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## PUBLIC HEALTH RESEARCH

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### Anthropometric Variables and Nutritional Status of Adolescent School Girls in a Food Insecure Rural Area of Bangladesh

*Mohammad Azizur Rahman<sup>1\*</sup> and Reza Ul Karim<sup>2</sup>*

<sup>1</sup> Faculty of Post Graduate Medicine and Research, University of Dhaka, Bangladesh.

<sup>2</sup> Chittagong University of Sciences and Technology, Chittagong, Bangladesh.

\*For reprint and all correspondence: Md.Azizur Rahman, Research Fellow, Faculty of Post Graduate Medicine and Research, University of Dhaka, Bangladesh, 1/2 Block-B, Green Road, Pardigulia, Tangail-1900, Bangladesh.

Email: [mdlabeled@gmail.com](mailto:mdlabeled@gmail.com)

#### ABSTRACT

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**Introduction** This study estimated the anthropometric variables and nutritional status of rural adolescent school girls of food insecure Bera subdistrict of Pabna district in Bangladesh.

**Methods** The cross sectional study was carried out in rural adolescent school girls of 21 governments approved high schools of Bera subdistrict of Pabna district, Bangladesh. Anthropometric and socio-demographic information from 2,196 adolescent girls were collected during 2011-2012 academic session. Height and weight were measured using standard procedure and the body mass index (BMI) was calculated. BMI was compared to the 2007 WHO growth reference. Height- for-age (HAZ), weight-for-age (WAZ) and BMI-for-age (BMIZ) were used to evaluate stunting, underweight and thinness respectively, based on the National Centre of Health Statistics (NCHS)  $< -2 Z$  score values. Classification of severity of malnutrition was done based on WHO recommendation. Mean BMI-for-age were less than those of 2007 WHO growth reference for girls at all ages.

**Results** The overall rate of stunting, underweight and thinness was 33.13%, 28.06% and 17.92% respectively. Based on WHO classification of severity of malnutrition, the overall prevalence of stunting was high (30-39%), whereas those of underweight 20-29% was high.

**Conclusions** This study concludes that poor anthropometric variables and nutritional status among the adolescents indicated a major public health problem in food insecure rural areas of Bangladesh. An intensive and comprehensive approach is required to improve the nutritional status of rural adolescent girls of Bangladesh.

**Keywords** Anthropometry - Variable - Nutritional status - Adolescent.

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## INTRODUCTION

Adolescent is a period of rapid growth and development. Approximately, 50% of adult body weight and 15% of final height is attained during adolescence, along with changes in body shape and composition<sup>1,2</sup>. In South Asian countries such as Bangladesh, chronic under nutrition can delay physical maturation and extend the adolescent growth period beyond 20 years of age<sup>3</sup>. In Bangladesh, a large number of adolescent girls suffer from various degrees of nutritional disorders. Poor nutritional status during adolescence is an important determinant of health outcomes at later stage of life. Adolescents are considered to be a nutritionally vulnerable segment of the population in rural area of Bangladesh. Due to enhanced growth during adolescence, the nutritional requirement is extremely important. A rapid growth rate combined with a marginal nutrient intake increased the risk of nutritional deficiencies in this population. They have to encounter a series of serious nutritional challenges not only affecting their growth and development but also their livelihood as adults. Stunting in adolescence is 32% in India, 36% in Bangladesh, and 47% in Nepal, and low body mass index (BMI) is 53% in India, 50% in Bangladesh, and 36% in Nepal<sup>4</sup>. In Bangladesh, 25-27% of adolescent girls are anemic (haemoglobin <12 g/dL)<sup>5,6</sup> and 30% in the age-group of 14-18 years are iron-deficient (serum transferrin saturation <15%)<sup>7,8</sup>. Half (47-54%) of school going children are vitamin A-deficient<sup>5,6</sup>. More than 60% of schoolgirls aged 10-16 years consumed protein, iron, and calcium less than 75% of the RDA for age<sup>6</sup>.

Adolescents remain largely neglected, especially girls from a deprived section in our rural society. Adolescent girls form an important vulnerable segment of the population of Bangladesh. Nutritional status of adolescent is an essential component of a country's overall human development. Their current nutritional status will decide the well being of the present as well as the future generations but often receive minimum attention<sup>9</sup>. It is a dynamic period of growth and development as children undergo physical, mental, emotional and social changes during this stage. Earlier age of adolescent provides a second opportunity for girls to attain 'catch up growth' and break the intergenerational cycle of malnutrition provided there is a significant increase in their nutrient intake<sup>10</sup>. There is insufficient information about nutritional status of adolescents school girls, particularly from rural areas in Bangladesh. Therefore, there is a need to generate some valuable information on the nutritional status of the adolescent girls from different parts. In this respect, the study has been made to assess the current nutritional status of the school going early adolescent girls using the anthropometric variable

from Bera subdistrict of Pabna district, Bangladesh, which mainly represents rural and food insecure area.

## MATERIALS AND METHODS

This cross- sectional study was undertaken at Bera subdistrict of Pabna district, which is one of the poorest area in Bangladesh. The study area is situated at 237 km from Dhaka, the capital city of Bangladesh. Bera is located at the coordinate 24.0667°N 89.6250°E. It has a total area of 248.6 km<sup>2</sup>. The areas of study are mostly remote and comprised of twenty one government approved high schools. There are 32 high schools altogether. The schools were selected by simple random method. The girls who were in class VI to class IX requested to participate in the study through the schools authority by general notice. The girls interested to participate were included in the study.

A total of 2,287 girls (10 to 14 years old) were enrolled during the 2011-2012 academic session at these schools, among them 2,196 (96.02%) were examined in the present study. The girls came from Muslim and Hindu communities of the villages. The recorded parameters were age, height and weight.

### *Inclusion criteria:*

The girls who were in class VI to class IX and interested to participate in the study

### *Exclusion criteria:*

The girls who were in class X and not interested to participate in the study.

### *Age determination*

The date of assessment and the date of birth were used to calculate the biological age of the adolescent girls.

### *Anthropometric measurements*

Anthropometric variables were considered in accordance with the standard techniques and procedures<sup>4</sup>.

### *Height*

Height in centimeters was marked on a wall with the help of a measuring tape. All girls were measured against the wall. They were asked to remove their foot wear and to stand with heels together and their heads were positioned in such a manner so that the line of vision was perpendicular to the body (Frankfurt plane). A glass scale was brought down to the topmost point on the head. The height was recorded to the nearest 1 cm.

### *Weight*

A bathroom scale was used. It was calibrated against known weights regularly. The zero error was checked for and removed if present, every day.

The clothes of the girls were not removed as adequate privacy was not available. Their weight was recorded to the nearest 500 grams. Technical errors of measurement (TEM) were calculated and they were found to be within reference values. To avoid variability among the data collectors, the same measurers were employed for a given anthropometric measurement.

The body mass index (BMI) was computed following the standard formula:  
 $BMI \text{ (kg/m}^2\text{)} = \text{Weight (kg) / Height (m}^2\text{)}$ .

#### *Assessment of Nutritional Status*

Three commonly used under nutrition indicators-underweight, stunting and thinness were used to evaluate the nutritional status of the subjects. The WHO 2007 reference were used to define underweight, stunting and thinness.

Z-scores were calculated following the standard formula:

$$\text{Z-score} = X - \text{Median of NCHS} / \text{Standard deviation of NCHS}$$

Where X is an individual value

The following scheme was utilized:

Underweight:  $< -2$  WAZ (Z-score for weight-for-age)

Stunting :  $< -2$  HAZ (Z-score for height-for-age)

Thinness :  $< -2$  BMIZ (Z-score for BMI-for-age)

The WHO classification (Table 1) was followed for assessing the severity of malnutrition<sup>5</sup>

#### *Statistical Analysis*

All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS, Version 11.5).

#### *Ethical Consideration*

Ethical permission for human studies was obtained from all concerned authorities before the commencement of the study. Consent from School authorities was also obtained prior to the conduction of the study by describing the nature and purpose of the said work.

## **RESULTS**

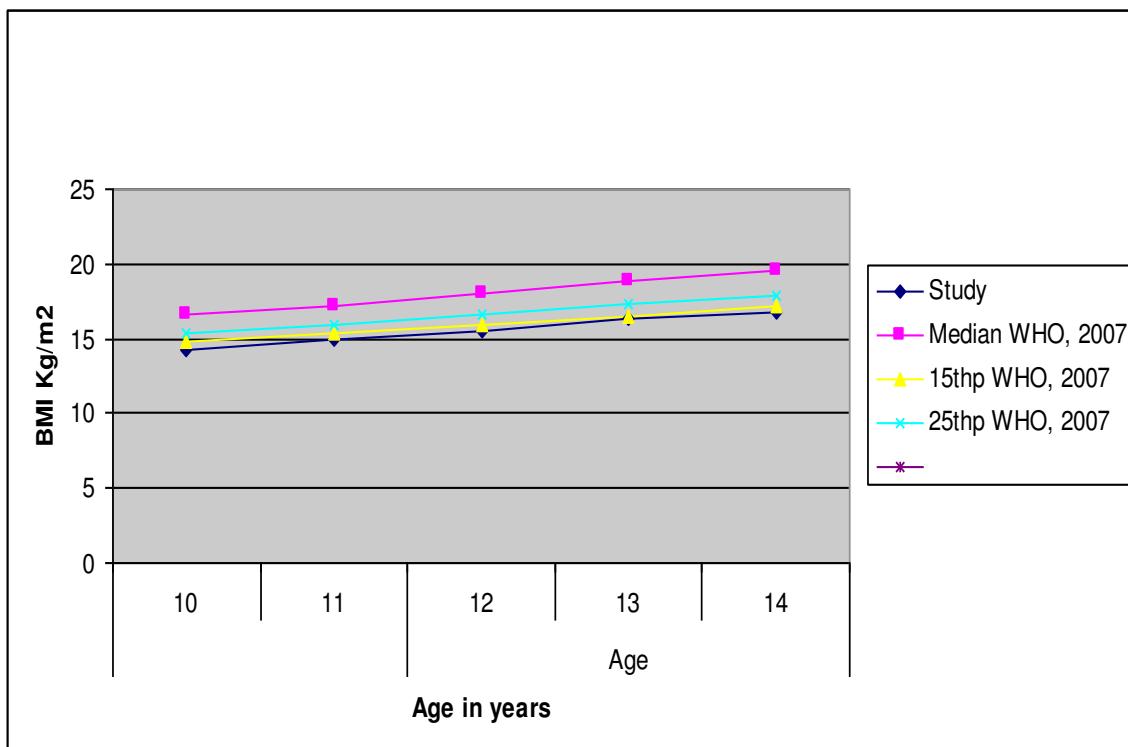
#### *Demographic characteristics of the participants*

A total of 2,196 rural adolescent girls of age 10 to 14 years old were studied. The age wise

distributions of the study samples are presented in table-2. A total of 24.3% were in the age of 10 years, 20.9% were in the age of 11 years followed by 20.76% in the age of 12 years. A total of 23.8% subjects were in the age of 13 years old. They were predominantly Muslims (92.2%) and the remaining 7.8% to Hindu by religion. Majority (60.2%) of the subjects were from the families that engaged in agriculture and 35.78% were engaged in labour (Table 2). Means and standard deviations of the anthropometric variables by age of the adolescent girls are presented in table 3. There is an increasing trend in mean weight of the subjects between 10 to 14 years of age. Similar trend was observed for height. Mean BMI increased progressively in all ages. The age specific mean BMI-for-age for the girls studied were also compared to the 2007 WHO reference population. The mean BMI-for-age of the study girls was below the 10th percentile of the reference until they reach 12 years of age. However, mean BMI-for-age for the adolescents older than 12 years of age was above the 10th percentile but below the 25th percentile of the 2007 WHO reference.

Table 4 presents the mean Z-scores for height-for-age, weight for- age and BMI-for-age of the adolescent girls. The mean (SD) WAZ, HAZ and BMIZ were -1.48 (0.2), -1.56 (0.2) and -1.23 (0.03) respectively. The mean (SD) WAZ, HAZ and BMIZ were -1.48 (0.2), -1.56 (0.2) and -1.23 (0.03) respectively. These values ranged from -1.6 (WAZ of age 11 years) to -1.1 (WAZ of age 10 years). Results revealed that the mean (SD) HAZ, WAZ and BMIZ were less than (negative values) the NCHS values for all ages.

Table 5 reveals the prevalence of underweight, stunting and thinness of rural adolescent school girls. The overall rate of undernutrition was 33.1%, while stunting was 28.1% and thinness was 17.91% respectively. The rate of undernutrition progressively increased with the advancement of age. However there was a slight decline in the rate of underweight from 13 to 14 years of age. The rate of stunting was increased considerably among girls. Based on the WHO classification of severity of malnutrition, the overall prevalence of stunting (30-39%) and underweight (20-29%) was high, whereas thinness ( $\geq 15\%$ ) was very high.



**Figure 1** Comparison of mean BMI for age of the study and 2007 WHO reference population

## DISCUSSION

The poor nutritional status during early adolescence among girls is an important determinant of health outcomes and it remains uninterrupted throughout their adolescent life. Undernutrition is documented as a public health problem contributing substantially to children's

survival<sup>11</sup>. Regardless of the scientific reports, high rates of under-nutrition at earlier age of adolescence has been reported in rural area of Bangladesh<sup>12</sup>. There are no previous studies that characterize the nutritional status of adolescent girls from the food insecure rural communities.

**Table 1** WHO classification of severity of malnutrition

Severity of malnutrition	Low (%)	Medium (%)	High (%)	Very High (%)
Underweight	<10	10-19	20-29	Equal or >30
Stunting	<20	20-29	30-39	Equal or >40
Thinness	<5	5-9	10-14	Equal or >15

Mean BMI-for-age of the present study at all ages were found to be much inferior when compared to the median reference data recommended by WHO 2007. Moreover, the apparent increase in the mean height, weight and BMI-for-age at later years of adolescence might be

a sign of improved growth to correct childhood deficits (Table 3). The mean height of the adolescents of the present study was higher but the mean weight and mean BMI of the adolescents were lower than the urban adolescents of Dhaka<sup>14</sup>

**Anthropometric Variables and Nutritional Status of Adolescent School Girls**

**Table 2** Socio-economic and demographic profile of the participants (n= 2,196)

Characteristics	f.	%	Characteristics	f.	%
<b>Age (in year)</b>					<b>Religion</b>
10	535	24.4	Muslim	2024	92.2
11	458	20.9	Hindu	172	7.8
12	456	20.8			
13	522	23.8			
14	225	10.3			
<b>Class</b>			<b>Family occupation</b>		
VI	582	26.5	Agriculture		60.2
VII	550	25.0	Labour		35.8
VIII	540	24.6	Service		2.6
IX	524	23.87	Business		1.5

**Table 3** Age-wise anthropometric variables of rural adolescent school girls

Age	f	Height (cm)	Weight (kg)	BMI (kg/m <sup>2</sup> )
		Mean ± SD	Mean ± SD	Mean ± SD
10	535	130.63 ± 8.1	24.43 ± 4.45	14.27 ± 1.89
11	458	136.56 ± 8.65	27.59 ± 5.33	14.88 ± 2.07
12	456	139.52 ± 9.14	30.25 ± 5.56	15.51 ± 2.49
13	522	143.66 ± 8.5	33.83 ± 5.56	16.37 ± 2.21
14	225	145.47 ± 6.07	35.68 ± 6.01	16.79 ± 2.21

**Table 4** Mean WAZ, HAZ and BMIZ of rural adolescent school girls

Age (year)	WAZ	HAZ	BMIZ
10	-1.1 [1.3]	-1.24 [1.3]	- 0.8 [0.7]
11	-1.6 [1.0]	-1.27 [1.3]	- 1.1 [1.0]
12	-1.6 [0.8]	-1.7 [1.33]	- 1.24 [1.2])
13	-1.6 [0.7]	-1.8 [1.2]	- 1.22 [1.0]
14	-1.48 [0.2]	-1.8 [1.2]	- 1.25 [1.14]
Total	-1.48 [0.2]	-1.56 [0.2]	-1.23 [0.03]

WAZ: Z-score for weight-for-age; HAZ: Z-score for height-for-age; BMIZ: Z-score for BMI for age.

**Table 5** Prevalence of underweight, stunting and thinness of rural adolescent school girls

Age (year)	f	Underweight (%)	f	Stunting (%)	f	Thinness (%)	f
10	535	28.9	155	21.4	114	22.3	119
11	458	28.2	129	24.8	113	20.9	96
12	456	32.9	150	31.7	145	21.2	97
13	522	31.7	165	34.6	181	16.1	85
14	225	31.7	71	32.6	73	16.4	37
Total	2196	33.13	670	28.06	626	17.92	434

*Factors significantly associated with stunting and thinness:*

In the multivariate analysis, among adolescents, young age (10–12 years v. >14 years) and literacy were associated with a 71% (95% CI 12, 91 %) and a 50% (95% CI 4, 74%) lower odds of stunting. The nutritional status of rural Bangladeshi adolescent girls deteriorates progressively with age. The food intake of the subject was associated with stunting. Thinness appeared to be associated with several factors. Among adolescents, having diarrhoea or dysentery in the previous month was strongly associated with thinness (OR57.40, 95% CI 1.43, 38.29) and performing more than two light-to-moderate activities per day (OR50.43, 95% CI 0.22, 0.82) and a history of symptoms of anaemia in the preceding month (OR52.72, 95% CI 1.38, 5.37) predicted thinness.

In the present study, the overall age combined prevalence of underweight, stunting and thinness were 33.13%, 28.06% and 17.92% respectively. Adolescent girls belonging to 12-14 years old were maximally prevalent by stunting and underweight. Thinness is more prevalent in the age group of 10-12 years old. This could be because of the growth spurt and sudden increase in height in this age group. Consistent with the findings of other studies<sup>14</sup>, the prevalence of thinness and stunting increased with the increase in age. About 39% of the adolescents were stunted (median <- 2 SD of NCHS height for age) irrespective of age. The results of the present study clearly indicate that the nutritional status of these adolescents was poor with a very high rate thinness of (17.9 %.) The prevalence of thinness is more in Indian adolescent girls in rural areas<sup>14,15,16</sup>.

According to the WHO classification of severity of malnutrition, the overall prevalence of underweight stunting was high, whereas thinness was very high. The rates of underweight were much higher than that reported from other study. This is substantiated by the fact that stunting, which is considered as the index of chronic or long-term duration of under nutrition, was observed during the entire period of adolescence. A noteworthy point was that majority of the girls

came from weaker section of our community. The relatively high prevalence of under nutrition observed among school girls located in the rural areas may be due to the inadequate dietary intake of food<sup>14</sup>. The fact that most of these children are from low socio-economic background mainly farmers, who themselves attended poor nutrition. Alongside, adolescent girls are the worst sufferers of the ravages of various forms of malnutrition because of their increased nutritional needs, chronic food insecurity and low social power. Other explanation for low nutritional status of school children was lack of awareness, to prevent nutritional diseases through locally available low cost food. Such factors affect the nutritional status of adolescent girls in rural area of Bangladesh.

Therefore, the school going adolescent girls, in their existing nutritional status are in great need of health promotion, health appraisal and health restoration. To overcome the nutritional problems and improve their health status, it becomes necessary to have exact information about the prevalence of under nutrition among adolescent girls in rural areas, so that appropriate preventive steps may be taken.

## CONCLUSIONS

This study provides evidence that the average adolescents school girls of Bera subdistrict of Pabna district in Bangladesh are under acute and chronic nutritional stress. Undernutrition is documented as a public health problem in these areas. The poor nutritional status during early adolescence among girls is an important determinant of health outcomes and it remains uninterrupted throughout their adolescent life. It also found that an intensive and comprehensive approaches are required immediately specially at rural food insecure area. This is important to public health policymakers, planners and organizations should implicated appropriate strategy for improvement of adolescent as well as community health care.

## RECOMMENDATIONS

Recently few NGO started food security, livelihoods and cash distribution programme in these areas under the support of World Food Programme and DFID. The food for education, water and sanitation and disaster risk reduction programme of the government is also working. But the coverage of the beneficiary is not sufficient to mainstream all the rural poor's family. Only the government national nutrition programme is working with coverage in the rural areas with very limited access to remote areas due to difficulty in communications and lack of infrastructures. Hence, more programmatic focus is necessary for the adolescent nutrition and health in the remote areas where undernutrition is severe.

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