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Gender differentials in the nutritional status of the adolescents in Parbhani District central Maharashtra

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Abstract
Background: Malnutrition, one of the most leading causes of mortality and morbidity worldwide, is growing in epidemic proportions among adolescents in developed and developing nations. Adolescents are the building resources and future citizens of the nation. The well-educated and healthy adolescents are necessary for development of nation. In India adolescents comprises a population of 236.5 million which is 19.6 per cent of total population. With this background current study was framed with the two key objectives that is- to assess gender differences in the prevalence of malnutrition (Stunting, Thinness, and Overweight & Obesity) among 13-18 year old adolescents of Parbhani Maharashtra and the various socio-demographic factors that influence their malnutrition.
Method: A cross sectional study of 300 adolescents of age group 13-18 years from various schools in Parbhani district of Maharashtra. Their anthropometric measurements were taken, and Z-scores were drawn using WHO Anthro Plus software. Besides calculating the percentages, t-test and correlation co-efficient were applied to determine the difference between two attributes. Statistical analysis was done using STATA14.
Results: The proportion of stunting, thinness and overweight among adolescents was 32.3%, 8.7% and 3.7% respectively. The burden of malnutrition was higher among boys compared to girls. BMI-for-age Z scores were almost similar in boys (-0.84) and girls (-0.88). The height-for-age Z score was better among girls (-1.45) compared to boys (-1.72). BMI-for-age Z scores and height-for-age Z scores were inversely associated with age. A significant correlation was observed between socio-demographic factors and anthropometric parameters.
Conclusion: The present study shows significant gender differentials in the nutritional status of the adolescents with burden of malnutrition being higher among boys compared to girls. There were significant variations of HAZ score and BAZ score across gender and age. Interventions that are economically and culturally appropriate for the elimination of childhood malnutrition should be supported.

Keywords: Malnutrition, adolescents, stunting, thinness, overweight

Introduction
Adolescence from Latin adolescere, meaning 'to grow up' is a transitional stage of physical and psychological development that generally occurs during the period between puberty to legal adolescence, and marks the metamorphosis of the child into the adulthood. It begins with the initiation of puberty and ends with the completion of the growth spurt, the attainment of adult stature height and the achievement of reproductive maturity [1]. The health and wellness of the adolescents is important as 37% of total bone mass accumulation, 15-25% of adult height gain and 45% of prospective skeletal growth occur during this age [2, 3].
Nutritional status is now recognized to be a prime indicator of the health of individuals. The World Health Organization believes that the ultimate objective of nutritional assessments is the improvement of human health. India is suffering from the dual burden of malnutrition i.e., undernutrition and overweight-obesity [4, 5, 6]. The number of undernourished children in India is highest in the world, and more than half of Indian children live in poverty [7, 8, 9]. The short-term effects of undernutrition (thinness or stunting) include being underweight, having poor academic performance and a higher risk of infection. Long-term, undernutrition in adolescents is associated with poor health in general and lowered economic output [3, 4]. Conversely, over-nutrition contributes to the early onset of non-communicable disorders such as cancer, diabetes, hypertension, coronary heart disease, and sleep apnea [10].
Gender differences and variations in the initiation of sexual maturation are significant factors to consider when assessing adolescents' nutritional needs [11].

Male and female growth rates tend to take different directions, which has consequences for interventions. According to studies, females in developing countries are closer to international reference standards for height and weight than males and adverse environments have a greater effect on males' development [12, 13, 11, 14].There is need to develop database on the nutritional status of the adolescents from the different parts of the country to enable the governmental and non-governmental agencies to formulate policies and initiate strategies for the wellbeing of adolescents. With this background current study was framed with the two key objectives that is-to assess the prevalence of malnutrition (Stunting, Thinness and Overweight & Obesity) among 13-18 year old adolescents from Parbhani Maharashtra and the various socio-demographic factors that influence malnutrition.

Methodology

For this cross-sectional study, a sample of adolescents of age group 13-18 years from various schools in Parbhani district of Maharashtra was selected. The sample size was calculated based on the prevalence of stunting among adolescents taken as 26.4% [15] and taking 20% relative error, by using the formula

$$\frac{4PQ}{L2}$$

$$\frac{4 \times 26.4 \times 73.6}{(5.28 \times 5.28)}$$

= 278, which was round off to 300. The samples were selected to give equal distribution of each age in years with 50 each from ages 13 to 18 and with equal numbers of boys and girls. Successive secondary and higher secondary schools were visited for data collection till all the number of required samples in each age group was met.

The data collection was done during January to March of 2021, following all covid norms. All the selected adolescents were personally interviewed by the investigator with help of a structured pre-tested questionnaire containing questions about socio-demographic factors such as name, age, type of family, size of the family, occupation of the father, monthly income, details of father and mother education were taken. Anthropometric measurements like, height in cm, weight in kg were measured by standardized equipment, and body mass index in kg/m^2 (BMI) was calculated as weight taken in KGs divided by height squared taken in meters.

Z-scores were drawn using WHO Anthtro plus software. Statistical analysis was done using STATA14. Simple arithmetic means with standard deviations were calculated for continuous data to interpret the results. Categorical data was represented as percentages. An association between the socio-economic factors and anthropometric parameter in the adolescents was evaluated using correlation coefficient. Unpaired t-test was conducted to observe the significance of differences in the mean z scores of boys and girls.

Results

Table 1: Socio-economic status of the selected adolescents

Parameter	Boys (N=150)		Girls (N=150)	
	N	%	N	%
1. Age (years)				
13	25	8.33	25	8.33
14	25	8.33	25	8.33
15	25	8.33	25	8.33
16	25	8.33	25	8.33
17	25	8.33	25	8.33
18	25	8.33	25	8.33
2. Monthly Income of Family				
Rs. < 10,000	60	40	43	28.66
Rs. 10,000<15,000	45	30	55	36.66
Rs. 15,000<20,000	45	30	52	34.66
3. Type of Family				
Nuclear	80	53.33	73	48.66
Joint	56	37.33	59	39.33
Extended	14	9.33	18	12
4. Family Size				
Small (upto 4)	46	30.66	22	14.66
Medium (5 to 8)	91	60.66	112	74.66
Large (9 or above)	13	8.66	16	10.66
5. Fathers Education				
Illiterate	37	24.6	15	10
Primary school	9	6	5	3.33
Middle school	16	10.6	19	12.66
High school	37	24.6	50	33.33
College	51	34	61	40.66
6. Mothers Education				
Illiterate	42	28	28	18.66
Primary school	16	10.6	25	16.66
Middle school	32	21.3	35	23.33
High school	46	30.6	50	33.33
College	14	9.3	12	8
7. Occupation				
Service				

Private	1	0.66	4	2.66
Government	1	0.66	6	4
Business	3	2	3	2
Agriculture	137	91.3	133	88.6
Labour	8	5.3	4	2.6

Data pertaining to age, monthly income, type of the family, family size, literacy level of parent's and occupation of the selected adolescents is depicted in Table 1.

The study sample comprises 50% of boys and 50% of girls from the age group of 13- 18 years with 25 adolescents in each group. Majority of the adolescent boys (40%) were belonging to low income group (Rs: <10,000 per month) and majority of the adolescent girls (36.6%) belonging to middle income group (Rs: 10,000 - <15,000 per month). Majority of the adolescent boys (53.3%) and girls (48.7%) belonged to nuclear family. Maximum number adolescent boys (60.7%) and girls (74.7%) belonged to medium sized family followed by small and large sized family. Adolescent boys' parents (24.6%) were more illiterate compared to adolescent girls' parents (10%). In this study agriculture was the prime occupation of most of the parents of adolescents.

Table 2: Mean BAZ and HAZ scores of the adolescents

Sr. No.	Category	N	BAZ Scores (Mean ± SD)	HAZ Scores (Mean ± SD)
	Total sample	300	-0.86 ± 1.01	-1.59 ± 1.01
	Gender			
1.	Male	150	-0.84 ± 1.01	-1.72 ± 1.02
2.	Female	150	-0.88 ± 1.01	-1.45 ± 0.98
	p-value		0.73	0.02
	Age			
1.	13	50	-0.90 ± 1.39	-1.55 ± 1.34
2.	14	50	-0.57 ± 1.24	-1.51 ± 0.97
3.	15	50	-0.95 ± 0.76	-1.50 ± 0.93
4.	16	50	-1.32 ± 0.95	-1.72 ± 0.90
5.	17	50	-0.87 ± 0.63	-1.66 ± 0.91
6.	18	50	-0.53 ± 0.69	-1.57 ± 0.97

Data pertaining to BMI-for-age Z scores (BAZ) and height for age Z score of the adolescent is presented in table 2. Mean BAZ scores were almost similar in boys (-0.84) and girls (-0.88). The mean values of BAZ scores worsened as the age increased from 13 years (-0.90) to 16 years (-1.32) then again improved from 17 years (-0.87) to 18 years (-0.53). The mean HAZ of girls (-1.45) was significantly better than boys (-1.72) (p = 0.02). The mean values of HAZ scores also worsened as the age increases from 13 years (-1.55) to 16 years (-1.72) then improved from the age of 17 years (-1.66) to 18 years (-1.57).

Table 3: Correlation coefficient of the anthropometric measurements with different age group, income and parental education of the adolescent boys and girls

Sr. No.	Parameters	Boys		Girls	
		Height (cm)	Weight (Kg)	Height (cm)	Weight (Kg)
1.	Age	0.608**	0.614**	0.364**	0.387**
2.	Monthly income	0.526**	0.657**	0.582**	0.440**
3.	Fathers education	0.441**	0.547**	0.489**	0.347**
4.	Mothers education	0.358**	0.495**	0.677**	0.536**

** Correlation is significant at 1 per cent

The data pertaining to correlation coefficient of anthropometric measurements with age, income and parental education of the adolescent boys and girls is given in Table 3.

A significant correlation has been observed between the anthropometric parameters and socio-demographic factors such as age, income and parental education. Anthropometric measurements of adolescent boys and girls (height and weight) were found to have a significant correlation (boys r = 0.608, 0.614 respectively; girls r = 0.364, 0.387 respectively) with the age (13 to 18 years). Anthropometric measurements of adolescent boys and girls (height and weight) were found to have a significant correlation (boys r = 0.526, 0.657 respectively; girls r = 0.582, 0.440 respectively) with monthly income. Anthropometric measurements of adolescent boys and girls (height and weight) were found to have a significant correlation (boys r = 0.441, 0.547 respectively; girls r = 0.489, 0.347 respectively) with fathers education. Anthropometric measurements of adolescent boys and girls (height and weight) were found to have a significant correlation (boys r = 0.358, 0.495 respectively; girls r = 0.677, 0.536 respectively) with mothers education.

Table 4: Prevalence of malnutrition among boys and girls

Category	Total (N)	Stunting (%)	Thinness (%)	Overweight (%)
Total	300	32.3	8.7	3.7
Male	150	39.7	10.7	4.7
Female	150	25	6.7	2.7

Data pertaining to burden of Stunting (Height-for-age Z score < -2SD), thinness (BMI-for-age Z score <-2SD) and overweight (BMI-for-age Z score >+1 SD) among study population was presented in table 4.

The overall prevalence of stunting, thinness and overweight

was 32.3%, 8.7% and 3.7% respectively. The prevalence of malnutrition was observed to be higher among the boys as compared to the girls. The burden of stunting was 39.7 among boys and 25% among girls. The prevalence of thinness was 10.7% among boys and 6.7% among girls. The burden of overweight was 4.7% and 2.7% among boys and girls respectively.

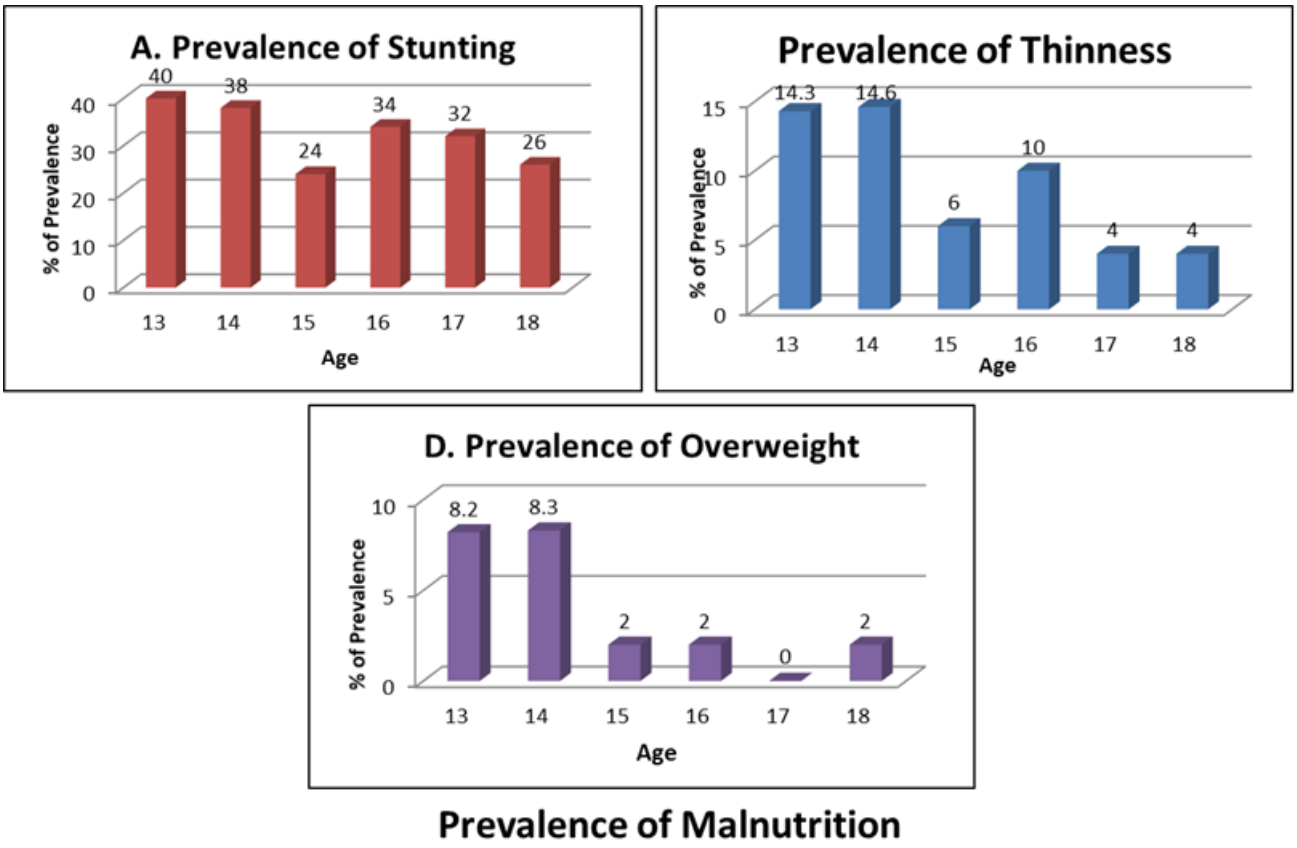

Fig 1: Prevalence of malnutrition among 13-18 year old adolescents

Prevalence of malnutrition (stunting, thinness, overweight & obesity) among 13-18 year old adolescent was represented in the figure 1.

The prevalence of stunting, thinness and overweight were found to be highest in 13-14 years. While stunting was >38% in 13, 14 years and it was <34% in 15, 16, 17 and 18 year adolescents respectively. Similarly, thinness was found to be >14% in 13 and 14 year old while 10% or less in 15-18 year adolescents. Whereas, overweight was > 8% in 13-14 year while 2% in 15-18 year adolescents. Only in the age group of 17, no burden of overweight. The prevalence of obesity was not found among adolescents aged 13-18 years.

Discussion

Our study was conducted to find out the gender differences in the nutritional status of the adolescents. Our analysis has shown that among study population overall prevalence of stunting, thinness and overweight was 32.3%, 8.7% and 3.7% respectively. The prevalence of malnutrition (stunting, thinness and overweight) was higher among boys compared to girls. The burden of stunting, thinness and overweight was higher among 13-and 14-year-old adolescents (early adolescents). Mean BAZ scores were almost similar in boys (-0.84) and girls (-0.88). The mean values of BAZ scores worsened as the age increased from 13 to 16 years then again improved from 17 to 18 years. The average HAZ (Height-For-Age) of girls (-1.45) were better than boys (-1.72). The mean values of HAZ scores worsened as the age increased from 13-16 years then improved from the age of 17 to 18 years. The socio-demographic factors of adolescent seemed to have an impact on their nutritional status.

Stunting

In our study the overall prevalence of stunting was 32.3% with higher burden in boys (39.7%). The prevalence was found to be higher than the findings of Pandurangi *et al*., [16] which was a secondary analysis of CNNS (Comprehensive National Nutrition Survey 2016-18) where the prevalence of stunting in India was estimated to be 27.4% among 10-19-year-old adolescents. Also contrary to our findings, CNNS has reported higher prevalence of stunting among girls. According to Bhargava, M *et al*., [17] done the secondary analysis of National Family Health Survey-3 & 4 (NFHS-3 & NFHS-4) the burden of stunting was found to be 25.2% in boys and 31.2% in girls. While as per NFHS-4 data the prevalence of stunting was found to be 32.2% in boys and 34.4% in girls, higher than NFHS-3.

The high rate of stunting among Indian adolescents indicates the persistence of pre-pubertal growth deficit. Additional nourishment is needed during the pubertal growth spurt, which can add 8.3 cm/year in females and 9.5 cm/year in boys [18]. In countries with high rates of malnutrition, the adolescent growth spurt may be prolonged in duration and last until late adolescence [19]. The NNMB studies record the dietary intake of adolescents aged 10 to 17 years. The average daily calorie intake for boys aged 10 to 12 was 1387 kcal, 1611

kcal for boys aged 13 to 15, and 1832 kcal for boys aged 16 to 17. The corresponding protein intakes for these age groups were 36 gm, 42 gm, and 50 gm [20]. These were significantly less than the recommended dietary allowances (RDA 2020, boys aged 10-12 year; 2220 Kcal & for 13-15 years; 2860 Kcal) which may lead to malnutrition.

Thinness

In the present study the prevalence of thinness was higher among boys (10.7%) compared to girls (6.7%). Similar results were seen by Bhargava, M *et al*., [17] in NFHS-3 & NFHS-4 data that thinness in boys and girls was 22.3% and 9.9% in NFHS-3 and 16.5% and 9% in NFHS-4(15-19 years). As per NFHS -3 data the state of Maharashtra had the highest levels of thinness (24.9%). Another finding of Pandurangi *et al*., [16] which was a secondary analysis of nationally representative data comprehensive national nutrition survey (CNNS 2016-18) has also reported similar findings where thinness was higher in boys (29.9%) than girls (18.9%). Similar to the findings by Kumar p *et al*., [21] the prevalence of thinness was higher among adolescent boys as compared to adolescent's girls (25.8 per cent vs. 13.1 per cent).

The current study has reported prevalence of malnutrition to be higher among early adolescents (13-14 years, >38%) compared to late adolescents. This finding was similar to Pandurangi *et al*., [16] did secondary analysis of CNNS 2016-18 which estimated the prevalence of thinness to be 27.6% in early adolescence and 20.9% in late adolescence. Irrespective of their gender, the prevalence of thinness was higher among early adolescents of Bihar and Uttar Pradesh as reported by Kumar p *et al*. [21]. As discussed by Baliga *et al*., [22] this could be attributed to rapid growth rate during adolescence and lack of calorie intake during early adolescents compared to late adolescents.

Overweight

In the present study the prevalence of overweight was 3.7% and was found to be high among boys (4.7%) than girls (2.7%). This is similar to the findings by Bhargava, M *et al*., [17] secondary Analysisi of NFHS-4 data that overweight/obesity in boys 6.2% (95% CI: 5.9, 6.4) and 5% (95% CI: 4.8, 5.1) in girls. Similarly findings by Pandurangi *et al*., [16] as per CNNS 2016-18, prevalence was high among boys (4.9%) compared to girls (4.7%). A study conducted by Ng, Marie, *et al*. [23] between 1980 and 2013, observed that among 1,769 population research revealed that the prevalence of overweight among children and adolescents in developing nations increased from 8.4 to 13.4% in girls and from 8.1 to 12.9% in boys. Late adolescent had lower burden of overweight than early adolescents. This is due to increased growth spurt in the early adolescent stage as compared late adolescent stage [24]. The odds of being overweight were higher among adolescents with better parental education and monthly income.

Socio-demographic factors

A strong correlation was observed between the anthropometric measurements of the adolescents and their socio-demographic factors. The height and weight of the adolescents were observed to have improved with better income and education status of the parents. The study by Assefa *et al*., [25] observed socio-economic factors to be associated with underweight and stunting among adolescents of Jimma Zone, South West Ethiopia, and also found that height was positively associated with income. Another study conducted by Gurzkowska *et al*., [26] found that monthly income was positively associated with weight, BMI and waist circumference in both the genders among adolescents. These findings were also found in various other studies [27, 25, 28].

Conclusion

There was significant gender differentials in the nutritional status of the adolescents with burden of malnutrition being higher among boys compared to girls. Overall prevalence of stunting, thinness and overweight was 32.3%, 8.7% and 3.7% respectively. The burden of stunting, thinness and overweight was higher among 13-and 14-year-old adolescents (early adolescents). There were significant variations of HAZ score and BAZ score across gender and age.

List of abbreviations

WHO : World Health Organization.
BAZ : BMI for age Z score.
HAZ : Height for age Z score.
SD : Standard deviation.
BMI : Body mass index.
CNNS : Comprehensive National Nutrition Survey.
NFHS : National Family Health Survey.
RDA : Recommended dietary allowances.
NNMB : National Nutrition Monitoring Bureau.

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