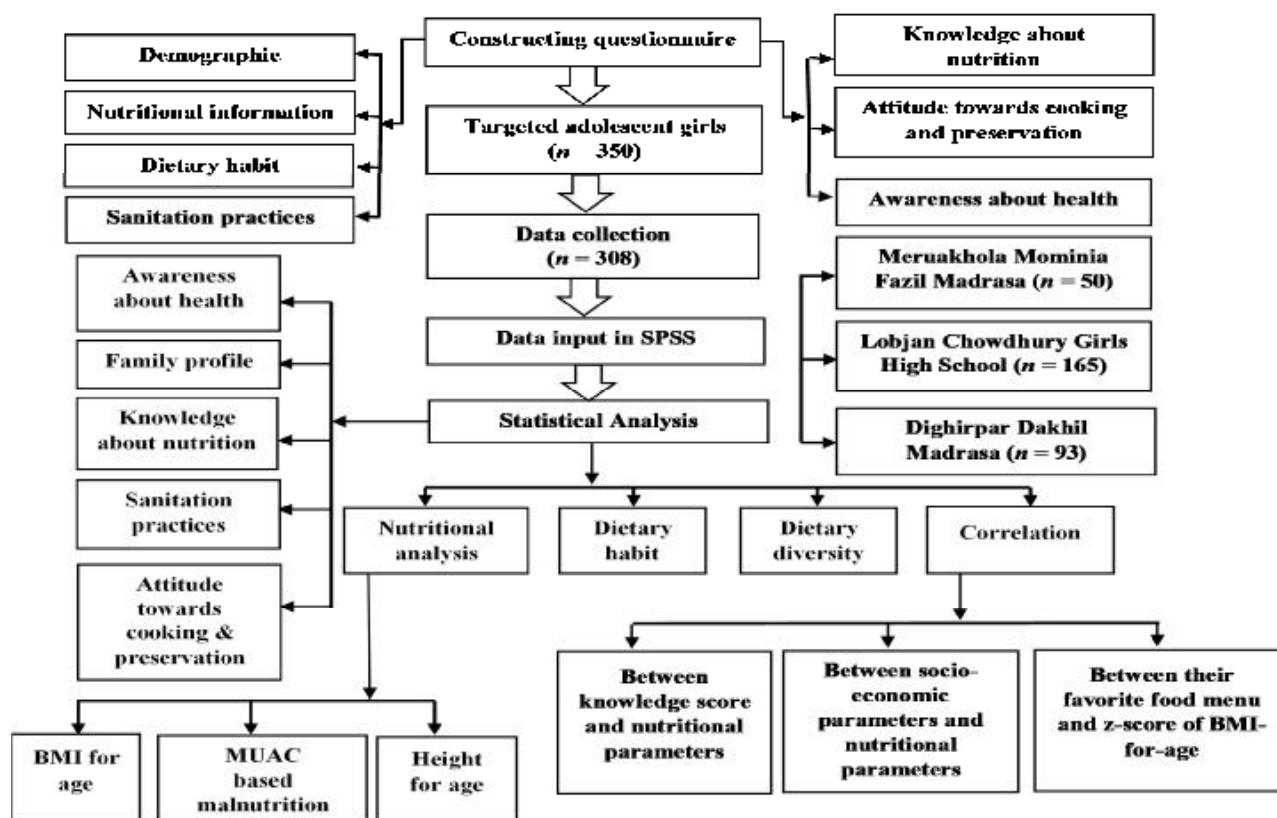


Figure 1: Design of the research study.

Table 1: Classification of different nutritional conditions of adolescent girls based on mid-upper arm circumference (MUAC).

Classification	MUAC (x in cm)
SAM	$x \geq 19$
MAM	$19 < x \leq 20$
RAM	$20 < x \leq 21$
Well nourished	$x > 21$

SAM=Severe Acute Malnutrition; MAM=Moderate Acute Malnutrition; RAM=Risk for Acute Malnutrition.

Table 2: Classification of different nutritional conditions based on BMI-for age and height-for-age of adolescent girls.

Categories	Classification	z-score (z)
BMI-for-age	Severely thin	$z < -3SD$
	Thin	$-3SD \leq z < -2SD$
	Possible risk of thinness	$-2SD \leq z < -1SD$
	Normal	$-1SD \leq z \leq 1SD$
	Overweight	$1SD < z \leq 2SD$
	Obese	$z > 2SD$
Height-for-age	Severely stunted	$z' < -3SD$
	Stunted	$-3SD \leq z' \leq -2SD$
	Normal	$z' > -2SD$

Table 3: Different categories of knowledge and awareness regarding nutrition.

Category	Knowledge and awareness (y in %)
Poor	$0 \leq y < 40$
Average	$40 < y < 60$
Good	$60 < y < 80$
Excellent	$y \geq 80$

classified as severe acute malnutrition (SAM), moderate acute malnutrition (MAM), risk for acute malnutrition (RAM), and well-nourished. The Body Mass Index (BMI) was calculated using formula of

$$\text{Body mass index (BMI)} = \frac{\text{Weight (kg)}}{\text{Height}^2 (\text{m}^2)}$$

BMI-for-age and height-for-age were computed using AnthroPlus software according to international growth references of World Health Organization (18). The classifications regarding nutritional condition were based on Z-score of BMI-for-age and height-for-age (Table 2). For appraising the situation of nutrition knowledge, one score was awarded for correct response and zero for incorrect response of each question. The percentage of total correct responses of all subjects about nutrition knowledge was presented in Table 3. Questions related to dietary habit, type of diet consumed, frequency of meals taken in last 24 hours, frequency of meal skipped in a day, source of tiffin meal, and their favorite food menu were asked and responses were recorded. For assessment of individual dietary diversity (IDD), dietary intake was estimated through a 24-hour recall method. Ten food groups were set to understand the situation of dietary diversity of selected girls. The

food groups were iron-rich foods (banana, arum spinach, eggplant, etc.), cereal-based food products (naan, paratha, bread, rice, etc.), potatoes, root vegetables, nuts, pulses, milk meal (yogurt, cheese, milk, etc.), oil, butter, fish, meat, vitamin A-rich fruits and vegetables (carrot, orange, sweet potato, mango, papaya, green vegetables, pumpkin, bean, etc.), egg, sugar, molasses, other fruits, vegetables and condiments (garlic, onion, etc.).

As there were ten food groups, a ten-scoring system was applied and scores less than 5 were considered as poor, 5 as medium, and 6 or more as high dietary diversities. A brief questionnaire was developed to ask each girl about frequency of their household's consumptions of eight different food groups based on a 24-hour recall method during the last seven days. The scoring was done according to established method of World Food Program (WFP) about Food Consumption Score (FCS) (19) that has a strong relationship with Household Dietary Diversity (HDD) (20). Questions related to sanitation practices were collected by questionnaire cum interview method. The WHO AnthroPlus (2007) software was used to evaluate the growth of girls. Data was analyzed by descriptive statistics using SPSS software (Version 23, Chicago, IL, USA).

Table 4: Family profile of the adolescent girls studying in different schools and madrasas of Sunamganj District.

Categories	Demographic	Meruakhola Mominia Fazil Madrasa (n=50)		Lobjan Chowdhury Girls High School (n=165)		Dighirpar Dakhil Madrasa (n=93)		Overall (n=308)	
		N	%	N	%	N	%	N	%
Religion	Muslim	50	100	152	92.1	93	100	295	95.8
	Hindu	-	-	13	7.9	-	-	13	4.2
Marital status	Unmarried	50	100	165	100	93	100	308	100
	Married	-	-	-	-	-	-	-	-
Family Members	Below 5	8	16	33	20	5	5.4	46	14.9
	5 to 10	41	82	126	76.4	79	84.9	246	79.9
	11 to 15	1	2	4	2.4	7	7.5	12	3.9
	Over 15	-	-	2	1.2	2	2.2	4	1.3
Education of Fathers	Uneducated	12	24	36	21.8	26	28	74	24
	Below class five	-	-	6	3.6	1	1.1	7	2.3
	PSC level	27	54	69	41.8	45	48.4	141	45.8
	JSC level	3	6	6	3.6	2	2.2	11	3.6
	SSC level	2	4	30	18.2	12	12.9	44	14.3
	HSC level	4	8	6	3.6	1	1.1	11	3.6
	Graduates	1	2	5	3	-	-	6	1.9
	Post graduates or above	1	2	-	-	1	1.1	2	0.6
	Others	-	-	1	0.6	4	4.3	5	1.6
Don't Know	-	-	6	3.6	1	1.1	7	2.3	
Education of Mothers	Uneducated	16	32	33	20	27	29	76	24.7
	Below class five	-	-	2	1.2	1	1.1	3	1
	PSC	29	58	93	56.4	51	54.8	173	56.2
	JSC	2	4	13	7.9	5	5.4	20	6.5
	SSC	3	6	17	10.3	9	9.7	29	9.4
	HSC	-	-	4	2.4	-	-	4	1.3
Graduate	-	-	3	1.8	-	-	3	1	

PSC=Primary School Certificate (equivalent to 5th grade), JSC=Junior School Certificate (equivalent to 8th grade), SSC=Secondary School Certificate (equivalent to 10th grade), HSC=Higher Secondary School Certificate (equivalent to 12th grade).

Results

Family profile of girls studying in Sunamganj District was presented in Table 4. All girls studying in Meruakhola Mominia Fazil Madrasa and Dighirpar Dakhil Madrasa were Muslim. 92.1% of girls studying in Lobjan Chowdhury Girls High School were Muslim and 7.9% were Hindu. 95.8% of students were Muslim, while 4.2% of girls were Hindu. All girls in Meruakhola Mominia Fazil Madrasa, Lobjan Chowdhury Girls High School, and Dighirpar Dakhil Madrasa were unmarried and 14.9%, 79.9%, 3.9%, and 1.3% had 'less than 5', '5 to 10', '11 to 15', and 'over 15' family members, respectively. Totally, 79.9% of girls had 5 to 10 family members and 24% of fathers were uneducated and 2.3% studied below 'Primary School Certificate (PSC) level. 45.8%, 3.6%, 14.3% and 3.6% of fathers passed PSC, Junior School Certificate (JSC), Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) level, respectively. Only 1.9% of girls' parents were graduates, while 0.6% were postgraduates. The

remaining 3.8% were listed within 'others' and 'don't know' categories. 24.7% of mothers of girls were uneducated and 1% studied below 'PSC level, and 56.2%, 6.5%, 9.4% and 1.3% passed PSC, JSC, SSC and HSC levels, respectively.

Only 1% of mothers were graduates and no mother was postgraduate. The girls' parents (45.8% of fathers and 56.2% of mothers) were educated up to PSC level. Around 12.3% of fathers were from rural areas (Meruakhola Mominia Fazil Madrasa and Dighirpar Dakhil Madrasa) and 11.7% were from urban regions (Lobjan Chowdhury Girls High School). Among fathers in urban areas, 1.9% were educated below class five, 22.4% passed PSC, 1.9% passed JSC, 9.7% passed SSC, and 1.9% passed HSC levels and 1.6% were graduates. In rural areas, 0.3% of fathers studied below class five, 23.4% passed PSC, 1.6% passed JSC, 4.5% passed SSC, and 1.6% passed HSC levels, 0.3% were graduates and 0.6% were 'postgraduates or above'. Among uneducated mothers, 14% were from rural areas and 10.7% from towns, while uneducated mothers were more

in rural areas. Regarding mothers in urban areas, 0.6% studied below class five, 30.2% passed PSC, 4.2% passed JSC, 5.5% passed SSC and 1.3% passed HSC levels and 1% was graduates. For mothers in countryside, 0.3% were below class five, 26% passed PSC, 2.2% passed JSC, and 3.9% passed SSC levels. The level of education between parents in countryside and parents in towns was similar. The living area of parents did not have any impact on education.

The occupational status of girls' parents in Sunamganj was presented in Table 5, while 6.8%

of girls' fathers were unemployed, 4.5% were private job holders, 5.2% government employees, 19.2% businessmen, 27.9% farmers, 18.2%, and 2.6% were immigrant and workers, respectively and 15.6% were categorized as 'others' (fishermen, drivers, bricklayers, rickshaw pullers, tailors, social workers, homeopathic doctors, traditional healers, religious leaders, etc.). Regarding laborers, 19.2% of fathers were local laborers, while 2.6% were immigrant workers. Only 1.6% of rural fathers were government employees as compared to 3.6%

Table 5: Occupational and income status of the parents of adolescent girls studying in different schools and madrasas of Sunamganj District.

Categories	Demographic	Meruakhola Mominia Fazil Madrasa (n=50)		Lobjan Chowdhury Girls High School (n=165)		Dighirpar Dakhil Madrasa (n=93)		Overall (n=308)	
		N	%	N	%	N	%	N	%
Occupation of father	Unemployed	4	8	14	8.5	3	3.2	21	6.8
	Private job holders	2	4	9	5.5	3	3.2	14	4.5
	Government employees	2	4	11	6.7	3	3.2	16	5.2
	Local laborers	10	20	37	22.4	12	12.9	59	19.2
	Businessmen	15	30	51	30.9	20	21.5	86	27.9
	Farmers	12	24	5	3	39	41.9	56	18.2
	Immigrant workers	-	-	7	4.2	1	1.1	8	2.6
	Others ¹	5	10	31	18.8	12	12.9	48	15.6
Occupation of mother	Housewives	47	94	153	92.7	93	100	293	95.1
	Private job holders	-	-	5	3	-	-	5	1.6
	Laborers	1	2	2	1.2	-	-	3	1
	Businesswomen	1	2	-	-	-	-	1	0.3
	Others ²	1	2	5	3	-	-	6	1.9
Monthly income of fathers (in taka*)	No income	5	10	17	10.3	3	3.2	25	8.1
	Below 5,000	6	12	22	13.3	10	10.8	38	12.3
	Below 10,000	23	46	47	28.5	31	33.3	101	32.8
	Below 20,000	13	26	45	27.3	34	36.6	92	29.9
	Below 50,000	2	4	19	11.5	6	6.5	27	8.8
	Above 50,000	-	-	3	1.8	1	1.1	4	1.3
	Others ³	1	2	12	7.3	8	8.6	21	6.8
Monthly income of mothers (in taka*)	No income	48	96	151	91.5	93	-	292	94.8
	Below 5,000	2	4	4	2.4	-	-	6	1.9
	Below 10,000	-	-	2	1.2	-	-	2	0.6
	Below 20,000	-	-	6	3.6	-	-	6	1.9
	Below 50,000	-	-	1	0.6	-	-	1	0.3
	Others ³	-	-	1	0.6	-	-	1	0.3
Provider of the family	Father	44	88	134	81.2	83	89.2	261	84.7
	Mother	2	4	6	3.6	-	-	8	2.6
	Brother	4	8	4	2.4	8	8.6	16	5.2
	Both father and mother	-	-	6	3.6	-	-	6	1.9
	Both father and brother	-	-	-	-	2	2.2	2	0.6
	Others ⁴	-	-	15	9.1	-	-	15	4.9

¹“Others” included fishermen, drivers, bricklayers, rickshaw pullers, tailors, social workers, homeopathic doctors, traditional healers, religious leaders etc. Some participants either simply did not know about their father's occupation or their fathers passed away. ²“Others” included tailors, immigrant workers etc. Some participants either simply did not know about their mother's occupation or their mothers passed away. ³Some respondents either did not have any idea about their parents' income or their parents passed away. ⁴“Others” included other family members such as cousins, uncles, in-laws etc. *1 United States Dollar (USD) = 84.93 Bangladeshi Taka (BDT) as of May, 2020.

of urban ‘government employee’ fathers.

Most of girls’ fathers living in rural and urban areas, were either farmers (16.6%) or businessmen (16.6%). 95.1% of mothers of girls were housewives, while 1.6%, 1%, and 0.3% were private jobholders, local laborers, and businesswomen, respectively and 1.9% were in other jobs (tailors, immigrant workers, etc.). 1.6% of rural mothers were private jobholders as compared to the 1.2% of urban ‘private job holder’ mothers. 0.6% of rural mothers were local laborers as compared to 0.3% of urban ‘local laborer’ mothers. Most of girls’ mothers in rural and urban areas were housewives. 45.5% of rural mothers were housewives as compared to 49.7% of urban ‘housewife’ mothers. The percentage of housewives in urban areas was slightly higher. 8.1% of girls’ fathers had no mentionable income, whereas 94.8% of mothers had no income. 12.3%, 32.8%, 29.9%, 8.8% and 1.3% of fathers’ monthly income were ‘below 5,000’, ‘below 10,000’, ‘below 20,000’, ‘below 50,000’ and ‘above 50,000 taka’, respectively. 6.8% of the respondents either simply did not have any idea about their fathers’ income or their fathers passed away.

As for monthly incomes of mothers, 1.9%, 0.6%, 1.9% and 0.3% of mothers’ monthly income were ‘below 5,000’, ‘below 10,000’, ‘below 20,000’, ‘below 50,000’ and ‘above 50,000 taka’, respectively. 0.3% of respondents either simply did not have any idea about their mothers’ income or their mothers passed away. 84.7% of families were dependent on father’s

income, whereas 2.6% and 5.2% of families were dependent on their mothers’ and brothers’ income, respectively. 1.9% of families were dependent on both fathers’ and mothers’ combined income, while 0.6% depended on fathers’ and brothers’ combined income. 4.9% of families depended on income of other family members such as cousins, uncles, in-laws, etc. 1.9% of ‘urban’ families depended on mother’s income as compared to 0.6% of ‘rural’ families who depended on mother’s income.

The nutritional status of girls based on MUAC was demonstrated in Table 6 showing 17.5% and 14% of girls suffering from SAM and MAM, respectively and 11.4% were at ‘risk of RAM, and 57.1% were ‘well-nourished’. 7.5% of ‘rural’ girls suffered from SAM as compared to 10.1% of ‘urban’ girls. 8.8% of ‘rural’ girls suffered from MAM, whereas 5.2% of ‘urban’ girls suffered from that. Risk of SAM was higher among girls in urban areas. But risk of malnutrition was lower among girls in urban areas (4.5%) compared to rural areas (6.8%). Among well-nourished girls, 23.4% lived in rural areas, while 33.8% were from urban areas.

Nutritional condition based on BMI-for-age of participants was given in Table 6 showing 1.3%, 7.8%, 57.5%, 7.5%, and 3.2% were ‘obese’, ‘overweight’, ‘healthy’, ‘thin’ and ‘severely thin’, respectively. Among ‘healthy’ girls in Sunamganj, 27% were from rural areas, whereas 30.5% resided in urban regions. A new category namely “possible risk of thinness (PRT)” was introduced to identify

Table 6: Nutritional status of adolescent girls studying in different schools and madrasas of Sunamganj District.

Considerations	Nutritional Conditions	Meruakhola Mominia Fazil Madrasa (n=50)		Lobjan Chowdhury Girls High School (n=165)		Dighirpar Dakhil Madrasa (n=93)		Overall (n=308)	
		N	%	N	%	N	%	N	%
		MUAC	SAM	11	22	31	18.8	12	12.9
	MAM	7	14	16	9.7	20	21.5	43	14
	RAM	5	10	14	8.5	16	17.2	35	11.4
	Well nourished	27	54	104	63	45	48.4	176	57.1
BMI-for-age	Edema	5	10.0	-	-	3	3.2	8	2.6
	Obese	-	-	4	2.4	-	-	4	1.3
	Overweight	2	4	19	11.5	3	3.2	24	7.8
	Normal	28	56.0	94	57	55	59.1	177	57.5
	PRT	9	18.0	29	17.6	24	25.8	62	20.1
	Thin	2	4.0	15	9.1	6	6.5	23	7.5
	Severely thin	4	8.0	4	2.4	2	2.2	10	3.2
	Total	50	100	165	100	93	100	308	100
Height-for-age	Severely stunted	2	4	6	3.6	5	5.4	13	4.2
	Stunted	15	30	38	23	29	31.2	82	26.6
	Normal	33	66	121	73.3	59	63.4	213	69.2
	Total	50	100	165	100	93	100	308	100

Mid-Upper Arm Circumference (MUAC); SAM=Severe Acute Malnutrition; MAM=Moderate Acute Malnutrition; RAM=Risk for Acute Malnutrition; PRT=Possible risk of thinness.

girls who were 'healthy' as per the World Health Organization reference based on z-score of BMI-for-age (11), nonetheless, were considered to be 'on verge of being thin' if their required daily nutrition would not be met continuously. 20.1% of adolescent girls were found to be at PRT.

10.7% of girls who fell within this category were from rural areas, whereas 9.4% were from urban regions. 2.6% of girls had edema. All girls with edema lived in rural areas and 1.9%, 2.5%, and 1.6% of 'rural' girls were 'severely thin', 'thin' and 'overweight', respectively; whereas 1.3%, 4.9%, and 6.3% of 'urban' girls were 'severely thin', 'thin' and 'overweight', respectively. The percentage of 'thin' and 'overweight' girls was higher in urban areas. All 'obese' girls were from urban areas, while a higher percentage of 'severely thin' girls were in rural areas. Nutritional status based on height-for-age of girls was displayed in Table 6 showing 4.2%, 26.6%, and 69.2% were 'severely stunted', 'stunted' and 'normal', respectively.

2.2%, 14.3%, and 29.9% of girls in rural areas

were 'severely stunted', 'stunted' and 'normal', respectively; whereas 1.9%, 12.3%, and 39.3% of 'urban' girls were 'severely stunted', 'stunted' and 'normal', respectively. The percentage of 'severely stunted' and 'stunted' girls was higher in rural areas. The percentage of adolescent girls with normal height for their age was higher in urban areas. According to report of Global Alliance for Improved Nutrition, 26% of girls were physically stunted in Bangladesh. As for Sunamganj District, the amount of physically stunted population was 30.8% compared to prevalence of 31-32% stunted population in north-eastern Sylhet region.

Nutritional knowledge of girls in relation to energy, protein, vitamins, minerals, and a balanced diet was exhibited in Table 7. The awareness about cooking hygiene, preservation practices, and health consciousness along with their knowledge status in general hygiene was indicated in Table 8 demonstrating 32.8%, 55.5%, 11.7% of girls' knowledge for selected topics were 'poor', 'average', and 'good', respectively (Table 8). None of girls' knowledge

Table 7: Correct responses of adolescent girls regarding nutritional knowledge studying in different schools and madrasas of Sunamganj District.

Topics	Knowledge of Nutrition	Meruakhola Mominia Fazil Madrasa (n=50)		Lobjan Chowdhury Girls High School (n=165)		Dighirpar Dakhil Madrasa (n=93)		Overall (n=308)	
		N	%	N	%	N	%	N	%
Energy	Nutrient provides maximum energy per gram	3	6	21	12.7	14	15.1	38	12.3
	Source of carbohydrates	10	20	69	41.8	36	38.7	115	37.3
Protein	Main function of protein	14	28	44	26.7	32	34.4	90	29.2
	Protein enriched foods	7	14	51	30.9	21	22.6	79	25.6
	Protein deficiency disease	12	24	47	28.5	30	32.3	89	28.9
Vitamins and minerals	Role of vitamin D	2	4	26	15.8	9	9.7	37	12
	Effect of excess vitamin intake	33	66	110	66.7	55	59.1	198	64.3
	Fat soluble vitamin	14	28	42	25.5	19	20.4	75	24.4
	Water soluble vitamin	13	26	37	22.4	17	18.3	67	21.8
	The cause for scurvy	15	30	52	31.5	30	32.3	97	31.5
	Vitamin A deficiency disease	21	42	107	64.8	52	55.9	180	58.4
	Vitamin enhances absorption of calcium	25	50	71	43	50	53.8	146	47.4
	Source of vitamins and minerals	38	76	107	64.8	66	71	211	68.5
	Iron deficiency disease	24	48	53	32.1	39	41.9	116	37.7
	Foods rich in iron	8	16	52	31.5	27	29	87	28.2
Balanced diet	Rich source of Iron	11	22	42	25.5	25	26.9	78	25.3
	Foods rich in calcium	4	8	32	19.4	10	10.8	46	14.9
	The reason for gill disease	18	36	61	37	32	34.4	111	36
	Role of balanced diet	35	70	131	79.4	77	82.8	243	78.9
	Health problems due to lack of balanced diet	35	70	123	74.5	71	76.3	229	74.4
	Beneficial fatty acids	12	24	38	23	35	37.6	85	27.6
	Ideal Balanced meal	31	62	97	58.8	54	58.1	182	59.1

Table 8: Correct responses of adolescent girls regarding cooking hygiene, preservation practices and health consciousness along with their knowledge status in general hygiene.

Topics	Awareness	Meruakhola Mominia Fazil Madrasa (n=50)		Lobjan Chowdhury Girls High School (n=165)		Dighirpar Dakhil Madrasha (n=93)		Overall (n=308)	
		N	%	N	%	N	%	N	%
		Cooking hygiene and preservation practices	The best way to eat an egg	24	48	87	52.7	25	26.9
Foods with bad smell should be thrown away to the dustbin	48		96	155	93.9	83	89.2	286	92.9
Duties before eating fruits	37		74	126	76.4	74	79.6	237	76.9
Foods is not preserved by salting	33		66	92	55.8	60	64.5	185	60.1
Section of a fridge should be used for egg preservation	6		12	17	10.3	18	19.4	41	13.3
Food-borne diseases can result from contamination of ready-to-eat food stored close to raw meat	24		48	76	46.1	44	47.3	144	46.8
Practices should be done to preserve vitamin C when cooking vegetables	35		70	125	75.8	57	61.3	217	70.5
Inadequate preservation is the most common factor responsible for food poisoning	24		48	77	46.7	41	44.1	142	46.1
Foods prepared too long in advance might give microbes time to grow	30		60	107	64.8	69	74.2	206	66.9
Chicken having <i>Salmonella</i> impacts after being cooked	15		30	36	21.8	15	16.1	66	21.4
Unsafe drinking habit	28		56	113	68.5	76	81.7	217	70.5
Practices induce sickness	27		54	101	61.2	63	67.7	191	62
Q1: Is it possible to maintain good health with proper amount of food consumption and regular exercises?									
Yes	26		52	95	57.6	51	54.8	172	55.8
No	19		38	58	35.2	30	32.3	107	34.7
Don't know	5	10	12	7.3	12	12.9	29	9.4	
Q2: Eating junk food instead of a normal diet has an adverse impact on health. Do you agree with the statement?									
Yes	24	48	108	65.5	50	53.8	182	59.1	
No	13	26	30	18.2	17	18.3	60	19.5	
Don't know	13	26	27	16.4	26	28	66	21.4	
Q3: After washing your hands, you should dry them with a multi-use kitchen towel. Do you agree with the statement?									
Yes	16	32	47	28.5	37	39.8	100	32.6	
No	24	48	88	53.3	35	37.6	147	47.7	
Don't know	10	20	30	18.2	21	22.6	61	19.8	
Q4: Do you agree that microbes may be present in the skin, nose and mouth of healthy people and can contaminate foods?									
Yes	22	44	71	43	40	43	133	43.2	
No	15	30	35	21.2	16	17.2	66	21.4	
Don't know	13	26	59	35.8	37	39.8	109	35.4	
Q5: To stay healthy, the school environment should be clean and clean. Do you agree with the statement?									
Yes	48	96	163	98.8	91	97.8	302	98.1	
No	2	4	1	0.6	1	1.1	4	1.3	
Don't know	-	-	1	0.6	1	1.1	2	0.6	
Poor	19	38	45	27.3	37	39.8	101	32.8	
Average	27	54	102	61.8	42	45.2	171	55.5	
Good	4	8	18	10.9	14	15.1	36	11.7	
Excellent	-	-	-	-	-	-	-	-	

was considered as ‘excellent’ based on obtained scores. The percentage of ‘poor’ knowledge among girls was higher in rural areas (18.2%) compared to urban regions (14.6%). The percentage of ‘average’ knowledge was lower among girls who resided in rural areas (22.4%) in comparison to urban regions (33.1%). The percentage of ‘high’ knowledge was the same for both rural (5.8%) and urban areas (5.8%).

Consumption of different food groups within the last 24 hours among girls was mentioned in Table 9 illustrating 46.9%, 93.9%, 40.1%, 33%, 37.9%, 90.9%, 68.3%, 34.3%, 26.9%, and 60.8% consumed iron-rich foods, cereal-based food products, nuts and pulses, milk meal, oil or fat, fish or meat, vitamin A-rich fruits and vegetables, egg, sugar or molasses and other fruits and vegetables, respectively. The dietary patterns of girls regarding consumption habits, IDD and FCS status were presented in Table 10 indicating 99.7% were non-vegetarian. During tiffin, most of them ate unpacked foods brought from outdoor school premises (37.5%) or unpacked school foods (32.2%).

The majority of girls were either ‘never skipped meal’ (43.5%) or ‘sometimes skipped meal’ (48.1%) during a day. Girls who used skip meals did so on dinner (31.8%). Most of girls (38.3%) used to eat during the morning period. The favorite food menu for most of girls was “rice, meat, fishes, vegetables, and fruits” (81.8%). 34.7% of girls used to eat vitamin-C-rich foods along with calcium-rich foods; while 42.9% did not consume. Dense violet-colored iodine-fortified salt was the preference of most of girls (68.8%) during cooking. The IDD status of 33.8%, 23.4%, and 42.8% of girls was ‘poor’, ‘medium’, and ‘high’, respectively. The percentage of ‘poor’ and ‘medium’ IDD status was higher among adolescent girls in rural areas (Figure 2). Regarding FCS, 0.6%, 11.7%, and 87.7% of girls’ scores fell within ‘poor’, ‘borderline’, and ‘acceptable’ categories, respectively. Considering living areas, all categories of FCS were higher in urban girls (Figure 3).

The sanitation practices of girls were given in Table 11. The source of drinking water of 61%, 34.7%, 0.6%, 0.3%, and 1.6% of families of girls was ‘deep tube well’, ‘shallow tube well’, ‘pond’, ‘well water’, and ‘supplied water’, respectively. Regarding excretion, 73.7%, 3.6%, 21.8%, and 1% of girls’ family members used ‘hygienic personal toilet’, ‘hygienic social public toilet’, ‘unhygienic toilet’ and ‘open places’, respectively. Considering washing their hands by soap, ash or sand, 86%, 29.5%, 80.2%, 1.9%, and 1.9% of the girls did so ‘after excretion’, ‘before preparing food’, ‘before eating’, ‘before feeding a child’ and ‘after wiping a baby after excretion’, respectively. When asked about their menstrual period, 79.5% of girls responded regular menstrual periods, while 18.5% replied negatively. In terms of sanitation practices during menstrual period, 39.9%, 17.9%, 26.9%, and 1.9% of girls used ‘napkin pads’, ‘new clean clothes’, ‘old unclean clothes’ and ‘tissue papers’, respectively.

The relationship between socio-economic conditions of parents and nutritional status of adolescent girls (by Eta association) was shown in Table 12. The socio-economic factors (such as the education, occupation, and income of parents) were weakly associated with nutritional conditions of adolescent girls. The z-score of BMI-for-age was found to be weakly associated (by Eta association) with education, occupation and income of parents of girls. The correlation values between z-scores of BMI-for-age and ‘education of father’, ‘education of mother’, ‘occupation of father’, ‘occupation of mother’, ‘income of father’ and ‘income of mother’ were 0.172, 0.245, 0.172, 0.07, 0.151, and 0.181, respectively.

The correlation values between z-scores of height-for-age and ‘education of father’, ‘education of mother’, ‘occupation of father’, ‘occupation of mother’, ‘income of father’ and ‘income of mother’ were 0.2, 0.125, 0.187, 0.104, 0.144 and 0.128, respectively. A weak relationship (correlation

Table 9: Percentage of adolescent girl’s consumption of different food groups based on a 24-hour recall period.

Food group	N	%
Iron rich foods (raw banana, arum spinach, eggplant etc.)	145	46.9
Cereal based food products (naan, paratha, bread, rice), potatoes, root vegetables	290	93.9
Nuts and pulses	124	40.1
Milk meal (yogurt, cheese, milk)	102	33
Oil, fat, butter (consumed separately, not as a cooking ingredient)	117	37.9
Fish /meat	281	90.9
Vitamin A rich fruits and vegetables (carrot, orange, sweet potato, mango, papaya, green vegetables, pumpkin, bean etc.)	211	68.3
Egg	106	34.3
Sugar, molasses, raw molasses (excluding tea)	83	26.9
Other fruits and vegetables (banana, apple, pineapple, watermelon, garlic, tomato, corn, onion etc.)	188	60.8

Table 10: Dietary pattern, individual dietary diversity status* and food consumption score status* of adolescent girls studying in different schools and madrasas of Sunamganj District.

Topics	Categories	Meruakhola Mominia Fazil Madrasa (n=50)		Lobjan Chowdhury Girls High School (n=165)		Dighirpar Dakhil Madrasha (n=93)		Overall (n=308)	
		N	%	N	%	N	%	N	%
Food consumption habits	Q1: In which type of dietary habit do you belong?								
	Vegetarian	-	-	-	-	1	1.1	1	0.3
	Non-vegetarian	50	100	165	100	92	98.9	307	99.7
	Q2: What do you eat during tiffin?								
	Home food	3	6	1	0.6	7	7.5	11	3.6
	Outdoor packet food	6	12	12	7.3	21	22.6	39	12.7
	Outdoor unpacked foods	26	52	33	20	57	61.3	115	37.5
	Packet foods of school	-	-	45	27.3	-	-	45	14.7
	Unpacked school foods	3	6	91	55.2	5	5.4	99	32.2
	Don't eat	12	24	1	0.6	3	3.2	15	4.9
	Sometimes don't eat	-	-	2	1.2	-	-	2	0.7
	Q3: Do you skip meal?								
	Yes	2	4	19	11.5	5	5.4	26	8.4
	No	21	42	54	32.7	59	63.4	134	43.5
	Sometimes	27	54	92	55.8	29	31.2	148	48.1
	Q4: In which segment of a day you skip your meal?								
	Breakfast	6	12	45	27.3	13	14	64	20.8
	Lunch	12	24	32	19.4	8	8.6	52	16.9
	Dinner	23	46	60	36.4	15	16.1	98	31.8
	Don't skip	9	18	28	17	57	61.3	94	30.5
	Q5: Which part of the day do you eat most?								
	Morning	24	48	43	26.1	51	54.8	118	38.3
	Noon	15	30	73	44.2	24	25.8	112	36.4
	Night	11	22	49	29.7	18	19.4	78	25.3
	Q6: What do you like to eat most?								
	Rice, meat, fish, vegetables, fruits	43	86	119	72.1	90	96.8	252	81.8
	Polao, meat, soft drinks	-	-	11	6.7	-	-	11	3.6
	Noodles, burger, samosa, sweet	4	8	25	15.2	2	2.2	31	10.1
	Bread, nut, vegetables, yogurt	3	6	10	6.1	1	1.1	14	4.5
	Q7: Do you eat Vitamin-C foods along with calcium rich foods?								
Yes	15	30	55	33.3	37	39.8	107	34.7	
No	22	44	80	48.5	30	32.3	132	42.9	
Sometimes	12	24	24	14.5	26	28	62	20.1	
Don't know	1	2	6	3.6	-	-	7	2.3	
Q8: What type of salt does your family use during cooking?									
Iodized salt (dense violet)	29	58	129	78.2	54	58.1	212	68.8	
Iodized salt (light violet)	6	12	20	12.1	18	19.4	44	14.3	
Salt without Iodine	15	30	13	7.9	21	22.6	49	15.9	
Don't know	-	-	3	1.8	-	-	3	1	
Individual dietary diversity status*	Poor	17	34	67	40.6	20	21.5	104	33.8
	Medium	16	32	29	17.6	27	29	72	23.4
	High	17	34	69	41.8	46	49.5	132	42.9
Food consumption score status*	Poor	-	-	2	1.2	-	-	2	0.6
	Borderline	8	16	25	15.2	3	3.2	36	11.7
	Acceptable	42	84	138	83.6	90	96.8	270	87.7

*Based on a 24-hour recall period

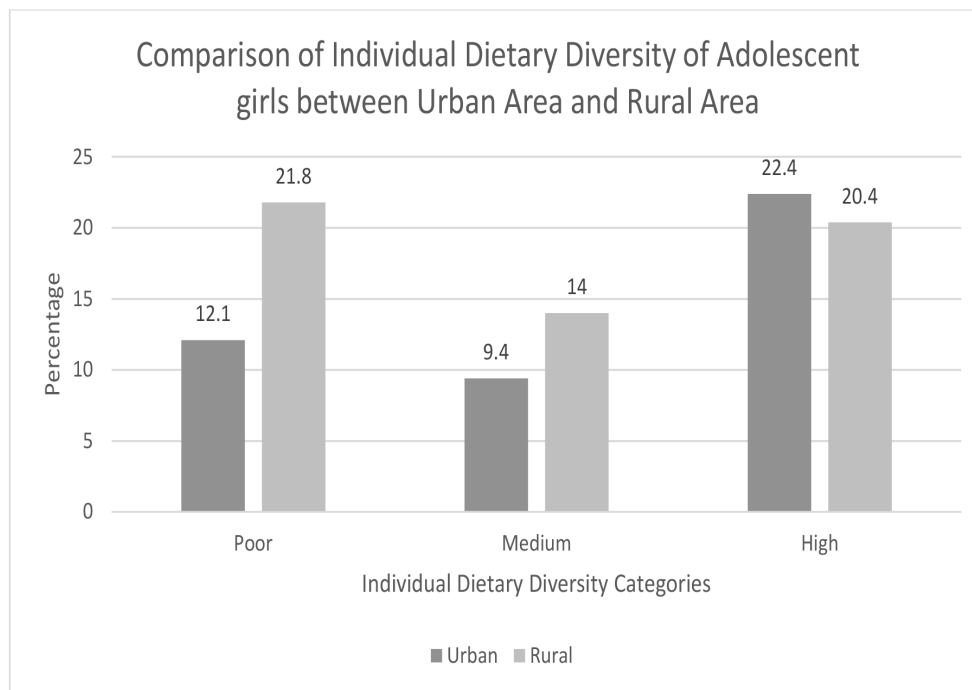


Figure 2: The Comparison of Individual Dietary Diversity of adolescent girls between urban and rural areas.

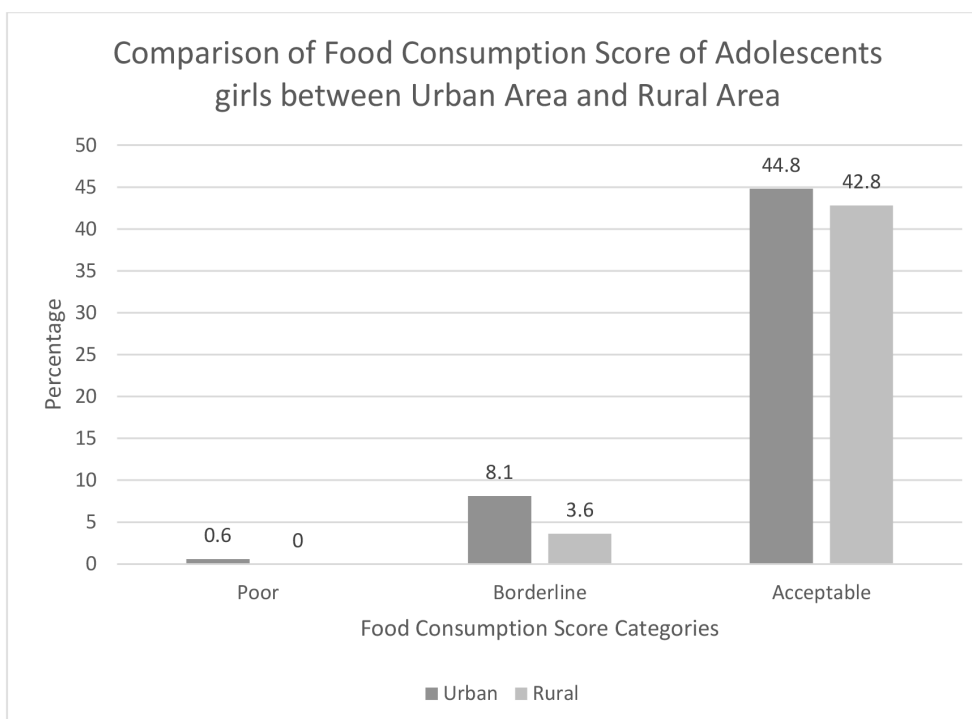


Figure 3: Comparison of Food Consumption Score of adolescents girls between urban and rural areas.

value=0.103 by Pearson correlation) was found between knowledge regarding nutrition, hygienic way of cooking, preservation, storage practices, and health of girls and their z-score of BMI-for-age. The correlation between consumption of favorite food menu (rice, fish, meat, vegetables, and fruits) and z-score of BMI-for-age was also found to be weak (correlation value=0.114 by Eta association).

Discussion

Among girls in the Sunamganj, most of girls were

from large Muslim families with a low socio-economic background. It is important to notice that not a single case of child marriage was found in the surveyed school and Madrasas which is widespread in Bangladesh in the last decade, even Bangladesh has been quite successful in preventing child marriage through years of fierce anti-child marriage campaign. The educational qualification of parents is a vital factor to judge the socio-economic status of a family, which is directly related to nutritional status (21). Most of the parents of girls did not have

Table 11: Sanitation practices of adolescent girls in Sunamganj District.

Sanitation practices	Meruakhola Mominia Fazil Madrasa (n=50)		Lobjan Chowdhury Girls High School (n=165)		Dighirpar Dakhil Madrasa (n=93)		Overall (n=308)	
	N	%	N	%	N	%	N	%
Q1: What is the present source of drinking water in your house?								
Deep tube well	30	60	120	72.7	38	40.9	188	61
Shallow tube well	17	34	36	21.8	54	58.1	107	34.7
Pond	2	4	-	-	-	-	2	0.6
Well water	1	2	-	-	-	-	1	0.3
Supplied water	-	-	4	2.4	1	1.1	5	1.6
Others	-	-	5	3	-	-	5	1.6
Q2: Where do your family members conduct their excretion?								
Personal toilet (hygienic)	36	72	150	90.9	41	44.1	227	73.7
Social public toilet (hygienic)	1	2	8	4.8	2	2.2	11	3.6
Unhygienic toilet	13	26	7	4.2	47	50.5	67	21.8
Open places	-	-	-	-	3	3.2	3	1.0
Q3: When do you wash your hand using soap, ash or sand?								
After Excretion	44	88	146	88.5	75	80.6	265	86
Before preparing food	13	26	49	29.7	29	31.2	91	29.5
Before eating	37	74	130	78.8	79	84.9	247	80.2
Before feeding a child	1	2	1	0.6	4	4.3	6	1.9
After wiping a baby after excretion	-	-	4	2.4	2	2.2	6	1.9
Others	2	4	4	2.4	1	1.1	7	2.3
Q4: Has your menstrual period started?								
Yes	38	76	132	80	75	80.6	245	79.5
No	12	24	27	16.4	18	19.4	57	18.5
Don't know	-	-	6	3.6	-	-	6	1.9
Q5: What do you use during period?								
Napkin pads	11	22	66	40	46	49.5	123	39.9
New clean clothes	8	16	37	22.4	10	10.8	55	17.9
Old unclean clothes	16	32	44	26.7	23	24.7	83	26.9
Tissue papers	1	2	3	1.8	2	2.2	6	1.9
Others	3	6	-	-	-	-	3	1

Table 12: Eta correlation of socio-economic conditions with nutritional status of adolescent girls in Sunamganj District.

Socio-economic conditions	Z-score of BMI-for-Age (by Eta correlation)	Z-score of Height-for-Age (by Eta correlation)
Education of father	0.172	0.2
Education of mother	0.245	0.125
Occupation of father	0.172	0.187
Occupation of mother	0.07	0.104
Income of father	0.151	0.144
Income of mother	0.181	0.128

sufficient education. Most of girls' parents received their education below the 'PSC level, i.e. 5th grade'. It is possible that nutritional condition of girls would have been better, if their parents were sufficiently educated (22-24). Most of parents were unskilled laborers with an average monthly income of 5,000 taka. It is quite impossible to buy nutritious food for family members with this little amount of monthly income. A study conducted in Sirajganj suggested

that socio-demography characteristics of parents had a direct impact on nutritional condition of adolescent girls (21). Most of families of adolescent girls were not able to purchase nutritious food with such insufficient income. Thus, low-income status of parents might lead to poor nutritional condition of adolescent girls (2, 22).

Similar findings on education and income were reported among parents of school-going children of

Navaron in Jashore District (2), pre-school children within Dalit communities in Jessore City (25), and parents of the adolescent girls in Sirajganj District (21). In our study, we found that only 3.2% of adolescent girls in Sunamganj District could be categorized as 'severely thin' indicating that prevalence of undernutrition, thinness, and stunting among adolescent girls of Bangladesh has gradually reduced over the past few decade as 9% of Bangladeshi adolescent girls were considered to be 'severely thin' in 2010 (10) and 16% of school girls in Dhaka City were reported as 'severely thin' in 1995 (11).

This decrease in undernutrition among Bangladeshi adolescent girls may be attributed to gradual improvement in overall socio-economic conditions of Bangladeshi people over the past decade and the increase in awareness about public health in general. Our findings also indicated that occurrence of undernutrition among Bangladeshi adolescent girls in Sunamganj District was lower than Bengali adolescent girls in North 24 Parganas, West Bengal, India (26) and the tribal adolescent girls of Paschim Medinipur District of West Bengal, India (27). Similarly, the prevalence of stunting (based on height-for-age) among adolescent girls of Sunamganj District (26.6%) was also observed to be lower than adolescent girls of Chittoor District in India (55.3%) (28).

Nevertheless, huge rooms for improvement still remain in improving nutritional conditions of adolescent girls all over Bangladesh. Similar findings were reported for school children of Navaron in Jashore District of Bangladesh (2). We investigated nutritional knowledge of adolescent girls along with their awareness of hygienic practices in some selected topics. The topics covered basic information related to energy, protein, vitamins, minerals, and a balanced diet. We also evaluated cooking hygiene, preservation practices, and health consciousness of adolescent girls along with their knowledge status in general hygiene. We found that one-third (32.8%) of the girls' knowledge status was 'poor'. The lack of proper nutritional knowledge and hygiene awareness might be the key cause of 'poor' knowledge status among adolescent girls (29).

The prevalence of 'poor' knowledge status (32.8%) among one-third of the adolescent girls of Sunamganj District is quite alarming because these girls are going to be 'mothers' in near future and a mother with good nutritional knowledge and proper awareness about hygiene can pave the way towards building a healthy nation. So, proper training campaigns should be arranged to ensure that these girls have proper knowledge regarding nutrition and personal hygiene along with their proper implementation in practical life. Although the majority of the girls' nutritional

knowledge was 'average' (55.5%), none of the girls' knowledge status could be considered as 'excellent' based on their obtained scores. This outcome implies that a mass nutritional awareness program should be initiated from the root levels of society as soon as possible in order to safeguard the health of future generations. Similar findings were reported for school going children of Navaron in Jashore District of Bangladesh (2).

The frequency percentage of consumption of different food groups in adolescent girls revealed that they mostly consumed cereal-based food products (such as rice, lentils, bread, etc.), potatoes, and root vegetables. This result conforms to report of Alam *et al.* (11) who mentioned that rice and lentils were staple food items of Bangladeshi adolescent girls. The individual dietary diversity status of most of girls was 'high' (42.9%), while FCS of most of girls was 'acceptable' (87.7%). It should be noted that 33.8% of girls who took part in this study had 'poor' individual dietary diversity status, whereas only 0.6% of adolescent girls had 'poor' FCS. It indicates that good food security (as FCS) is highly correlated with HDD in Sunamganj District (20). Similar findings were reported for school going children of Navaron in Jashore District of Bangladesh (2).

In terms of sanitation practices, the source of drinking water was mostly 'deep tube well' (61%). The family members of most of girls (73.7%) used the hygienic personal toilet to conduct their excretion. However, 21.8% of them still used unhygienic toilets. The majority of girls used to wash their hands habitually after excretion (86%) and before eating (80.2%). Provision of clean water within the household premise, promotion of hand washing, accessibility of sanitary napkins, poverty alleviation, and behavior changes are essential in order to safeguard adolescent girls' health (30). The menstrual period of most of girls (79.5%) already started. Most of girls either used 'napkin pads' (39.9%) or 'old unclean clothes' (26.9%) during their menstrual period which can cause infections in their reproductive tracts (26).

However, the practice of using 'old unclean clothes' during menstrual period among adolescent girls in Sunamganj District (26.9%) was found to be much lower as previously reported (42%) (12). The infections of the reproductive tract nowadays have become a serious matter of concern for reproductive health of adolescent girls in developing countries (31). The lack of proper knowledge and economic limitations might have influenced them towards these unhygienic practices (4, 13, 32). The overall reproductive health and nutritional conditions of adolescent girls are directly hindered by such

unhygienic practices and it needs to be changed (24, 33). Therefore, Proper sanitary awareness training campaigns and seminars should be conducted at school and college levels on a regular basis in order to ensure the secure reproductive health of adolescent girls in Bangladesh.

Conclusion

Most of adolescent girls of Sunamganj District who took part in this study were vulnerable to malnutrition due to their lack of knowledge regarding nutrition and personal hygiene. In spite of having good food security, a high percentage of adolescent girls in Sunamganj District are still undernourished due to economic limitations along with a lack of proper nutritional knowledge and awareness of hygienic practices. Therefore, education regarding nutrition and personal hygienic practices is needed to create a positive impact on the nutritional status of the young demographic of Sunamganj District. Besides, the Bangladeshi government should develop a policy to improve the socio-economic conditions of rural population in Sunamganj District to bring about sustainable nutritional development among adolescent girls of this district.

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Conflict of Interest

There were none conflict on this research.

References

- Ahmed F, Khan MR, Akhtaruzzaman M, et al. Long-term intermittent multiple micronutrient supplementation enhances hemoglobin and micronutrient status more than iron + folic acid supplementation in Bangladeshi rural adolescent girls with nutritional anemia. *J Nutr.* 2010;140:1879-86. DOI:10.3945/jn.109.119123. PMID:20702745.
- Sarkar A, Arafat Y, Alam M, et al. Study on Dietary Pattern and Nutritional Status of School Going Children in Navaron, Jashore, Bangladesh. *Am J Food Sci Technol.* 2020;8:70-4.
- Kabir Y, Shahjalal HM, Saleh F, et al. Dietary pattern, nutritional status, anaemia and anaemia-related knowledge in urban adolescent college girls of Bangladesh. *J Pak Med Assoc.* 2010;60:633-8. PMID: 20726192.
- Konwar P, Vyas N, Hossain SS, et al. Nutritional status of adolescent girls belonging to the tea garden estates of Sivasagar District, Assam, India. *Indian J Community Med.* 2019;44:238-42. DOI:10.4103/ijcm.IJCM_357_18. PMID:31602111.
- Patil S, Joglekar C, Desai M, et al. Nutritional status and psychological impairment in rural adolescent girls: pilot data from “Kokan” region of western India. *Front Public Health.* 2018;6:160. DOI:10.3389/fpubh.2018.00160. PMID:29977886.
- Kulkarni R, Surve S, Patil S, et al. Nutritional status of adolescent girls in tribal blocks of Maharashtra. *Indian J Community Med.* 2019;44:281-84. DOI:10.4103/ijcm.IJCM_369_18. PMID:31602120.
- Choudhary S, Mishra CP, Shukla KP. Nutritional status of adolescent girls in rural area of Varanasi. *Indian J Prev Soc Med.* 2003;34:53-61.
- Kahssay M, Mohamed L, Gebre A. Nutritional status of school going adolescent girls in Awash Town, Afar Region, Ethiopia. *J Environ Public Health.* 2020;2020:7367139. DOI: 10.1155/2020/7367139. PMID:32148529.
- Walters C, Bendulo P, Stoecker BJ. Assessment of dietary diversity, antenatal care, food taboos, meal frequency, and nutritional status of pregnant adolescents in rural Malawi: a cross-sectional study. *Afr J Food Agric Nutr Develop.* 2019;19:14555-70. DOI:10.18697/ajfand.86.17530.
- Perveen R, Raiz A, Khan UM. Assessing the influence of nutrition education among adolescent Girls (13-16 years). *Adv Obes Weight Manag Control.* 2017;6:144-7. DOI:10.15406/aowmc.2017.06.00167.
- Alam N, Roy SK, Ahmed T, et al. Nutritional status, dietary intake, and relevant knowledge of adolescent girls in rural Bangladesh. *J Health Popul Nutr.* 2010;28:86-94. DOI:10.3329/jhpn.v28i1.4527. PMID: 20214090.
- Chowdhury S, Shahabuddin AM, Seal AJ, et al. Nutritional status and age at menarche in a rural area of Bangladesh. *Ann Hum Biol.* 2000;27:249-56. DOI:10.1080/030144600282136. PMID: 10834289.
- Rah JH, Christian P, Shamim AA, et al. Pregnancy and lactation hinder growth and nutritional status of adolescent girls in rural Bangladesh. *J Nutr.* 2018;138:1505-11. DOI:10.1093/jn/138.8.1505. PMID: 18641198.

- 14 Berhanu G, Whiting SJ, Henry C, et al. Assessment of knowledge, attitudes and practices of mothers' on pulse incorporated complementary food and associations with diet diversity and nutritional status of their children in two rural districts of Sidama, South Ethiopia. *Int J Nutr Sci.* 2017;2:1017.
- 15 Caamao D, de la Garza A, Beltrán-Ayala P, et al. Nutrition and neurodegenerative diseases: the role of carbohydrates and gluten. *Int J Nutr Sci.* 2016;1:1007.
- 16 Fatima W, Alqhatani NS, mohammad Ahmad L. Assessment of nutritional status and its related factors among female adolescent girls: a school based study in arar city, kingdom of Saudi Arabia. *Health Sci.* 2019;8:133-44.
- 17 Jelliffe DB, World Health Organization. The assessment of the nutritional status of the community (with special reference to field surveys in developing regions of the world. World Health Organization; 1966.
- 18 Mushtaq MU, Gull S, Mushtaq K, et al. Height, weight and BMI percentiles and nutritional status relative to the international growth references among Pakistani school-aged children. *BMC Pediatr.* 2012;12:31. DOI:10.1186/1471-2431-12-31. PMID: 22429910.
- 19 Wiesmann D, Bassett L, Benson T, et al. Validation of the world food programme s food consumption score and alternative indicators of household food security. *Int Food Policy Res Inst.* 2009.
- 20 Maxwell D, Coates J, Vaitla B. How do different indicators of household food security compare? Empirical evidence from Tigray. Medford, USA: Feinstein International Center, Tufts University. <http://fic.tufts.edu/assets/Different-Indicators-of-HFS.Pdf>. 2013 Aug.<http://fic.tufts.edu/assets/different-indicators-of-HFS.pdf>
- 21 Razzak A, Juliana FM, Hossain S, et al. Socio-demography characteristics of parents of the adolescent girls in a nutrition education based intervention study in rural Bangladesh. *J Nutr Health Food Eng.* 2017;7:281-284. DOI:10.15406/jnhfe.2017.07.00237.
- 22 Arage G, Assefa M, Worku T. Socio-demographic and economic factors are associated with nutritional status of adolescent school girls in Lay Guyint Woreda, Northwest Ethiopia. *SAGE Open Med.* 2019;7:2050312119844679.
- 23 Hassan F, Asim M, Salim S, et al. House ownership, frequency of illness, fathers' education: the most significant socio-demographic determinants of poor nutritional status in adolescent girls from low income households of Lahore, Pakistan. *Int J Equity Health.* 2017;16:122. DOI:10.1186/s12939-017-0621-z. PMID: 28693602.
- 24 Rose-Clarke K, Pradhan H, Rath S, et al. Adolescent girls' health, nutrition and wellbeing in rural eastern India: a descriptive, cross-sectional community-based study. *BMC Public Health.* 2019;19:673. DOI:10.1186/s12889-019-7053-1. PMID: 31151394.
- 25 Islam A, Hasan MT, Lina NN, et al. Assessment of nutritional status and its determinants among pre-school children within dalit communities of jessore city in Bangladesh: a cross-sectional study. *Int J Nutr Food Sci.* 2018;7:65-70. DOI: 10.11648/j.ijnfs.20180702.14.
- 26 Banerjee SR, Chakrabarty S, Vasulu TS, et al. Growth and nutritional status of Bengali adolescent girls. *Indian J Pediatr.* 2009;76:391. DOI:10.1007/s12098-009-0015-3. PMID: 19205646.
- 27 Maiti S, Ghosh D, Paul S. Determinants of Nutritional Status among Tribal Adolescent in Paschim Medinipur District of West Bengal. *Int J Prev Med.* 2012;3:298-9. PMID: 22624089.
- 28 Reddy SUK, Chaudhuri S, Amrin SF, et al. Nutritional status and dietary intake among unmarried adolescent girls in rural area of Chittoor district: a community based survey. *Int J Community Med Public Health.* 2019;6:4034-42. DOI: 10.18203/2394-6040.ijcmph20194013.
- 29 Mallick N, Mukhopadhyay S, Ray S. Eating attitudes and its relationship with nutritional status: a micro level study on a group of adolescent girls in the city of Howrah, West Bengal. *Int J Adolesc Med Health.* 2017;30. DOI:10.1515/ijamh-2016-0083. PMID: 28063258.
- 30 Chattopadhyay A, Sethi V, Nagargoje VP, et al. WASH practices and its association with nutritional status of adolescent girls in poverty pockets of eastern India. *BMC Women's Health.* 2019;19:89. DOI:10.1186/s12905-019-0787-1. PMID: 31277634.
- 31 Das P, Baker KK, Dutta A, et al. Menstrual hygiene practices, WASH access and the risk of urogenital infection in women from Odisha, India. *PLoS One.* 2015;10:e130777. DOI:10.1371/journal.pone.0130777. PMID: 26125184.
- 32 Dars S, Sayed K, Yousufzai Z. Relationship of menstrual irregularities to BMI and nutritional status in adolescent girls. *Pak J Med Sci.* 2014;30:141-4. DOI:10.12669/pjms.301.3949. PMID: 24639848.
- 33 Roba K, Abdo M, Wakayo T. Nutritional status and its associated factors among school adolescent girls in Adama City, Central Ethiopia. *J Nutr Food Sci.* 2016;6:2. DOI:10.4172/2155-9600.1000493.