

Prevalence and Trends in Malnutrition, Individual and Country Level Adulthood Dual Burden of Malnutrition in Rural Bangladesh: Findings from Bangladesh Integrated Household Survey, 2011 – 2015

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Abstract

An increasing proportion of adolescents are exposed to different forms of malnutrition through the rapid nutrition and food system transition and have a dual burden of malnutrition directly. We aimed to investigate the trends in country and individual level dual burden of malnutrition among adolescents of rural Bangladesh. Using nationally representative data, we calculated the prevalence of malnutrition at each survey year and annualized rates of prevalence change over time. We also investigated the country and individual level dual burden in adolescents. The prevalence of stunting in the first survey (25.5%, 95%CI: 24.1-26.8) represents a slight decline from the observed prevalence in the second survey (25%, 95%CI:23.8-26.3). Overall, the prevalence of thinness also declined but not significantly that is 16.3%(95%CI:15.1-17.5) in 2011 to 16.1% (95%CI:15-17.2) in 2015. In contrast to undernutrition, overweight prevalence increased significantly ($p=0.004$) between two rounds (5.1%, 95%CI:4.5-5.8 and 3.9% 95%CI:3.3-4.5 respectively). Both country and individual level dual burden has been increased substantially. Only 1.08% of adolescents were concurrently stunted and overweight in 2011 that increased to 1.32% in 2015. Moreover, the dual burden is much more prevalent among older adolescents compared to younger ones (19% vs 39%). Rural areas of Bangladesh experienced a rapid increase in the prevalence of overnutrition and a slower decline in the prevalence of undernutrition indicating a shift in policies and programs is needed to address both sides of malnutrition.

Keywords

Adolescent, Dual Burden, Malnutrition, Rural Bangladesh

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1. Introduction

Adolescence is the transitional period between childhood and adulthood with distinct psychological, physiological, and social features. According to World Health Organization (WHO) adolescence can be defined as the segment of life between the ages of 10-19 years [1]. Adolescents are a somewhat neglected group although they are a nutritionally vulnerable group for their extra requirements for growth, their eating pattern and lifestyle, their risk-taking behaviour

as well as susceptibility to environmental influences [2]. Adolescents make up roughly 20% of the total world population. Adolescent has an higher demographic weight in developing countries, for instance roughly 22% in Bangladesh [3, 4]. Adolescence is a period of rapid growth: up to 45% of skeletal growth and 15 to 25% of adult height is achieved [5]. During the growth sprout, up to 37% of the total bone mass may be accumulated during adolescence.

Anthropometry is the single most non-invasive, inexpensive and universally applicable method for assessing overall

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nutritional status [6]. The global prevalence of underweight among children and adolescents is 8.4% for girls and 12.4% for boys [7]. One in 5 girls aged 5-19 years and nearly one-third boys are underweight in South Asia [8]. Worldwide, about 4% of school going adolescent girls aged 13–15 years are underweight, although more than 10% of surveyed girls were underweight in Mauritius, Sudan, Bangladesh, Maldives, Cambodia, and Vietnam [9]. In Bangladesh, underweight prevalence is much higher among boys compared to girls (22.8% vs 12.8%) [10]. Low height for age (stunting) in adolescents reflects poor nutrition, infection and environmental stress accumulated from the fetal period throughout young adulthood. 44% of adolescent girls aged 15-19 years are stunted in Bangladesh [7].

The instantaneous manifestation of both undernutrition and overweight or obesity known as Dual Burden of malnutrition (DBM) affects low and middle- income countries (LMICs) [11]. Globally, the age-standardized prevalence of obesity among children and adolescents increased from <1% in 1975 to 5.6% in girls and nearly 8% in boys in 2016 [8]. In Bangladesh, overweight prevalence is almost equal among boys and girls (8.5% in boys, 8.4% in girls). However, the dual burden of malnutrition can occur at the individual, household and population level. The DBM at the population or country-level is defined as having a high prevalence of both undernutrition and overweight and obesity in at least one population group. Of the 126 LMICs, the number of countries facing country-level DMB was 48 in 2010 [12]. On the other hand, a person with the simultaneous presence of two or more types of malnutrition is called an individual-level dual burden. Western lifestyle and eating pattern are spreading in whole Bangladesh bringing nutritional transition. Furthermore, malnutrition reduces the physical work capacity and endurance capacity of this growing workforce through an adverse effect on height and muscle mass. Adolescents as a critical age group, require evidence-based strategies and particular policies with a special focus on nutrition action whether their nutrition-related needs are adequately addressed.

2. Methodology

2.1. Study Design and Data Source

The present study is based on Bangladesh Integrated Household Survey (BIHS). Relevant data were extracted from the first round of baseline survey conducted in 2011 and the second round of BIHS conducted in 2015. BIHS is the only nationally representative survey in Bangladesh that collects detailed data on agricultural production and practices and anthropometric measurements of all household members [13]. Since October 2010, the policy Research and Strategy Support Program (PRSSP) for food security and agricultural

development, funded by United States Agency for International Development (USAID) and implemented by the International Food Policy Research Institute (IFPRI), has been providing evidence-based policy research support in Bangladesh.

The BIHS sample is nationally representative of rural Bangladesh as well as representative of rural areas of each of the seven administrative divisions of the country: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet. A sound and appropriate statistical method (two-stage stratified sampling of households) was used to calculate the total BIHS sample size of 6,500 households. The first round of the BIHS was conducted in 2011-2012, which is used as a reference point to measure progress through repeat survey [14]. The PRSSP carried out the second BIHS round in 2015 which was administered on the same samples of households surveyed in the baseline creating a two-round panel.

The BIHS round 1 questionnaire was reviewed by the Ministry of Food and Disaster Management, Government of the People's Republic of Bangladesh. For the BIHS Round 2, the Ministry of Agriculture reviewed the questionnaires and authorized the survey. Oral consent to participate in the surveys was received from the respondents. The present analysis is based on adolescents aged 11 to 19 years who had valid anthropometric measurements.

2.2. Anthropometric Measurement and Nutritional Status

Two widely used measures for malnutrition, height-for-age z score (HAZ) and BMI-for-age z score (BAZ) were used to examine the nutritional status of Bangladeshi rural adolescents. The value of HAZ and BAZ were calculated using World Health Organization (WHO) 2006 growth standard [15] and following WHO recommendations, any adolescent with height-for-age z score (HAZ) either above +6 or below -6 and BMI-for-age z score (BAZ) above +5 or below -5 were excluded [16]. Stunting was defined as height-for-age less than -2SD below the median of the height-for-age WHO reference population. Thinness was defined as BMI-for-age less than -2SD below the WHO growth standard median and overweight as BMI-for-age greater than +1SD of the WHO growth standard median [17, 18].

2.3. Data Analysis

WHO Anthro Plus software (version 3.3.2) was used to calculate z scores. The anthropometric data were converted to z score and then transformed to SPSS (version 25) for further analysis. Chi-squared statistic for trend (regression) was calculated to evaluate trend across the two rounds [19]. Statistical significance was evaluated with two-sided tests with a significance threshold of 0.05.

3. Results

A total of 8263 adolescents were included in the study. Table

1 shows the characteristics of the study populations for each of the survey. There was almost equal distribution for both age and sex in all survey samples.

Table 1. Sample characteristics in two Bangladesh Integrated Household Survey (BIHS)

Year of survey	2011-2012	2015
Total Household interviewed	6500	6500
Number of adolescents with anthropometric information	3867	4396
Adolescent's characteristics		
Sex, n (%)		
Male	1889(48.8)	2165(49.2)
Female	1978(51.2)	2231(50.8)
Age group, n(%)		
11 -14	2319(60.0)	2422(55.1)
15-18	1548(48.0)	1974(44.9)
Number of adolescents in 7 administrative divisions, n (%)		
Barisal	434(11.2)	462(10.5)
Chittagong	704(18.2)	754(17.2)
Dhaka	1071(27.7)	1257(28.6)
Khulna	517(13.4)	598(13.6)
Rajshahi	285(7.4)	367(8.3)
Rangpur	252(6.5)	301(6.8)
Sylhet	604(15.6)	657(14.9)
Adolescents out of the plausible limit of stunting, n (%)	6(0.16)	-
Adolescents out of the plausible limit of thinness, n (%)	4(0.10)	7(0.16)

3.1. Trends in Nutritional Status

The nutritional status of rural adolescents has improved steadily over the period (2011 to 2015). The level of stunting has declined slightly from 25.5% in 2011 to 25% in 2015 (Table 2). Over the period 2011 to 2015, the level of thinness also declined slightly from 16.1% to 16.1%. Prevalence of overweight as assessed by BMI-for-age (BAZ) increased significantly between 2011 and 2015, from 3.9% during 2011

to 5.1% during 2015 ($p=0.004$). Overall, 22.6% of adolescent boys were stunted in 2011, increasing to 23.3% in 2015. However, among adolescent girls, stunting rates were much higher and decreased from 28.2% in 2011 to 26.8% in 2015. Thinness prevalence increased among girls and younger adolescents while a slight reduction occurred among boys and older adolescents. Moreover, Overweight prevalence has increased significantly in all age groups

Table 2. Percentage of adolescents by nutritional status according to two nutritional indices: height for age and BMI for age.

Indicator	BIHS- 2011			BIHS- 2015			P-value trend
	n/N	Mean ^a	%(95%CI)	n/N	Mean ^a	%(95%CI)	
Stunting (HAZ < -2SD)							
Total	984/3861	-1.31	25.5(24.1-26.8)	1099/4396	-1.26	25.0(23.8-26.3)	0.56
Sex							
Male	426/1886	-1.18	22.6(20.7-24.5)	504/2165	-1.14	23.3(21.5-25.1)	0.69
Female	556/1975	-1.45	28.2(26.2-30.2)	597/2231	-1.37	26.8(24.9-28.6)	0.25
Age							
11-14	504/2316	-1.11	21.8(20.1-23.6)	479/2422	-0.99	19.8(18.2-21.4)	0.06
15-18	477/1545	-1.63	30.9(28.5-33.2)	621/1974	-1.58	31.5(29.4-33.6)	0.76
Thinness (BAZ < -2SD)							
Total	629/3863	-0.94	16.3(15.1-17.5)	706/4389	-0.89	16.1(15.0-17.2)	0.96
Sex							
Male	384/1886	-1.12	20.4(18.5-22.2)	410/2160	-1.03	19.0(17.3-20.7)	0.51
Female	245/1977	-0.77	12.4(11-13.9)	294/2229	-0.76	13.2(11.8-14.7)	0.48
Age							
11-14	409/2315	-0.96	17.7(16.1-19.3)	451/2416	-0.94	18.7(17.1-20.3)	0.37
15-18	219/1548	-0.91	14.2(12.4-16)	252/1973	-0.84	12.8(11.3-14.3)	0.41
Overweight (BAZ > + 1SD)							

Indicator	BIHS- 2011			BIHS- 2015			P-value trend
	n/N	Mean ^a	%(95%CI)	n/N	Mean ^a	%(95%CI)	
Total	150/3863	-0.94	3.9(3.3-4.5)	223/4389	-0.89	5.1(4.5-5.8)	0.004
Sex							
Male	56/1886	-1.12	3.0(2.2-3.8)	97/2160	-1.03	4.5(3.6-5.4)	0.008
Female	94/1977	-0.77	4.8(3.8-5.7)	129/2229	-0.76	5.8(4.8-6.8)	0.13
Age							
11-14	99/2315	-0.96	4.3(3.4-5.1)	132/2416	-0.94	5.5(4.6-6.4)	0.04
15-18	51/1548	-0.91	3.3(2.4-4.2)	92/1973	-0.84	4.7(3.8-5.7)	0.02

Abbreviations: CI: confidence interval; HAZ: height-for-age z score, BAZ: BMI-for-age z score; BIHS: Bangladesh Integrated Household Survey
^a Mean of underlying continuous variables (HAZ and BAZ respectively)

Table 3. Changes in nutritional status by division.

Division	Stunting	Thinness	Overweight
Barisal	Decreased	Decreased	Increased
Chittagong	Decreased	Increased	Decreased
Dhaka	Decreased	Increased	Increased
Khulna	Increased	Decreased	Increased
Rajshahi	Decreased	Decreased	Increased
Rangpur	Decreased	Increased	Increased
Sylhet	Increased	Decreased	Increased

The findings highlight substantial regional variation (Table 3). In Barisal and Rajshahi divisions, patterns resemble national trends. Except for the Chittagong division, overweight prevalence has increased substantially. In Dhaka and Rangpur division, a steep increase in thinness was observed.

3.2. Annualized Change in Prevalence

Table 4 depicts the absolute and annualized change in

country-level prevalence of stunting, thinness and overweight for Bangladeshi rural adolescents. Overall, a small reduction in stunting and thinness occurred with annual changes in prevalence 0.125% and 0.05% / year respectively. The magnitude of annual overweight changes is quite similar among boys and girls (0.37 vs 0.25%/year). Among older adolescents, the rate of increase in overweight is slightly higher.

Table 4. Absolute and annualized change in stunting, thinness and overweight prevalence from the first survey to the last survey.

	stunting		Thinness		overweight	
	Absolute change (%)	Annualized change (% per year)	Absolute change (%)	Annualized change (% per year)	Absolute change (%)	Annualized change (% per year)
Total	-0.5	-0.125	-0.2	-0.05	1.2	0.3
Sex						
Male	0.7	0.17	-1.4	0.35	1.5	0.37
Female	-1.4	-0.35	0.8	0.2	1	0.25
Age(year)						
11-14	-2	-0.5	1	0.25	1.2	0.3
15-18	0.6	0.15	-1.4	0.35	1.4	0.35
Division						
Barisal	-0.7	-0.17	-1.1	-0.27	3.1	0.77
Chittagong	-4.8	-1.2	0.4	0.1	-0.8	-0.2
Dhaka	-1.6	-0.4	1.2	0.3	1.2	0.3
Khulna	4.9	1.22	-3.7	-0.92	2.8	0.7
Rajshahi	-2	-0.5	-0.3	-0.07	2.4	0.6
Rangpur	-3	-0.75	4.1	1.02	1.3	0.32
Sylhet	5.7	1.42	-1.2	-0.3	0.4	0.1

3.3. Dual Burden

Dual burden at population or country level can be determined by the ratio of country-level stunting to overweight prevalence. The gradual reduction in prevalence ratio indicates that overweight prevalence is increasing but at the same time stunting prevalence is decreasing (Table 5). From 2011 to 2015, a sharp reduction in stunting to overweight prevalence is notable. All the 7 divisions experience an increase in stunting to overweight prevalence ratio.

Table 5. Country-level dual burden (ratio of stunting prevalence to overweight prevalence).

	BIHS- 2011	BIHS- 2015
Total	6.54	4.90
Sex		
Male	7.53	5.18
Female	5.88	4.62
Age (year)		
11-14	5.07	3.6
15-18	9.36	6.70
Division		
Barisal	9.21	4.25
Chittagong	8.0	8.46
Dhaka	5.49	4.0
Khulna	3.41	2.78
Rajshahi	3.77	2.34
Rangpur	9.96	5.65
Sylhet	10.64	11.09

We also examined individual level dual burden by cross tabulating stunting and overweight status within adolescents (Table 6). The percentage of adolescents who are concurrently stunted and overweight (individual level dual burden) changed from 1.08% to 1.32%. During this period. The percentage of stunted who are also overweight has also

increased. For all regions except Chittagong and Sylhet, patterns are most consistent with national trends of increasing individual-level dual burden. Compared with younger adolescents, the individual-level dual burden is more prevalent among older adolescents.

Table 6. The proportion of adolescents experiencing individual level dual burden.

	Concurrently stunted and overweight n(%)		% of stunted who are overweight	
	BIHS- 2011	BIHS- 2015	BIHS- 2011	BIHS-2015
Total	42 (1.08)	58 (1.32)	4.27	5.27
Sex				
Male	13 (0.69)	25 (1.5)	3.05	4.96
Female	29 (1.47)	33 (1.48)	5.22	5.52
Age group				
11-14	22 (0.95)	19 (0.78)	4.36	3.97
15-18	20 (1.29)	39 (1.97)	4.19	6.28
Division				
Barisal	4 (0.92)	11(2.38)	3.57	9.57
Chittagong	9 (1.28)	4 (0.53)	3.73	1.79
Dhaka	14 (1.31)	17 (1.35)	5.55	6.16
Khulna	4 (0.78)	12(2.0)	4.93	9.76
Rajshahi	1 (0.35)	3 (0.82)	1.75	4.55
Rangpur	3 (1.19)	4 (1.33)	5.08	6.45
Sylhet	7 (1.16)	7 (1.06)	3.91	3.0

4. Discussion

The nutritional status of adolescents has a profound impact on their immediate and future health [20] Overweight and obesity in adolescence due to unhealthy eating behavior and inadequate physical activity poses a risk for future health including Non-Communicable Diseases (NCD) such as diabetes, hypertension, stroke, certain types of cancer and obstructive sleep apnea [21] The present study is the first to directly compare the prevalence of stunting, thinness and overweight in rural Bangladeshi adolescents, to estimate the dual burden of malnutrition and to examine regional differences.

Our study suggests that the trends in overall malnutrition varied for three individual forms of malnutrition. Unfortunately, a decline in stunting is occurring alongside an increase in overweight in most of the rural settings. Consequently, the dual burden is becoming a reality in an increasing number reflected by decreasing trend in stunting prevalence to overweight prevalence. The country-level dual burden ratios for adolescents here indicate that although stunting prevalence is still higher than overweight but the differences between the two form of malnutrition is getting smaller as demonstrated by 6.54 in 2011 and 4.90 in 2015. For Dhaka division, both annualized increment in overweight and individual level dual burden prevalence is higher.

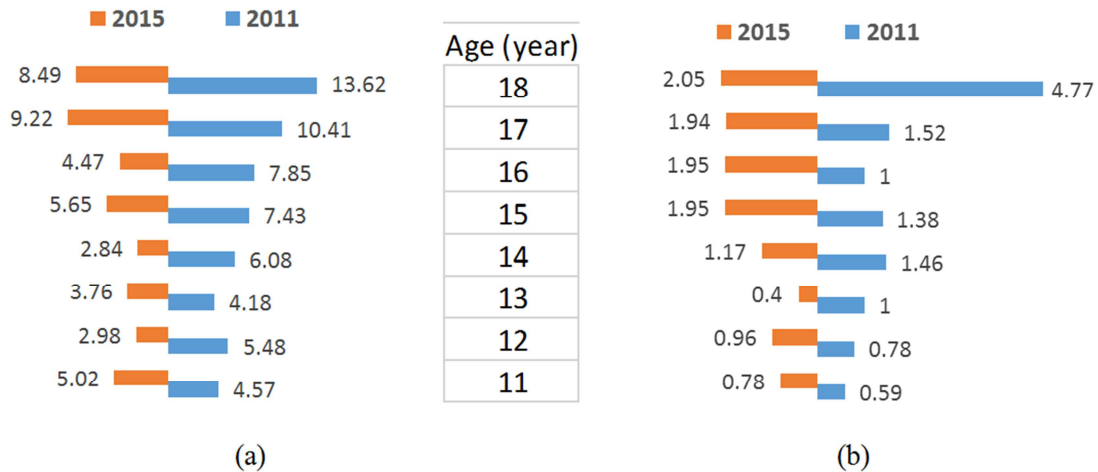


Figure 1. Age-specific changes in (a) stunting prevalence to overweight prevalence (b) individual level dual burden.

We found that the dual burden of under and over-nutrition also occurs on the individual level. A substantial proportion of adolescents in rural areas are concurrently stunted and overweight and a remarkable number of stunted adolescents are also overweight as well. A key contribution of our work is the exploration of age-specific trends in the dual burden of malnutrition. Overweight rates increased in all age groups. Additionally, the magnitude of changes in the dual burden of malnutrition is more extreme in older adolescents. Surprisingly, at the age of 18, a sharp decline in a combined form of stunting and overweight (individual level dual burden) is noticed.

Although the stunting rate is declining, it is still high. Stunting in adolescence reflects poor nutrition, infection and environmental stress accumulated from the fatal period through young adulthood. Stunting is especially important to consider among adolescent girls because pre-pregnancy stunting is a risk factor for poor pregnancy outcomes including Small for Gestational Age (SGA) and preterm birth [22]. Additionally, the stature of the mother is associated with her pelvic size. Small pelvic size can lead to obstructive labor which is a common cause of maternal death. As a result of upward changes in the country’s economic condition and food system that makes less nutritious foods including different ultra-processed foods cheaper and more accessible as well as a decrease in physical activity due to major technological shifts makes overweight more prevalent in Low-income countries like Bangladesh.

Strength and limitations

The study is not beyond of limitations. First of all, due to the cross-sectional nature of data, we can’t make statements about age-specific trends within the same adolescents. Second, Mymensingh is a new division created from the Dhaka division and this information is not available in BIHS.

Despite these limitations, we believe our results are valid attempts at quantifying trends in adulthood malnutrition and estimating dual burden. To our knowledge, this is the first study that investigates the trends in the individual and country-level dual burden of malnutrition among rural adolescents of Bangladesh using nationally representative samples. We used an international classification system to define malnutrition that ensures cross-comparison of estimates with those from other regions.

5. Conclusion and Recommendation

Whilst improved substantially, the prevalence of stunting and thinness remains high among rural Bangladeshi adolescents. However, in contrast to undernutrition, this study documented a significant increase in overweight prevalence. In concert, these individual indicator trends produce a dual burden of malnutrition. The double burden of malnutrition is a new nutrition reality for Bangladesh. We need to implement interventions to improve diet quality and eating behavior to address adulthood undernutrition and overnutrition. A joint effort by the government, non-governmental organizations and community involvement are necessary to overcome the malnutrition problem among adolescents.

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