Original Article

NUTRITIONAL ESTIMATES OF SCHOOL GOING CHILDREN BASED ON ANTHROPOMETRIC MEASUREMENTS: STUDY FROM A RURAL AREA OF VARANASI

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Abstract:
Background: With the adoption of western lifestyle the problem of overweight and obesity is gradually increasing in children, while problem of malnutrition is persisting continuously in the country. With this background a school based cross sectional study was conducted to assess the nutritional status of school going children in a rural area: Chiraigaon block of Varanasi.
Study period: July 2010 to September 2010
Methods: A school-based study with cross-sectional design was adopted. A total of 1448 school children were examined from 3 middle-schools that were selected by simple random sampling method. Height and weight of the children were measured, and BMI and other parameters were assessed.
Results: On applying the BMI-for-age criteria, twelve percent of the children (12.4% boys and 11.1% girls) were found underweight while 5.4% were overweight or obese (5.71% of the boys and 4.63% of the girls). But when the previous WHO's BMI classification was used, 86.5% children had BMI <18.5 (88.4% of total boys and 81.9% of all girls).
Conclusion: Nutritional status of school going children based on WHO criteria of BMI for age has been satisfactory. However, this approach needs scientific validation by undertaking a multi-centric study.

Keywords: Anthropometric measurements, Nutritional estimates, BMI-for-age, Adolescents

Introduction:
The basic objective of anthropometric assessment at the community level is to provide an estimate of prevalence and severity of malnutrition. Anthropometry quantifies body mass, provides a semi-quantitative estimate of the components of body mass, particularly the bone, muscle and fat compartments and provides information regarding nutritional status.[1] Growth monitoring by anthropometric measurement during childhood and adolescent period, is not only an important health indicator but also a predictor of various morbidities in the community. Most of the attempts of generating anthropometric profile have so far focussed on pre-school children and a very few have dealt with the school-going and adolescent age groups.[2] With this background this study was conducted with the objective to assess the nutritional status of school-going children by anthropometric measurements.

Materials and methods:
A school-based cross-sectional study was envisaged to assess the nutritional status of children using anthropometry. It was decided by the researchers to restrict the study mostly to children who have not yet attained their puberty to avoid discrepancies caused by pubertal growth spurts. Taking into consideration the time restraints and convenience, three out of the total 46 middle schools in Chiraigaon Community Development Block of Varanasi were selected through simple random sampling. A total of 1448 school children from standard Ist to standard VIIIth were enrolled in the study and examined in July 2010 with due permission from the school authorities. Observations were made by first three authors after going through a training of the procedure of anthropometry by the department of Community Medicine, IMS, BHU and accuracy of the data was cross checked by the forth author. Height of all children was measured using standardised steel anthropometric rod with parallel bar. The accuracy of steel anthropometric rod was 0.1 centimetre. The weight was measured using a weighing machine (*Libra*) with an accuracy of ±100 g. The subjects were asked to remove their footwear and accessories before measuring their weights with school uniforms. The scales were recalibrated after each measurement. Accuracy of the weighing scale was verified from time to time against known weights. Data thus generated was analysed using SPSS software.
Body mass index was (BMI) calculated as 'body weight (in kilograms)/ height (in meters) squared'. The age and gender-specific cut-off points for BMI recommended by Cole *et al*,(2000)[3] were applied in identifying the underweight, overweight and obese among the included subjects. Besides, previous WHO classification of BMI cut-off values was also used to classify these parameters, and results from both were compared.

Results:
A total of 1448 children were enrolled in the study from age 4 to 16 years. Out of total children 1016 (70.16%) were boys and 432 (29.83%) were girls. Majority of children (45.3%) belong to age group 10 to 12 years **(Table. 1)**.

Table: 1. Demographic profile of study subjects

AGE (Years)	GIRLS		BOYS		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
4-6	116	26.8%	216	21.2%	332	22.9%
7-9	80	18.6%	180	17.8%	260	17.9%
10-12	172	39.8%	484	47.6%	656	45.3%
13-16	64	14.8%	136	13.4%	200	13.8%
Total	**432**	**100.0%**	**1016**	**100.0%**	**1448**	**100.0%**

There was no significant difference between mean BMI of boys (16.08±2.16) and girls (16.34±2.45). When BMI for age was used 174 (12.0%) children were found underweight, in which 126 (12.4%) were boys and 48 (11.1%) were girls. Prevalence of overweight or obese (e" 85th percentile) was 5.4% (5.71% boys and 4.63% girls). No significant difference was found between the sex distribution in underweight and over-weight children **(Table. 2)**. But when previous WHO's BMI classification was used 86.5% children were found underweight, constituted by 88.4% of the boys and 81.9% of the girls. The difference was significant between boys and girls ($p<0.05$). Thus, results discordance was observed between the two aforesaid scales when applied to the same study population.

Table: 2. Body Mass Index for age of study subjects

Sex	Underweight (BMI for age < 5th percentile)		Healthy weight (BMI for age 5th to <85th percentile)		Overweight (BMI for age 85th to <95th percentile)		Obese (BMI for age ≥95th percentile)		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
Boys	126	12.4	832	81.9	40	3.9	18	1.8	1016	100.0
Girls	48	11.1	364	84.3	18	4.2	2	0.5	432	100.0
Total	**174**	**12.0**	**1196**	**82.6**	**58**	**4.0**	**20**	**1.4**	**1448**	**100.0**
$x^2 = 4.425$, df= 3, p= 0.219										

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Eighty four (5.8%) children were found wasted according to their age (6.7% of the boys and 3.7% of the girls. There was no significant difference in wasting between both sexes. **(Table. 3.1)**

Table: 3.1. Nutritional status of study subjects according to their weight for age

	Wasted (Weight for age < 2 SD)		Normal (Weight for age between ± 2 SD)		Weight for age (> 2 SD)		Total	
	Number	%	Number	%	Number	%	Number	%
Boys	68	6.7	934	91.9	14	1.4	1016	100.0
Girls	16	3.7	412	95.4	4	0.9	432	100.0
Total	**84**	**5.8**	**1346**	**93.0**	**18**	**1.2**	**1448**	**100.0**
x^2= 5.553, df= 2, p= 0.06								

While wasting was more prevalent in the higher age groups, weight beyond the normal (3rd to 97th percentile) range decreased with increasing age in both sexes. (Table 3.2)

Table: 3.2. Status of weight of children according to their age

Age group (Year)	Wasted (Weight for age < 2 SD)		Normal (Weight for age between ± 2 SD)		Weight for age (> 2 SD)		Total	
	Number	%	Number	%	Number	%	Number	%
BOYS								
4-6	6	2.8	202	93.5	8	3.7	216	100.0
7-9	16	8.9	160	88.9	4	2.2	180	100.0
10-12	34	7.0	448	92.6	2	0.4	484	100.0
13-16	12	8.8	124	91.2	0	0.0	136	100.0
Total	**68**	6.7	**934**	91.9	**14**	1.4	1016	**100.00**
GIRLS								
4-6	0	0.0	112	96.6	4	3.4	116	100.0
7-9	2	2.5	78	97.5	0	0.0	80	100.0
10-12	12	7.0	160	93.0	0	0.0	172	100.0
13-16	2	3.1	62	96.9	0	0.0	64	100.0
Total	**16**	**3.7**	**412**	**95.4**	**4**	**0.9**	**432**	**100.00**

Eighty (5.5%) children were found stunted according to their age which included 5.7% of the boys and 5.1% of the girls. There was no significant difference in stunting between both the sexes **(Table. 4.1)**.

Table: 4.1. Nutritional status of study subjects according to their height for age

	Stunted (Height for age < 2 SD)		Normal (Height for age between ± 2 SD)		Height for age > 2 SD)		Total	
	No.	%	No.	%	No.	%	No.	%
Boys	58	5.7	856	84.3	102	10.0	1016	100.0
Girls	22	5.1	382	88.4	28	6.5	**432**	**100.00**
Total	**80**	**5.5**	**1238**	**85.5**	**130**	**9.0**	**1448**	**100.0**
x^2= 5.100, df= 2, p= 0.07								

Stunting increased with increase in age for both the boys and girls while the reverse was seen for height >2SD **(Table 4.2)**.

Table: 4.2. Status of height of boys according to their age

Age group (Year)	Stunted (Height for age < 2 SD)		Normal (Height for age between ± 2 SD)		Height for age > 2 SD)		Total	
	Number	%	Number	%	Number	%	Number	%
BOYS								
4-6	2	0.9	140	64.8	74	34.3	216	100.0
7-9	14	7.8	154	85.6	12	6.7	180	100.0
10-12	32	6.6	438	90.5	14	2.9	484	100.0
13-16	10	7.4	124	91.2	2	1.5	136	100.0
Total	**58**	**5.7**	**856**	**84.3**	**102**	**10.0**	1016	**100.00**
GIRLS								
4-6	4	3.4	90	77.6	22	19.0	116	100.0
7-9	4	5.0	72	90.0	4	5.0	80	100.0
10-12	4	2.3	166	96.5	2	1.2	172	100.0
13-16	10	15.6	54	84.4	0	0.0	64	100.0
Total	**22**	**5.1**	**382**	**88.4**	**28**	**6.5**	**432**	**100.00**

Three hundred and forty six (23.9%) children (24.6% boys and 22.2% girls) were found with weight less than 90% of the reference value for their corresponding height **(Table 5)**.

Table: 5. Nutritional status of study subjects according to weight for height

Weight for height (%)	Boys		Girls		Total	
	Number	%	Number	%	Number	%
≤ 60	0	0.0	0	0.0	0	0.00
60.1 – 70	0	0.0	0	0.0	0	0.00
70.1 – 80	12	1.2	4	0.9	16	1.1
80.1 – 90	238	23.4	92	21.3	330	22.8
>90	766	75.4	336	77.8	1102	76.1
Total	**1016**	**100.0**	**432**	**100.0**	**1448**	**100.00**
x^2= 1.008, df= 2, p= 0.604						

Discussion:

In the present study 12% of children were found underweight and 5.4% were found overweight or obese when BMI-for-age criteria was used but when previous WHO criteria was used, the prevalence of underweight was 86.5%. **P.R. Deshmukh *et al*** (2006)[4] reported 75.3% underweight adolescents in rural Wardha and **Choudhary S *et al***[5] reported that 68.52% of adolescents had BMI less than 18.5 kg/square meter in rural area of Varanasi. **Shahabuddin *et al***[6] had reported 67.0% prevalence of thinness in Bangladesh.

In the present study alarming difference in the prevalence of *underweight* was observed by using the BMI-for-age criteria (<5th percentile) and BMI < 18.5 cut-off. The discrepancy in labelling of the cases as per different definitions/classifications (more so, usage of different terminologies like thinness, chronic energy deficiency and wasting) could be confusing to health managers and planners. Interpretation of weight for height (wasting) and weight for age (underweight) have differing relevance in different situations. Similarly, conventional approaches to the combined use of height for age and weight for age are awkward and give biased results. BMI itself does not consider age, which is important in children and adolescents. Because of these various limitations, WHO has recommended BMI for age as the best indicator for use in children and adolescents as it incorporates the required information on age. It has been validated as an indicator of total body fat at the upper percentiles, and it provides continuity with recommended adult indicator. Given the observed incoherence between the two criteria, the present study in discussion indicates the scope to take up the comparison with a bigger sample size to recommend the more acceptable criteria with better validity and analyze the possible policy implications.

Using all the three indices (weight for age, height for age, weight for height) of boys and girls were similar thereby indicating no gender discrimination. Increasing deficit in terms of weight and height for age with advancing age could be due to inclusion of some children with puberty spurt, where nutritional requirements are more.

Conclusion:

Majority of school going children in the study area were normal on the basis of three nutritional indices (weight for age, height for age, weight for height). Alarming differences in the nutritional status by using WHO proposed BMI for age criteria and previous WHO BMI cut off 18.5 for undernourished requires scrutiny on a larger data base through multi-centric studies.

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