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Descriptive analysis of anthropometric profile and dietary pattern of adolescents in rural and urban-gradient of North Bengaluru, Karnataka

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ABSTRACT

The present descriptive study was planned for documenting demography, socioeconomic status (SES), anthropometry, dietary diversity score (DDS), food and nutrient adequacy of the adolescents (13-15 years) from north rural-urban Bengaluru; keeping in view the changes in life style and food consumption patterns. Baseline data indicated that majority of adolescents belonged to lower middle class. Most boys (77%) and girls (73%) had medium DDS (5-9), while only a few (i.e., 22% and 23% respectively) had high DDS (>9). The anthropometric data suggested that height (girls: 152.68±7.03cm; boys: 157.16±8.58cm), weight (girls: 48.24±9.81kg; boys: 51.39±9.27kg), mid-upper arm circumference (girls: 21.17±3.39cm; boys: 22.17±2.98cm) and skin fold thickness (girls: 14.07±0.95mm; boys: 11.31±0.79mm) were significantly different (p<0.05) between boys and girls. The BMI (body mass index) was 20.66 and 20.77 kg/m2 for girls and boys respectively. Further classification indicated that, majority of the adolescents were normal (girls: 64%; boys: 70%), followed by underweight (girls: 22.67%; boys: 20.67%), overweight (girls:10.67%; boys: 8%) and obesity

+grade I (girls: 2.66%; boys:1.33%). Despite being normal, the results denote the prevalence of over and under nutrition amongst adolescents. Food intake adequacy revealed that fruits and vegetables had less than 60-65% adequacy in both the groups and fruits were significantly lower (girls: 41.8%; boys: 48.2%). The nutrient adequacy was higher in boys than girls for macro and micronutrients (Fe, Ca, Zn, P, niacin, folate, and Vit C). However, adequacy results made it clear that foods and nutrient consumption was below the recommended standard allowances. The lower adequacy intake specified that there is need to provide nutrition education to the adolescents. Descriptive studies like this could be useful in documenting existing issues and providing customized plan of action to alleviate malnutrition problems in adolescents by updating the existing nutritional programmes and policies.

Keywords: *anthropometry, dietary diversity score, BMI, nutrient adequacy.*

INTRODUCTION

Adolescents and youth are considered as developmental assets for any country's long-term progress and a healthy adolescent population can contribute towards nations sustainable and wholesome development. In India, the youth (15-29 years) contributed to 27.2 per cent of total population in the year 2021 (Youth in India, 2022). This period of adolescence is marked as period of transition, where the eating preferences, foods habits and choices are developed (Vijayalakshmi and Katte 2022). Factors like urbanization might be one of the major contributors for changing food preferences (Pandey *et al.,* 2020). Snacking and frequent consumption of processed foods or fast foods lacking nutrient density has become a prominent feature of adolescent diet leading to its poor nutritional quality (Mahajan *et al.,* 2012). It has been widely observed that diets poor in nutrition and highly processed unhealthy foods are major risk factors for the life-style disorders (López-Sobaler *et al.,* 2019). The current situation indicates that health problems caused due to nutritional deficiency and sedentary lifestyle in adolescents are on rise, leading to elevation in triple burden of malnutrition (overnutrition, undernutrition, micronutrient deficiency). Anthropometric indices throughout the period of 2019-2021 in India highlighted that adolescent (approximately 40%) including both male and female (15-19 years) were under-weight with low BMI (<18.5 kg/m2) and were at risk of nutritional deficiencies, undernutrition. Additionally, there is rise in overnutrition cases leading to overweight and obesity (Youth in India, 2022; Ramachandran and Kalaivani 2022).

With the reference to prevailing problems in adolescents, there is need to document the current trends regarding their food consumption pattern, dietary diversity, anthropometric status, anemia profile and the socioeconomic status. This descriptive study can assist in understanding the existing problems of the adolescent children and devise appropriate solutions for their prevailing problems. This study also analyses the gender disparities regarding nutrition in adolescent girls and boys and propose possible solutions.

MATERIALS AND METHODS

2.1 Area and sample size: In the present study data was collected from purposive random sample of 300 adolescent girls and boys (150 each) of government schools belonging to rural-urban gradient of North Bengaluru.

2.2 Data collection: Through a semi-structured interview pre-tested interview, data was collected about the demographic profile, socioeconomic status, food habits, dietary diversity (FAO 2010), food and nutrient intake adequacy, anthropometry and hemoglobin profile of the respondents. Standard protocols were followed while measuring anthropometric profile viz. height, weight, MUAC (mid upper arm circumference), SFT (skin fold thickness) (Jelliffee, 1966). Body mass index was calculated and compared to WHO standards (2010) and classified as normal, obese grade I, overweight, and underweight (WHO, 2010). The haemoglobin (Hb) values (g/dl) were documented as reported by the individuals and further the documented were compared with standards based on WHO classification as reported by Shaka, and Wondimagegne (2018), to analyze the number of respondents falling in normal (girls: ⩾12; boys: ⩾ 13), mild (girls: 10 – 11.9; boys: 10 – 12.9), moderate (girls and boys: 7-9.9) or severe anemia (girls and boys: <7) category. Classification of girls and boys in different socio-economic status (SES) classes [viz., upper class (I: 26-29), upper middle class (II: 16-25), lower middle class (III: 11-15), upper lower (IV: 5-10) and lower socio-economic class (V:<5)] were done using modified Kuppaswamy SES scale 2022 (Kumar *et al.*, 2022). Dietary data of adolescents was noted using 24-hour recall method, pre-standardized vessels were shown to the respondents and data for intake quantities of cooked and raw food were calculated. The actual quantity of food groups consumed were considered as a base to calculate the nutrient intake based on the food composition table (Longvah *et al.*, 2017). Later, food group and nutrient per cent adequacy was calculated using standard recommended dietary intake (RDI) and recommended dietary allowances (RDA) (ICMR-NIN 2020) with following formula.

$$\text{Per cent nutrient/intake adequacy} = \frac{\text{Intake of each nutrient/food group}}{\text{RDA for the nutrient /RDI for food group}} \times 100$$

2.3 Research Ethics: Before initiation of data collection, the study was presented in front of institutional ethical committee for Human Research (University of Agricultural Sciences, GKVK, Bengaluru (No. DR/STA/Ethical Committee/2020-21) dated 05-04-2021) and approval was obtained. Further, all the participants were given detailed information about the study and informed consent was taken from the school authority, parents and adolescents. Data was collected through a semi-structured interview and participants were informed regarding their voluntary participation and their withdrawal at any time from the study is feasible.

2.4 Statistical analysis: The data was represented as frequency, percentage and mean ± sd (standard deviation) wherever applicable. Suitable statistical tests i.e., chi-square and t-test were applied using SPSS software.

RESULTS AND DISCUSSION

3.1 Demographic and SES profile: Table 1 indicates the demographic profile of the selected respondents. Majority girls under the study belong to 10th std (41%) and were 15 years old (40%), while majority boys were in 8th std (44%) and 13 years old (43%). Compared to joint family (boys: 20% girls: 14%), more respondents were from nuclear family (boys: 80% girls: 86%). More than half of girls selected in present study were first born (55%) and majority boys were second born (47%). Association was observed between gender and family size, and ordinal position, where majority girls belonged to small family (1-4 members) and were first child in the family; while in case of boys' majority were second born children and belonged to medium family size having 5-7 members. It was noted that in both the groups, head of the family was father (84%) and their education was secondary level (67%). Considering the SES, it was found that maximum respondents belonged to lower middle class (85%), while only a few belonged to upper lower (9%) and upper middle (6%) category. Gender wise there was no difference in their SES status (Table 1).

Table 1
Baseline information on socio-demographic profile of the respondents

Variables	Gender				Total (N=300)	χ^2	p value
	Girls (n=150)		Boys (n=150)				
	Count	(%)	Count	(%)			
Age (years)							
13	38	25	65	43	103 (34)	12.269	0.002*
14	52	35	47	31	99 (33)		
15	60	40	38	25	98 (33)		
Education							
8th Std	38	25	66	44	104 (35)	13.944	0.001*
9th Std	50	33	47	31	97 (32)		
10th std	62	41	37	25	99 (33)		
Family type							
Joint	21	14	30	20	51 (17)	1.914	0.167
Nuclear	129	86	120	80	249 (83)		
Family size							
Small (1-4)	88	59	68	45	156 (52)	19.564	0.000*
Medium (5-7)	48	32	80	53	128 (43)		
Large (> 7)	14	9	2	1	16 (5)		
Ordinal position of the child							
First child	83	55	61	41	144 (48)	9.493	0.050*
Second child	56	37	71	47	127 (42)		
Third child	11	7	14	9	25 (8)		
Fourth child	0	0	2	1	2 (1)		
Fifth child	0	0	2	1	2 (1)		
Head of the family (HOF)							
Father	124	83	127	85	251 (84)	0.220	0.639
Mother	26	17	23	15	49 (16)		

Education of HOF							
Illiterate	1	1	1	1	2 (1)	2.437	0.875
Primary	4	3	5	3	9 (3)		
Secondary	106	71	96	64	202 (67)		
PUC	28	19	34	23	62 (21)		
Diploma	4	3	4	3	8 (3)		
Degree/UG	7	5	9	6	16 (5)		
Graduate	0	0	1	1	1 (0)		
SES class (Modified Kuppaswamy SES scale 2022)							
SES class	**Girls (n=150)**		**Boys (n=150)**		**Total (N=300)**	**χ2**	**p value**
Lower Middle (III)	126	84	130	87	256 (85)	0.678	0.713
Upper Lower (IV)	15	10	11	7	26 (9)		
Upper Middle (II)	9	6	9	6	18 (6)		

3.2 Anthropometric indices of the adolescents: It was noted that there was significant difference when the average anthropometric data of the adolescent population was compared using t-test. The girls had significantly higher age (14.15 yrs.) than boys (13.82 yrs.), while the height, weight, BMI, MUAC and haemoglobin were higher in boys (157.16cm, 51.39 kg, 20.77kg/m2, 22.17cm, 12.17g/dl respectively) when compared to girls (152.68cm, 48.24 kg, 20.66kg/m2, 21.17cm, 11.33g/dl respectively) (Table 2). The average BMI both in boys and girls indicated that it was in normal range. However, further classification of the BMI designated that majority subjects belonged to normal category (girls: 64%; boys: 70%), while there were underweight (girls: 22.67%; boys: 20.67%) and overweight + obesity (girls: 13.33%; boys: 9.33%) subjects found in both groups (Table 3). Further, figure 1 depicts the BMI for age z scores (BAZ) highlighting the prevalence of double burden of malnutrition. Though majority subjects were normal, underweight and overweight was noted and these results are closer to a previous study by Beevi *et al.*, (2017), normal adolescents were 45 per cent, while 51 per cent were underweight and approximately 3 per cent were overweight. Laxmi (2021), also confirmed that in their study majority adolescents fell under underweight category, followed by normal and at risk of obesity.

The mean skin fold thickness (SFT) was significantly higher in girls (14.07 mm) than boys (11.31 mm) indicating that girls had higher fat content than boys. There could be several reasons for the same including the lack of physical activities in girls than boys. In general, body fat tends to be on higher side in female as compared to the male counterparts (Blaak 2001), which could be one of the other reasons for higher SFT in girls. Previous study also reported that school going and adolescent girls has significantly higher SFT (triceps and subscapular) than boys (Ramírez-Vélez *et al.*, 2016).

Table 2
Mean anthropometric and haemoglobin levels of adolescent girls and boys

Parameters	**Gender**		**t test**	**p value**
	Girls (n=150)	**Boys (n=150)**		
Age (years)	14.15±0.79	13.82±0.81	3.516	0.001*
Height (cm)	152.68±7.03	157.16±8.58	-4.947	0.001*
Weight (Kg)	48.24±9.81	51.39±9.27	-2.855	0.005*
BMI (kg/m²)	20.66±3.73	20.77±3.17	0.273	0.758
MUAC (cm)	21.17±3.39	22.17±2.98	-2.707	0.007*
SFT (mm)	14.07±0.95	11.31±0.79	27.276	0.000*
Hb (g/dl)	11.33±0.849	12.17±0.899	8.335	0.000*

Table 3
Body Mass Index (BMI) classification of adolescent

	Gender				
	Girls (n=150)	**Boys (n=150)**	**Total**	**χ2**	**p value**
BMI classification*					
Underweight (<18.5 kg/m2)	34 (22.67%)	31 (20.67%)	65	1.780	0.619
Normal (18.5 to 24.9 kg/m2)	96 (64%)	105 (70%)	201		
Overweight (25 to 29.9 kg/m2)	16 (10.67%)	12 (8%)	28		
Obesity class I (30 to 34.9 kg/m2)	4 (2.66%)	2 (1.33%)	6		
Total	150	150	300		

Based on WHO classification

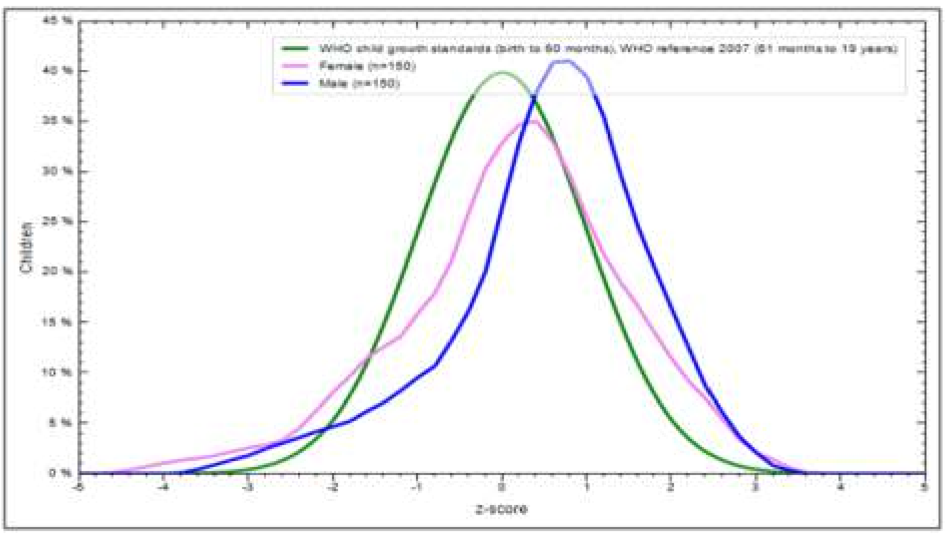

Fig 1. Z-score for BMI-for-age (gender wise distribution) of the adolescents

Chisquare analysis showed that there was no association between gender, in both boys and girls majority of the subjects had anemia. Haemoglobin classification indicated that more than 70 per cent adolescents were anaemic, with girls (74%) and boys (70.66%) having either mild, moderate or severe anemia. Only 26 per cent girls and 29 per cent boys were normal, with haemoglobin above 12 g/dl and 13 g/dl respectively (Fig 2). In case mild anemia prevalence was more in boys (59%) than girls (53%). In a study conducted by Zeleke *et al.,* (2020), it was indicated that amongst school children from 10 – 19 years from Dilla town Ethiopia, higher anemia prevalence was detected in male than female children. Thus, there is need to conduct in-depth research for analyzing the causes and factors associated with male anemia. Additionally, the anemia policies or programmes only emphasizing on female population can be modified with equal attention to anemia as problem in male counterparts. Similar suggestions have been given by Kumar *et al.,* (2021) for reformulating anemia progammes by also considering the male population.

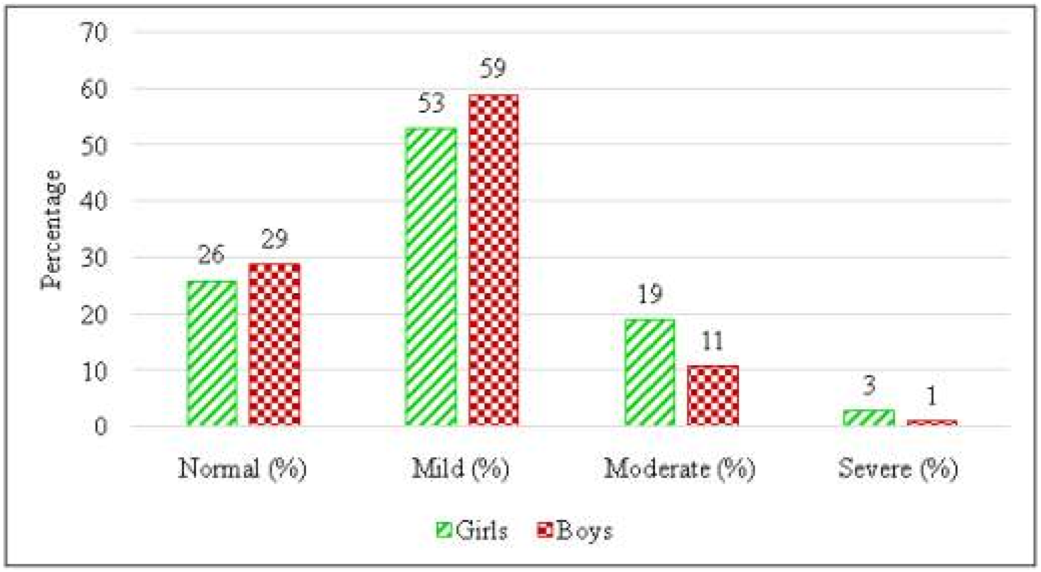

Fig 2. Haemoglobin classification of the adolescents

3.3 Dietary pattern assessment of the adolescents: Dietary diversity score (DDS) was not gender associated as revealed by chi-square analysis. It was observed that majority girls (73%) and boys (77%) had medium DDS, followed by high (girls: 23%; boys: 22%) and only a few i.e., 4 per cent (girls) and 1 per cent (boy) had low DDS (Table 4). Despite majority subjects having medium DDS, their food intake were below the recommended dietary intakes thereby the food and nutrient intake adequacy was also low (Figure 3, 4).

Table 4
Dietary diversity score of adolescent girls and boys

Dietary diversity terciles*	Gender				Total (N=300)	χ^2	p value
	Girls (n=150)		Boys (n=150)				
	N	(%)	N	(%)			
Low (1-4)	6	4%	2	1%	8	2.220	0.330
Medium (5-9)	109	73%	115	77%	224		
High (>9)	35	23%	33	22%	68		
Total	**150**	**100%**	**150**	**100%**	**300**		

***(FAO 2010)**

The food intake adequacy indicated that the consumption of food groups (cereals and millets, pulses, milk and milk products, roots and tubers, other vegetables, fruits) was lower in girls when compared to boys. Only the cereals and millets (CM) and pulses (P) intake adequacy was above 70% (boys: 76.5% (CM), 74.2% (P); girls: 74.6% (CM); 73% (P)), while it ranged from 66.7-67.5% for sugar, 64.8-63.9% for other vegetables. The GLV (green leafy vegetable) intake adequacy lower for boys (58.9%) than girls (63.1%), however, it was less than the RDI in both groups. The intake adequacy for fruits was below 50% in both boys (48.2%) and girls (41.8%). Moore et al., (2012) also confirmed that adolescent girls had lower intake of fruits, dairy and vegetables. Educational status of the head of the family has shown to have impact on food consumption pattern of the adolescents, it was seen that lower SES and educational status led to consumption of poor diets (Audain *et al.,* 2014; Alkerwi *et al.,* 2015). This could be one of the major reason for inadequate food and nutrient adequacy in the present population, as majority of them belonged to lower middle class (Table 1).

In line with the food intake adequacy, the nutrient intake adequacy was also lower than the recommended dietary allowances (ICMR, 2020). Majority of micronutrients viz. iron, zinc, thiamine, riboflavin, niacin, folate had adequacy only up to 50 – 65 per cent, while energy, protein, calcium, vitamin C had adequacy above 85 per cent and total dietary fiber had above 70 per cent. The reason for higher intake of calcium was daily consumption of their staple food – finger millet. The subjects also confirmed of daily consumption of lime during covid pandemic, where through the anganwadi teachers nutrition awareness was created regarding daily consumption of citrus foods to boost immunity. Previous study has also indicated that the intake of nutrients was less in adolescents than RDA (Shafiee *et al.,* 2015). The overall results designate that there is need for nutritional education for improving the intake of fruits and vegetables to meet the nutritional needs of the adolescents for reducing the burden of micronutrient deficiencies.

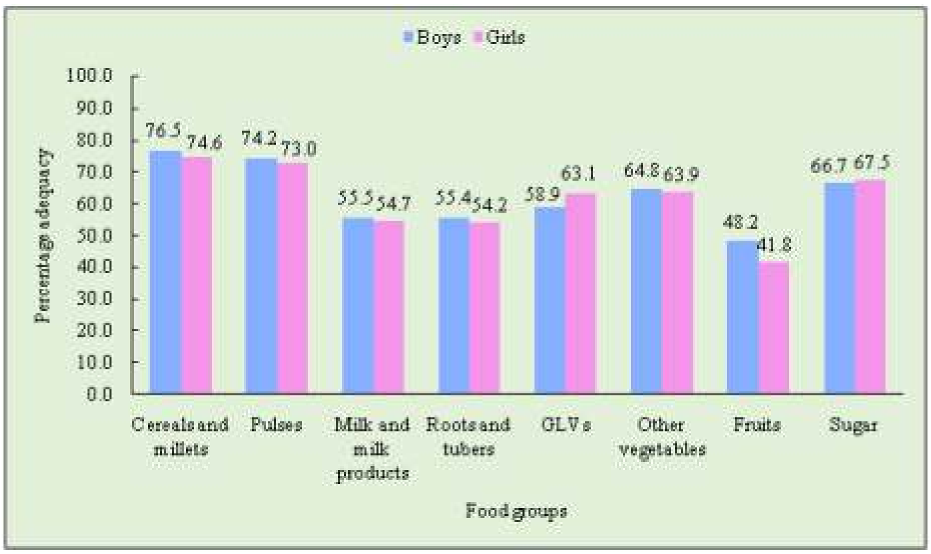

Fig 3.Per cent food intake adequacy of the rural adolescent children.

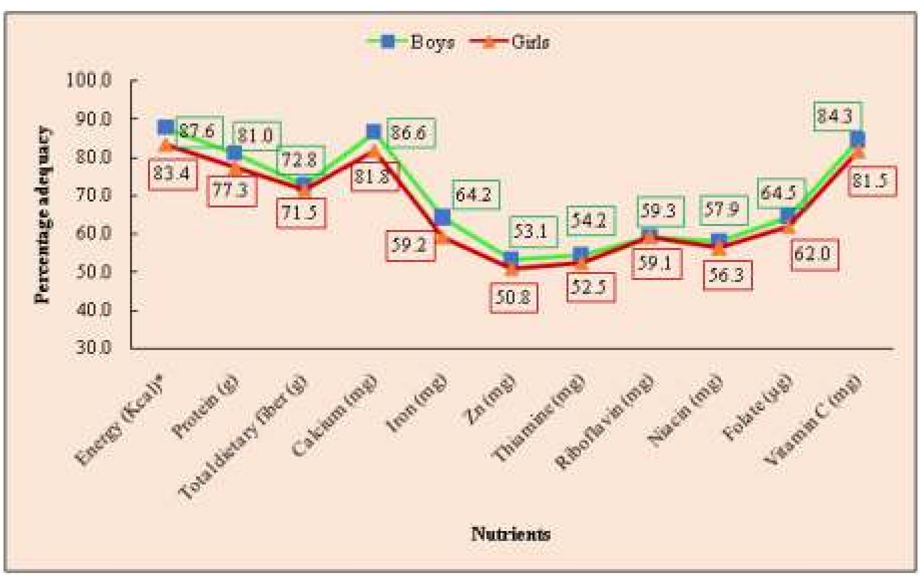

Fig 4: Per cent nutrient adequacy of the rural adolescent children

Note: *Energy is represented as EER (Estimated Energy Requirement) as there is no RDA for energy.

CONCLUSION

More attention is required on framing and updating the health-related policies for the adolescent keeping in consideration both boys and girls. There is need to highlight the importance of nutrition education in schools for the adolescents as well as their parents.

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