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Nutritional status of school going children and adolescents aged 9-13 years at Haldia in West Bengal, India

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Abstract

Background Malnutrition in children and adolescents is a global problem. In developing nations of Africa and Southeast Asia, the prevalence of undernutrition in children is very high. There is scanty data with respect to the nutritional status of school going children and adolescents, especially from sub-urban and rural areas in India.

Objective A study was undertaken among boys (n= 174) and girls (n= 128) aged 9-13 years in a sub-urban area of Purba Medinipur district of West Bengal in India to understand age and sex variation of nutritional status of the subjects.

Methods A cross-sectional study among the school-going children and adolescent aged 9-13 years was done during June-September 2009 in Haldia.

Results Age and sex variation of anthropometric characteristics (body mass index or BMI and conicity index or CI) revealed that remarkable sections of both the sexes were suffering from underweight (8.30%), stunting (14.60%) and wasting (2.80%). Significant sex differences were observed in cases of mean CI (P=0.001), weight-for-age *z*-score (P = 0.0001) and weight-for-height *z*-score (P = 0.0001).

Discussion Besides notable prevalence of under nutrition in both sexes, situation of the girls is worse (underweight – 11.70% and stunting – 21.10%) compared to the boys. This is most evident among the subjects of both sexes aged 11 and 12 years. **[Paediatr Indones. 2010;50:159-65]**.

Keywords: *under nutrition, children, BMI, CI, thinness*

Growth and nutrition are the best indicators of well-being of children and adolescents. The development of database on these dimensions in different countries and populations is necessary to take policy measures for the welfare of the children. Remarkable proportions of children and adolescents in underdeveloped, developing and developed nations are suffering from malnutrition (undernutrition or overnutrition). This is a major concern for the scientists and governments in every part of the world. Scientists have considerable interest in collection of data on growth and nutrition around the world. The school-going ages have high significance because this is the chief period for growth and nutrition of children and adolescents. [1] In these age groups deficiencies of protein/calorie in diet result in underweight, wasting, stunted growth, low immunity, and also impaired cognitive and motor development and learning. Globally, malnutrition is a

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major public health problem especially in developing nations of Africa and Southern Asia including India.[2-3]

Anthropometrics can be used to evaluate health, growth, nutrition and development in infants, children and adolescents.[2-4] It has now been well established that body mass index (BMI) is the one of the most appropriate parameters for determining nutritional status among adolescents.[2,5-6] Undernutrition and thinness in children and adolescents are estimated by stunting (low height for age), underweight (low weight for age) or wasting (low weight for height) following different internationally and regionally recommended standards.[7-9] Stunting reflects failure of linear growth due to subnormal health and or nutritional conditions. Underweight reveals low body mass relative to age.

Malnutrition in children is the consequence of large number of factors related to poor and insufficient diet, severe chronic diseases, etc. There have been numerous studies that have dealt with the epidemiology of underweight and stunting among poor pre-adolescent children from different developing countries.[7-8] Several recent studies have investigated health and nutritional status of adolescents from different parts of India.[10-13] However, there is scanty information on the nutritional status of adolescents from urban and peri-urban or sub-urban West Bengal. Hence, it was necessary to assess the nutritional status of this demographic group of children and adolescents. The present investigation was undertaken to assess the nutritional status of school going children and adolescents in a sub-urban area of a district that is about 100 kilometers away from Kolkata, the capital of the state of West Bengal, India.

Methods

The present investigation was attempted to record anthropometric characteristics and nutritional status and also to estimate the overall prevalence of undernutrition among 9-13 years old school going children and adolescents of Purba Medinipur District in the state of West Bengal. The other principal aim was to assess age-sex trends in the levels of undernutrition of the subjects under study that include both boys (n=174) and girls (n=128). All the subjects selected and sorted for the present study were on the basis their midyear age, i.e. 9.5 to 13.5 on average. So in the text, ages like 9.5 and 9 or 13.5 and 13 years are mentioned in similar senses.

The present cross-sectional study among the school-going children and adolescents was carried out during June-September 2009 in a school in Haldia of Purba Medinipur District. The *Poura Path Bhavan* School has been selected for carrying out the field work among the students of grade III to VII. The age-group of the students was 9 to 13 years. Total 174 boys and 128 girls took part in this study.

The school is located in a semi-urban area of an industrial town of Haldia. The population in Haldia Township and adjoining areas is heterogeneous in nature. People belonging different communities, castes or religious groups are joining different occupational activities. The children of low to medium socioeconomic strata of the society generally take admission in this school. Monthly tuition fees for students are around Rs. 150 (about 3 US$) and there was no defaulter in the present sample. The school is not residential but they provide indoor games, physical exercises, yoga and other co-curricular activities for all students. The basic information of date of birth, socio economic background of these students and their families were collected from the office records of this school as well as from the parents. Subjects who were involved in this study belong to similar socio-economic background. They have similar activity patterns and moderately similar kind of life style habits at home. So the subjects were chosen selectively. Their general health condition, history of diseases and other information related to their physical activity patterns during school hours and outside school were also recorded.

The subjects were chosen randomly but later they were screened selectively and put together in accordance with fulfillment of the above-mentioned criteria, so the method was cross-sectional and the sampling procedure was purposive. The sample size may be small but in the preliminary investigation, the results show some trends of age sex variation of nutritional status of the adolescent boys and girls at their growing age through anthropometric methods.

Anthropometric measurements of lightly-clothed subjects were taken by the trained investigators (SDB and SM) using standard anthropometric techniques and internationally accepted protocols on the right side of the body of subjects following international

standards.[14-16] All measurements were taken using standard Martin's anthropometer and standard measuring tape to the nearest tenth of a centimeter. Standard weighing scale (Libra, New Delhi) was used to record the weight to the nearest 0.5 kg. Measurements selected were stature or height (HT in centimeter), body weight (BW in kilogram or kg) and waist circumference (WC in centimeter). Technical errors of measurements (TEM) calculated were found to be within acceptable limits. Derived anthropometric indices (body mass index and conicity index) were computed using the following standard equations and classifications were presented following international standards.

The body mass index (BMI) was calculated from weight and height measurements using the formula:

$$BMI = \text{Weight (kg)} / [\text{Height (m)}]^2$$

Conicity index (CI) has been calculated using following formula:

$$CI = \text{Minimum Waist Circumference (m)} / 0.109 \times \sqrt{\text{Weight (kg)}} / \sqrt{\text{Height (m.)}}$$

Anthropometric assessment was undertaken to identify children with undernutrition. The Z score values of two indices were used to measure of chronic undernutrition i.e. height for age (HA) and weight for height (WH), with reference to NCHS standards of growth and development. Fifty percentile was fixed as median on height for age (HA) and weight for height (WH). Children and adolescents having -2SD from the median on height for age were considered as stunted and those with -2SD from the median on weight for height were identified as wasted. Thinness was evaluated following the recently published international BMI cut-off points.[17-18]

The following scheme was considered:

Stunting (ST) : < - 2 HAZ (Z-score for height-for age)
Underweight (UW) : < - 2 WAZ (Z-score for weight-for age)
Wasting : < - 2 WHZ (Z-score for weight-for-height)
Thinness : < - 2 BMIZ (Z-score for BMI- for- Age)

Individual response rate for subjects was 85%. Ethical approval had been granted by the Ethics Committee of Vidyasagar University before the commencement of the study. Written consent for non-invasive anthropometric measurements was taken from the school authority and the parents of the subjects who took part in the study.

Most of the equations were computed following standard formula.[2,14-16] The distributions of anthropometric and body composition variables were not significantly skewed. Student's t-tests were performed to test for differences in mean anthropometric characteristics between boys and girls. One-way ANOVA were used to test for differences in mean Anthropometric characteristics between the age-groups in two sexes separately. All statistical analyses were done using the SPSS (11.00) Statistical Package. Statistical significance was set at $P < 0.05$.

Results

Table 1 displays the statistics (mean and SE) of anthropometric characteristics, derived indices measuring nutritional status of boys and girls aged 9.5 – 13.5 years. The sex difference is estimated by student t-test. The mean age in months in slightly less in boys but has no significant sex difference. In most of the anthropometric parameters no significant sex differences have been recorded. The boys and

Table 1. Age (months) and anthropometric characteristics of boys and girls of Haldia in Purba Medinipur, West Bengal

	Variables	Boys# (n=174)	Girls# (n=128)	t	p
1	Age, yr	131.68 (1.26)	132.83 (1.47)	0.592	0.554
2	BW, kg	33.3 (0.63)	33.57 (0.85)	-0.257	0.798
3	HT, cm	138.2 (0.78)	137.93 (0.93)	0.292	0.770
4	BMI, kg/m2	17.2 (0.21)	17.41 (0.31)	-0.557	0.578
5	WC, cm	64.62 (0.59)	63.19 (0.73)	1.519	0.130
6	Conicity	1.22 (0.01)	1.19 (0.01)	3.346	0.001
7	WAZ	-0.56 (0.07)	2.23 (0.39)	-7.080	0.0001
8	HAZ	-0.78 (0.07)	-0.71 (0.10)	-0.561	0.576
9	WHZ	0.00 (0.13)	-1.07 (0.10)	6.486	0.0001

Values are presented as mean (SD)

girls show more of less similar mean values of all the characters excepting CI, Weight for Age Z-score (WAZ), and Weight for Height Z-score (WHZ) values. Sex difference in CI is highly significant (P=0.0001). Mean WAZ, WHZ also exhibit high and significant sex difference (P=0.0001). However, mean BMI (Body Mass Index) that generally indicates nutritional status and overall adiposity is not significantly different in either sex.

The age wise distribution of BMI and CI estimating nutritional status of both boys and girls are presented in **Table 2**. The age group differences with respect to these parameters are tested by analysis with variance (ANOVA). BMI exhibits statistically significant age difference (P=0.0001) in boys. On the other hand, CI displays significant age differences in girls (P = 0.001). Further, it is clearly noticed that there is a trend of increasing mean of both BMI and CI, starting from the age of 9.5 to age of 12.5 with a little decline in the age of 13.5 among the boys. This indicates an up rise or positive growth trend of all the characters up to the age 12.5 and after that growth rate gradually declines. However, no such clear trend has been observed in case of the girls.

In **Tables 3** and **4**, age-wise prevalence of different levels of nutritional status of the boys and girls are displayed with reference to the classification of thinness, over weight and obesity recommended by

Table 2. Age variation of BMI and CI of boys and girls of Haldia in Purba Medinipur, West Bengal

Age	Sex	N	BMI#	CI#
9.5	Boys	51	16.09 (0.36)	1.21 (0.01)
	Girls	34	16.67 (0.55)	1.23 (0.01)
10.5	Boys	42	16.82 (0.40)	1.21 (0.01)
	Girls	31	18.07 (0.65)	1.17 (0.01)
11.5	Boys	37	17.37 (0.44)	1.21 (0.01)
	Girls	26	16.76 (0.63)	1.19 (0.01)
12.5	Boys	12	20.07 (0.85)	1.25 (0.01)
	Girls	12	17.68 (0.95)	1.21 (0.02)
13.5	Boys	32	18.19 (0.42)	1.23 (0.01)
	Girls	25	18.14 (0.80)	1.14 (0.01)
ANOVA		BOYS	F=7.408 P=0.0001	F=1.205 P=0.311
		GIRLS	F=1.189 P=0.319	F=5.191 P=0.001

Values are presented as mean (SD)

Table 3. Age variation of BMI and nutritional status of of boys and girls of Haldia in Purba Medinipur, West Bengal (According to the classification by Cole et al, 2000, 2008)

Age (years)	Ref	BMI thinness								Over weight 25kg/m²		Obese 30kg/m²	
		Boys				Girls				Boys		Girls	
		16	17	18.5	Normal	16	17	18.5	Normal	25	30	25	30
9.5	Cole	12.57	13.34	14.45	14.46-19.45	12.53	13.29	14.43	14.44-19.44	19.46	23.39	19.45	23.46
Boys –51	N	0	3	10	34	0	5	5	17	3	1	6	1
Girls- 34	%	0.00	5.88	19.61	66.67	0.00	14.71	14.71	50.00	5.88	1.96	17.65	2.93
10.5	Cole	12.77	13.58	14.80	14.81-20.19	12.78	13.59	14.81	14.82-20.28	20.20	24.57	20.29	24.77
Boys –42	N	1	1	6	25	1	1	3	16	8	0	7	3
Girls- 31	%	2.44	2.44	14.63	60.98	3.23	3.23	9.68	51.60	19.51	0.00	22.58	9.68
11.5	Cole	13.03	13.87	15.16	15.17-20.88	13.15	14.01	15.32	15.33-21.19	20.89	25.58	21.20	26.05
Boys –37	N	1	0	4	27	2	2	4	16	4	1	1	1
Girls- 26	%	2.70	0.00	10.82	72.96	7.69	7.69	15.38	61.54	10.82	2.70	3.85	3.85
12.5	Cole	13.37	14.25	15.58	15.59-21.55	13.65	14.56	15.93	15.94-22.13	21.56	26.43	22.14	27.24
Boys –12	N	0	0	1	6	1	0	3	6	1	4	2	0
Girls- 12	%	0.00	0.00	8.33	50.00	8.33	0.00	25.00	50.00	8.33	33.34	16.67	0.00
13.5	Cole	13.83	14.74	16.12	16.13-22.26	14.20	15.14	16.57	16.58-22.97	22.27	27.25	22.98-28.19	28.20
Boys –32	N	1	0	5	23	4	1	7	10	3	0	3	0
Girls- 25	%	3.13	0.00	15.62	71.88	16.00	4.00	28.00	40.00	9.38	0.00	12.00	0.00

Note: Mid-year age of the subjects are considered for comparison

Cole *et al*.[17, 18] The results show significant proportions of thinness in both boys and girls in different age groups. 25.49% of boys in 9.5 years and 48.00% girls aged 13.5 years are found to be suffering from undernutrition (thinness). Very less proportion of boys and girls are found to be obese. There is declining trend of thinness in boys starting from 9.5 years to 12.5 years has been observed. But no such clear age trend of either rise or fall of any level of nutritional status is observed in case of girls. Some sections of both boys and girls exhibit overweight and obesity but small sample size may be the reason of such results. The overall situation however exhibits very poor health and undernutrition of the children and adolescents in this area.

The age wise variation of Z – scores (-2.00 standard deviation of WAZ, HAZ, WHZ) of both boys and girls are displayed in table 5. It is found that for all ages (9.5 – 13.5 years) and for both the sexes, prevalence of underweight stunting and wasting are 8.3%, 14.60% and 2.80%. Among the boys, underweight (13.51%) and stunting (19.35%) is highest in age of 11. This is also true when both the sexes are taken together. In girls, prevalence of underweight (16.67%) and stunting (33.33%) are highest in the age of 12.5 years which are considered as medium and very high respectively in the scale recommended by WHO.[2]

Table 4. Prevalence of nutritional status measured by BMI (according to Cole et al. 2000, 2008) of boys and girls of Haldia in Purba Medinipur, West Bengal

Age (in years)	Sex	N	Thinness	Normal	Over weight	Obesity
9.5	Boys	51	25.49	66.67	5.88	1.96
	Girls	34	29.42	50	17.65	2.93
10.5	Boys	42	19.51	60.98	19.51	0.00
	Girls	31	16.14	51.60	22.58	9.68
11.5	Boys	37	13.53	72.96	10.81	2.70
	Girls	26	30.76	61.54	3.85	3.85
12.5	Boys	12	8.33	50.00	8.33	33.34
	Girls	12	33.33	50.00	16.67	0.00
13.5	Boys	32	18.74	71.88	9.38	0.00
	Girls	25	48.00	40.00	12.00	0.00

Discussion

This investigation is a kind of preliminary record of data and information of anthropometric characters measuring nutritional status of school going adolescent boys and girls aged 9.5 to 13.5 years in Haldia, Purba Medinipur of West Bengal in India. The overall sample size of both the sexes including the age wise number of the subjects were not so remarkable. However, some results indicate clear trends of age sex variation and sexual dimorphism of nutritional status in boys and girls. A trend of increment of BMI with age in both boys and girls at least in some cases indicate growth trend. Sexual dimorphism is not so clear but age wise variation is significant in some occasions like BMI in boys and CI in girls. The stunting, wasting and undernutrition measured by the respective Z-score values indicate remarkable proportions of boys and girls are suffering from thinness and undernutrition. The situations of the adolescent girls have been observed to be even worse compared to the boys in the same age group(s). The results reflect very poor nutrition of the adolescents when both sexes are pooled together. A similar study with higher sample

Table 5. Rates of undernutrition in boys and girls of Haldia in Purba Medinipur, West Bengal

Z-scores	Sex	All ages (9.5 to 13.5 yrs) %	Age Years (months)				
			9.5 (108-119)	10.5 (120-131)	11.5 (132-143)	12.5 (144-155)	13.5 (156-167)
WAZ	Boys	5.70	9.80%	0.00%	13.51	0.00%	6.25%
(underweight)	Girls	11.70	11.76%	0.00%	15.38%	16.67%	16.00%
	Total	8.30	10.58%	0.00	14.28%	8.33%	10.53%
HAZ	Boys	9.80	9.80%	7.14%	19.35%	8.33%	6.25%
(stunting)	Girls	21.10	14.71%	6.45%	30.77%	33.33%	32.00%
	Total	14.60	11.76%	6.84%	22.22%	20.83%	17.54%
WHZ	Boys	3.70	1.96%	4.76%	2.70%	0.00%	0.00%
(wasting)	Girls	0.00	0.00%	0.00%	0.00%	0.00%	0.00%
	Total	2.80	1.18%	2.73%	1.58%	0.00%	0.00%

Note: Age variation of Z-Scores (-2SD) below to the NCHS median values

size in this region and also data from other places can throw some more light in this dimension. It is necessary to develop databases of the health and nutritional profile of the children and adolescents in India where remarkable sections have already been reported to be suffering from poor nutrition and belongs to very low socio-economic status.

Anthropometric parameters used for the evaluation of nutritional status are proxy indicators.[19] These measures represent indirect estimation of undernutrition and do not consider the dimensions like nutrient intake or biochemical tests. In population based investigations in 3rd world countries, cross-sectional study of anthropometric assessment of nutritional status is important for wide-range survey.

Undernutrition is a major public health crisis in developing nations like India. Wasting and stunting are the two commonly used indicators for estimation of undernutrition among children and adolescents. Underweight (UW) is a composite indicator that implies undernutrition of both acute and chronic type. Stunting (ST) indicate high degrees of chronic undernutrition. These indices are compared with the international standard references by NCHS.[20,21] Children whose values of body measurements fall below –2SD z scores of NCHS median are considered undernourished having UW and ST. The results of the present study (table 5) exhibit low degrees of stunting, wasting and underweight when both sexes taken together. Among the girls, stunting (21.1%) and underweight (11.7%) are at medium levels. In some previous studies[12,19,20,22] done in rural and tribal areas in India, high degrees of UW, ST and wasting have been reported. Since stunting is an indicator of chronic or long-term undernutrition, the children and adolescents and especially the girls of the present sample can be said to have prolonged deficiency in nutrition.

Competing interest – None

Acknowledgments

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