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Original Research Article

A comparison of nutritional status of rural and urban adolescent girls from schools in North India: a cross-sectional study

Neha Goyal*

Department of Community Medicine, Teerthanker Mahaveer Medical College and Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India

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***Correspondence:**
Dr. Neha Goyal,
E-mail: drgoyalneha@gmail.com

ABSTRACT

Background: Adolescence is a nutritionally vulnerable period for a number of specific reasons, including high requirements for growth, eating patterns and lifestyles, risk-taking behaviour and, susceptibility to social and environmental influences. The objectives of the study were to compare the nutritional status of rural and urban school going adolescent girls by anthropometric measurements.
Methods: A cross-sectional study was carried out in urban as well as rural schools of Haldwani block of district Nainital from October 2012 to September 2014. Multistage random sampling was used to select the requisite number, 770 (443 rural and 327 urban) of school going adolescent girls of 10 to 19 years of age, who were interviewed and anthropometric measurements were recorded for assessing the nutritional status. WHO 2007 growth standards for 5-19 years old for girls was followed. Height-for-age Z scores and BMI-for-age Z scores were calculated with help of WHO Anthro Plus Software version 1.0.4. Data was analysed using SPSS v.20.
Results: Mean weight and mean BMI of adolescent girls in urban area was significantly higher than those in rural area, while mean height in two groups was not significantly different. Mean height-for-age and the mean BMI-for-age of the study girls was below median of the 2007 WHO reference throughout the adolescent period.
Conclusions: Thinness was significantly higher in rural girls while overweight and obesity was not significantly different in rural and urban girls.

Keywords: Nutritional status, Adolescent girls, Rural, Urban

INTRODUCTION

Adolescence, between the ages of 10 and 19 years, is a transitional phase between childhood and adulthood characterized by nutritional vulnerability for a number of specific reasons, including high requirements for growth, eating patterns and lifestyles, risk-taking behaviour and, susceptibility to social and environmental influences.[1,2] Among adolescents, girls constitute a more vulnerable group particularly in developing countries like India with 243 million adolescents and where, of the total female population 10.7% and 9.7% are adolescent girls in age groups 10-14 years and 15-19 years respectively.[3-5] In the age group 15 to19, nearly half of the girls (47%) are thin and at the same time, 2.4 percent of the girls in this age group are overweight in India.[6] This high prevalence of under-nutrition is accounted to the consumption of only two-thirds of the recommended energy requirement according to National Nutrition Monitoring Bureau (NNMB) report.[7] Especially in rural sectors of India this condition is even worse where rural adolescent girls commonly bear heavy work burdens and fulfil their responsibilities while suffering from malnutrition.[2]

The growth spurt during this second decade of life has been seen as a period of potential interest for catching up

deficits of childhood and for the purpose growth monitoring by anthropometric measurements can provide an important health indicator for both under nutrition and over nutrition issues. Anthropometry has its own merits in being universally applicable, simple, inexpensive, and non-invasive technique which can be an excellent tool for guiding public health policies as well as individual interventions.[8] Evident from the reports of the World Health Organization is that in South East Asian Region a large number of adolescents, who constitute 20% of the population in these countries, suffer from malnutrition, which adversely impacts their health and development swayed by rural-urban differential.[9]

Objective

To compare the nutritional status of rural and urban school going adolescent girls by anthropometric measurements.

METHODS

The present cross-sectional study was conducted to assess the nutritional status of adolescent girls in urban and rural schools of Haldwani from October 2012 to March 2014, using simple anthropometric measurements. Sample size was calculated using the formula n = 1.96 x 1.96 pq/d^2, taking estimated prevalence of malnutrition p of 65% with d of 5% at 95% confidence level.[10] Multistage random sampling was used to select the requisite number of girls. Informed verbal consent from school authorities was obtained after explaining the purpose of study. A total of 770 (443 rural and 327 urban) school going adolescent girls of 10 to 19 years of age were interviewed and anthropometric measurements were recorded for assessing the nutritional status.

Weight was measured to the nearest 500 grams using a portable weighing machine, which was standardized by calibrating it against known weights regularly and to zero before each measurement. Students were asked to remove footwear and emptied their pockets while standing on the weighing machine.

Height in centimetres was marked on a wall with the help of a measuring tape and height of all the girls was measured against the wall. They were asked to remove their foot wear and to stand with heels together and their heads positioned so that the line of vision (Frankfurt's plane) was perpendicular to the body. A scale was placed above the head and height was measured to the nearest 0.1 centimetre. Body Mass Index (BMI) was calculated using the standard formula: BMI (kg/rn^2) =Weight (kg)/Height^2 (m^2).

Age was calculated in months as period between date of visit and date of birth. Subjects were asked about their date of birth and it was confirmed with appropriate documents in school also.

For anthropometric comparison, we followed the WHO 2007 growth standards for 5-19 years old for girls, which are also recommended for use in the manual on New Dietary Guidelines for Indians, 2011 by NIN, ICMR.[11,12] Height-for-age Z scores and BMI-for-age Z scores were calculated with help of WHO Anthro plus Software version 1.0.4.[13] Weight for-age Z scores are not applicable after age of 10 years and therefore have not been considered.

Stunting was defined as Height-for-age < 2SD according to WHO 2007 growth standards for 5-19 years old for girls. Thinness was defined as BMI-for-age Z scores less than one, and severe thinness as BMI-for-age Z score less than two. Overweight is defined as BMI-for-age Z score more one, and obesity as BMI-for-age Z score more one two.[14]

Statistical analysis

Data was analysed using SPSS v.20. The descriptive statistical analysis of the data obtained was depicted in terms of mean and standard deviation (SD). Levene's test was used to test homogeneity of variances. The independent sample t-test was done to assess differences in the anthropometric variables. A two-tailed p value less than 0.05 was considered significant. Normality was also tested using the Shapiro-Wilk test for each of the anthropometric variables. Binary logistic regression to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) were used to assess the possible rural-urban differences. The Chi square test was used for assessing statistically significant association.

RESULTS

Mean age of study subjects was 14.29±1.81 years. Out of 443 rural school girls 292 (65.90%) and 151 (34.10%) belonged to 10 to 14 and 15 to 19 year age categories respectively. Out of 327 urban school girls 137 (41.90%) and 190 (58.10%) belonged to 10 to 14 and 15 to19 year age categories respectively.

Mean weight of adolescent girls in present study was 40.38±8.41kg and it varied from 27.25±5.07 kg at age of 10 years to 44.80±7.36 kg at 19 years. Maximum mean weight was found to be 48.85±9.56 kg at age of 17 years. Mean height of adolescent girls was 150.18±6.97cm and it has progressively increased from 136.81±7.50 cm at age of 10 years to 155±4.47cm at 19 years. Mean BMI of adolescent girls was. 17.79±2.96 kg/m^2. Mean BMI of adolescent girls varied from 14.46±1.77 kg/m^2 at age of 10 years to 18.58±2.34 kg/m^2 at 19 years.

The age wise distribution of mean height, weight and BMI of the adolescent girls and comparison of these growth parameters among rural and urban girls. Combining all ages, the mean height, weight and BMI of the adolescent girls from rural and urban schools were respectively 149.65±7.37 cm and 150.57±6.45 cm,

39.49±8.63 kg and 41.33±7.94 kg, and 17.50±3.01 kg/m^2 and 18.14±2.89 kg/m^2. An independent sample t test showed that the mean weight and mean BMI of urban school girls was significantly higher than rural school girls (t=3.01, p<0.05 and t=2.98, p<0.05) while mean height in two groups was not significantly different. The age wise differences of mean parameters among rural and urban girls were largely insignificant except the statistically significant differences in mean height at 17 years and the mean weight and BMI at 19 years of age (Table 1).

Table 1: Mean anthropometric measures of adolescent girls according to age (n=770).

Age (in completed years)	Mean Height (cm) ±SD Rural	Mean Height (cm) ±SD Urban	P* value	Mean Weight (kg) ±SD Rural	Mean Weight (kg) ±SD Urban	P* value	Mean BMI (kg/m^2) ±SD Rural	Mean BMI (kg/m^2) ±SD Urban	P* value
10	137.35± 7.89	136.00 ±3.00	0.717	27.28 ±5.31	28.60 ±3.13	0.612	14.34 ±1.74	15.46 ±1.69	0.232
11	138.59 ±5.85	138.08± 5.31	0.793	30.31 ±6.24	32.08 ±8.92	0.462	15.69 ±2.45	16.65 ±3.56	0.316
12	146.05 ±6.93	146.28± 9.54	0.925	35.02 ±6.99	35.78 ±7.56	0.738	16.31 ±2.49	16.50 ±1.81	0.802
13	148.63± 5.65	148.81± 5.64	0.872	36.74 ±7.46	37.62 ±5.64	0.524	16.54 ±2.53	16.94 ±2.04	0.398
14	150.78± 5.64	150.69± 5.67	0.913	40.50 ±6.66	39.86 ±6.74	0.529	17.79 ±2.72	17.53 ±2.74	0.532
15	151.98 ±5.50	151.67± 5.62	0.741	42.87 ±8.28	42.15 ±7.85	0.602	18.54 ±3.40	18.27 ±3.01	0.634
16	153.54 ±5.53	152.35± 5.02	0.258	43.65 ±7.81	44.30 ±6.43	0.641	18.47 ±2.84	19.08 ±2.63	0.261
17	156.25 ±4.41	153.41± 3.71	0.005**	46.59 ±6.17	46.22 ±7.93	0.832	19.08 ±2.46	19.60 ±3.06	0.454
18	158.50 ±5.18	152.80± 5.71	0.090	51.00 ±8.26	45.40 ±11.41	0.325	20.37 ±3.73	19.38 ±4.33	0.670
19	157.00 ±4.24	153.66± 4.93	0.495	52.80 ±4.24	40.00 ±3.60	0.041**	21.07 ±5.58	16.91 ±0.66	0.006**
Total	149.65 ±7.37	150.57 ±6.44	0.073	39.49 ±8.63	41.33 ±7.93	0.003**	17.50 ±3.00	18.14 ±2.89	0.003**

*Independent sample t test; **Statistically significant, p (two-tailed) <0.05.

Table 2: Height-for-age Z scores among rural and urban adolescent girls.

Age (in completed years)	Rural (n=443)			Urban (n=327)		
	≥-2 Z score	<-2 Z score	Mean height-for-age Z scores	≥-2 Z Score	<-2 Z score	Mean height-for-age Z scores
10	14 (100)	-	-0.20	5 (100)	-	-0.41
11	29 (90.63)	3 (9.38)	-0.95	12 (100)	-	-1.03
12	31 (86.11)	5 (13.89)	-0.75	12 (85.71)	2 (14.29)	-0.72
13	76 (87.36)	11 (12.64)	-1.11	30 (81.08)	7 (18.92)	-1.08
14	103 (83.74)	20 (16.26)	-1.29	58 (84.06)	11 (15.94)	-1.30
15	59 (79.73)	15 (20.27)	-1.40	48 (75)	16 (25)	-1.45
16	29 (82.86)	6 (17.14)	-1.31	66 (80.49)	16 (19.51)	-1.49
17	30 (93.75)	2 (6.25)	-0.98	31 (86.11)	5 (13.89)	-1.40
18	8 (100)	-	-0.69	4 (80)	1 (20)	-1.55
19	2 (100)	-	-0.94	2 (66.67)	1 (33.3)	-1.45

≥-2 Z score= Normal, <-2 Z score= Stunted; Figures in parentheses denote percentages.

Table 3: BMI-for-age Z scores among rural and urban adolescent girls.

Age (in completed years)	Rural (n=443)			Urban(n=327)		
	≥-2 Z score	<-2 Z score	Mean BMI-for-age Z scores	≥-2 Z score	<-2 Z score	Mean BMI-for-age Z scores
10	10 (71.43)	4 (28.57)	-1.49	5 (100)	-	-0.72
11	25 (78.13)	7 (21.88)	-1.01	9 (75)	3 (25)	-0.66
12	28 (77.78)	8 (22.22)	-1.02	12 (85.71)	2 (14.29)	-0.82
13	63 (72.41)	24 (27.59)	-1.23	31 (83.78)	6 (16.22)	-0.97
14	98 (79.67)	25 (20.33)	-0.92	59 (85.51)	10 (14.49)	-1.04
15	61 (82.43)	13 (17.57)	-0.85	51 (79.69)	13 (20.31)	-0.96
16	27 (77.14)	8 (22.86)	-1.03	75 (91.46)	7 (8.54)	-0.73
17	30 (93.75)	2 (6.25)	-0.82	33 (91.67)	3 (8.33)	-0.66
18	7 (87.50)	1 (12.5)	-0.48	4 (80)	1 (20)	-0.91
19	2 (100)	-	-0.12	2 (66.67)	1 (33.3)	-1.8

≥-2 Z score = Normal/Overweight/Obese <-2 Z score = Moderate/ Severe undernourished; Figures in parentheses denote percentages.

Table 4: Comparison of nutritional status of rural and urban adolescent girls (n=770).

Nutritional Status		Rural (n=443)	Urban (n=327)	P value*	OR (95% CI)
Stunting	Height for age <-2SD/stunting present	70 (15.8%)	71 (21.70%)	0.036	1.4 (1.0-2.1)
	Height for age ≥-2SD	373 (84.2%)	256 (78.30%)		
Thinness	BMI for age <-2SD/thinness present	94 (21.20%)	48 (14.70%)	0.021	0.6 (0.4-0.9)
	BMI for age ≥-2SD	349 (78.80%)	279 (85.30%)		
Severe thinness	BMI for age <-3SD/severe thinness Present	44 (9.90%)	27 (8.30%)	0.427	0.8 (0.4-1.3)
	BMI for age ≥-3SD	399 (90.10%)	300 (91.70%)		
Overweight	BMI for age >1SD/overweight present	21 (4.7%)	15 (4.6%)	0.92	0.9 (0.4-1.9)
	BMI for age ≤1SD	422 (95.3%)	312 (95.4%)		
Obesity	BMI for age >2SD/obesity present	5 (1.1%)	6 (1.8%)	0.41	1.6 (0.4-5.4)
	BMI for age ≤2SD	438 (98.9%)	321 (98.2%)		

* Chi-square test, Fisher exact test; OR= Odds ratio, CI=Confidence interval.

Mean height-for-age Z scores for both rural and urban girls have negative values at all ages which implies that mean height-for-age of the study girls was below respective median values in WHO 2007 reference population at all ages. It has also been evident that mean height-for-age of rural girls was below the -1SD of the 2007 WHO reference between 13 to 16 years of age but above -1SD at 10 to 12 and 17 to 19 years of age. Observing the same for urban girls, mean height-for-age was below the -1SD of the reference population throughout the adolescent period except at 10 and 12 years of age (Table 2).

Mean BMI-for-age Z scores for both rural and urban girls have negative values at all ages which implies that mean BMI-for-age of the study girls was below respective median values in WHO 2007 reference population at all ages. It was apparent that mean BMI-for-age of rural girls was below the -1SD of the 2007 WHO reference between 10 to 13 years of age but above -1SD at 14, 15 and 17 to 19 years of age. Discerning for urban girls, mean BMI-for-age was above -1SD of the reference population throughout the adolescent period except at 14 and 19 years of age (Table 3).

The prevalence of stunting, thinness, severe thinness, overweight and obesity among rural girls was 15.8%, 21.2%, 9.9%, 4.7% and 1.1% respectively, while respective prevalence among urban girls was 21.7%, 14.70%, 8.3%, 4.6% and 1.8%. Stunting which was significantly lower among rural girls as compared to urban girls. Significant differences has also been observed comparing 10 to14 years and 15 to19 years age categories and it was found to be significantly lower for 10 to14 years aged girls combining both rural and urban categories. On contrary thinness was significantly higher in rural girls, and 21.0% and 15.20% of girls were found thin in 10 to 14 and 15 to19 years categories respectively and the difference being statistically significant. 9.9% and 8.3% girls were severely thin in rural and urban areas respectively. 4.7% and 4.6% of girls in rural and urban schools were overweight respectively, and 1.1% of rural and 1.8% of urban girls were obese, and the observed differences were statistically insignificant. Bivariate analysis has shown the Odds of being stunted was 1.4

(1.0-2.1) among girls of rural schools as compared to their urban school girls and adolescent girls from urban schools were 1.6 (0.4-5.4) times more likely to be obese as compared to those belonging to rural schools (Table 4).

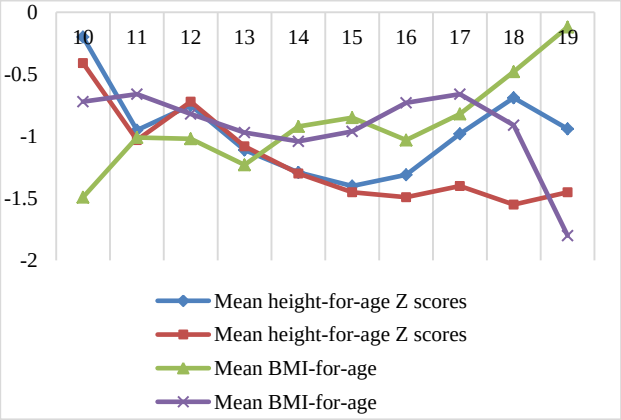

Figure 1: Mean height-for-age Z scores, BMI-for-age Z scores of study subjects.

DISCUSSION

Anthropometric measures are the most important means of assessing nutrition and health in communities, especially in children and adolescents. Furthermore, recently available and appropriately developed WHO 2007 growth standards can serve as a reference against which changes in nutritional status can be measured. In India, a home to nearly 113 million adolescent girls who suffer from both under-nutrition and over-nutrition issues, nutritional status assessment using WHO 2007 growth standards for 5-19 years old for girls, has not been investigated sufficiently and therefore comparison with data reported in the literature is difficult because of the use of different references. Anthropometric indices expressed in terms of Z-scores for comparison with reference have a major advantage that for population-based applications, it allows the mean and standard deviation to be calculated for a group of Z scores.[8] Weight for-age Z scores are not applicable after age of 10 years and therefore have not been considered.[11] Waist circumference and waist-hip ratios have limited usefulness in the absence of validated cut-off points among adolescents and BMI measurement of adolescents is recommended.[2] In present study we focused on rural-urban differential in anthropometric measurements and as is to be expected, across age groups, the probability of being underweight generally declines and chances of being overweight/obese increases with urban residence according to most of studies in literature.[1] Bivariate analysis in our study has also shown the Odds of being stunted was 1.4 (1.0-2.1) among girls of rural schools as compared to their urban school girls and adolescent girls from urban schools were 1.6 (0.4-5.4) times more likely to be obese as compared to those belonging to rural schools. Nearly half of the girls (47%) are thin and at the same time 2.4% are overweight in India and present study has revealed that 21.2% and 14.7% of rural and urban girls were thin respectively, and 4.7% and 4.6% were overweight in rural and urban areas respectively.[1] Once final height is attained, stunting becomes a permanent consequence of past malnutrition rather than being a sign of present malnutrition. The growth spurt of adolescence has been seen as a period of potential interest for catching up growth deficit of childhood. If there is indeed catch-up growth in height, adolescence can provide a final chance for intervention to promote additional growth, with potential benefit in terms of physical work capacity and for girls, of diminished obstetric risk.[2] In present study stunting was 15.8% and 21.7% among rural and urban girls respectively and this is concomitant with the findings of other studies revealing high prevalence of under nutrition in other parts of India.[15-17] In present study mean height of adolescent girls from rural area was 149.65±7.37 cm which was observed to be higher than 142.9 cm as reported by Maliye et al among rural adolescent girls in Wardha.[18] In present study mean height of adolescent girls from urban area was 150.57±6.45 cm which was observed to be higher than 142.2±10.2 cm as reported by Chaudhary et al among urban adolescent girls in Nagpur.[19] Apparently there is a positive linear increasing trend in the mean height of girls between ages 10-19 years combined for both rural and urban students in present study. In a study using 2007 WHO reference conducted by Mulugeta et al in Northern Ethiopia increasing age was found to be a strong predictor of stunting and this was in close resemblance with our study in which stunting was significantly higher in 15 to 19 years age category.[20] This could possibly be related to the growth spurt and sudden increase in height in early adolescence. In present study overall mean BMI of urban girls was 18.14±2.89 kg/m^2 and 14.7% of the urban girls were underweight while Basu et al in a study in Gujarat found mean BMI of urban girls was 19.3±3.8 kg/m^2 and 39.8% were underweight.[21] In present study it was found that overall mean weight and mean BMI of adolescent girls in urban area was significantly higher than rural area, while mean height in two groups was not significantly different. As far as literature from Uttarakhand is concerned high prevalence of wasting and stunting has been reported by Semwal et al in Dehradun among early adolescent girls of 10-14 years age.[22] Using WHO 2007 growth reference Nawab et al at Aligarh found prevalence of overweight and obesity among school going adolescent females as 7.9% and 3.9% respectively and in our study overall overweight and obesity was found in 4.7% and 1.4% using similar growth reference.[23] Prevalence of obesity and overweight among girls was 6.4% and 13.35% respectively in a study done in south Gujarat.[24] The report on regional WHO Consultation on nutritional status of adolescent girls reported 45% prevalence of stunting. A number of studies conducted throughout the world on nutritional status of adolescent girls reported high prevalence of under nutrition among girls.[25-30] Rural-urban differential is affected by influence arising from being in government

and nongovernment schools irrespective of place of residence which needs distinct consideration. Inference in present study is influenced by less than 1% extreme values which were not considered to be outliers as the standardized value is above the cut-off value determined from the ranking of the extreme values done to determine, with some certainty, the magnitude of the potential cut-off point for an observation to be viewed as unusual outlier. Another limitation of this inference was age wise variation in frequency of study subjects.

CONCLUSION

The study concluded that, under-nutrition was prevalent among the girls. The girls were shorter and thinner than the 2007 WHO reference population. Present study has revealed that overall mean weight and mean BMI of adolescent girls in urban area was significantly higher than those in rural area, while mean height in two groups was not significantly different. Second decade of life provides a final critical opportunity for actions to intervene malnutrition and promote growth with potential benefit in terms of physical work capacity for girls and of diminished obstetric risk, hence preparing them for the demands of forthcoming childbearing and breastfeeding. Besides existing efforts that are being going on in our country to combat malnutrition among adolescent girls, further exploration of nutritional status is needed in terms of dietary habits and nutrient intake among both urban and rural girls.

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