A COMPARATIVE STUDY ON NUTRITIONAL STATUS OF ADOLESCENTS IN URBAN AND RURAL FIELD PRACTICE AREAS OF SOUTH INDIA.

P. MERCY,[1*] P. SUDHA KUMARI[2], B. RENUKA[3]

[1]*Department of Community Medicine, Dhanalakshmi Srinivasan Medical College and Hospital, Siruvachur, Perambalur, Tamil Nadu. M.G.R. Medical University, Tamil Nadu, India.*

[2]*Department of Community Medicine, Viswabharathi Medical College, Kurnool, Dr. N.T. R. University of Health Sciences, Andhra Pradesh, India.*

[3]*Department of Community Medicine, Kurnool Medical College, Kurnool, Dr. N.T.R. University of Health Sciences, Andhra Pradesh, India.*

Corresponding author: mercyclaret5175@gmail.com

ABSTRACT

Introduction: Adolescence is a critical time in a person's growth and development. Unmet nutritional needs can lead to stunted growth, delayed development, anaemia, and poor mental health. Good nutrition is an important part of leading a healthy lifestyle. Physical activity and adequate nutrition are essential to attain and maintain a healthy weight, reduce the risk of chronic diseases, and promote overall health. This study aimed to assess and compare the nutritional status of adolescents in the urban and rural field practice areas of a tertiary care teaching Hospital. **Methods:** We conducted a school-based cross-sectional study among 416 adolescents aged 10–19 years residing in the urban and rural field practice areas of the Tertiary Care Teaching Hospital. We collected data between March 2023 to March 2025 using simple random sampling and a semi-structured questionnaire. **Results:** In urban areas, 13.46%, 7.21%, and 5.76% of adolescents were underweight, overweight, and obese, respectively, compared with 12.5%, 13.94%, and 6.25% in rural areas. Mean haemoglobin was 11.4 g/dL in urban areas and 11.3 g/dL in rural areas, while the prevalence of anaemia was 48.07% in urban areas and 57.21% in rural areas. **Conclusion:** The prevalence of underweight was higher among urban adolescents, whereas overweight was more common among rural adolescents. The prevalence of obesity was nearly equal in both urban and rural areas. Mean haemoglobin levels were comparable between urban and rural adolescents; however, the prevalence of anaemia was higher among rural adolescents.

Keywords: Adolescent, Anemia, Nutritional status, Overweight, Underweight.

INTRODUCTION

The World Health Organization (WHO) defines adolescents as people between the ages of 10 and 19. In the nations of the South-East Asia Region (SEAR), about 360 million adolescents make up almost 20% of the total population. Because adolescents contribute around 45% of prospective skeletal growth, 15–25% of adult height gain, and 37% of total bone mass accumulation, their health and well-being are crucial (WHO 2024, Dobner et al. 2018, Victora et al. 2008).

Improper nutrition affects not only the current health of adolescents but also puts them at high risk of chronic diseases later in life (Ghai, 2023). Malnutrition in adolescents, whether undernutrition (underweight) or overnutrition (overweight and obesity), increases the risk of both physical and mental health issues. (Ahmad et al., 2018; Caleyachetty et al., 2018). For example, adolescents with nutrition deficiencies are likely to face short stature, cognitive impairment, impaired mental functioning, and reduced immunity. In contrast, overweight and obese adolescents often experience low self-esteem, distorted body image, and are at higher risk for developing noncommunicable diseases, including mental disorders. (Christian et al. 2018, Ahmad et al. 2018, Rose-Clarke et al. 2019, Caleyachetty et al. 2018).

Several public health issues, including anaemia, stunted growth, delayed development, and decreased mental functioning, can arise from unmet dietary needs during adolescence. Adolescent girls who retain a small in adulthood are more likely to experience unfavourable pregnancy and reproductive outcomes, such as postpartum haemorrhage, obstructed labour, and other related problems.

Anaemia in adolescence has been linked to stunting, poor physical growth, and delayed cognitive development (Agrawal et al., 2018). Iron deficiency anaemia can lower resistance to infections, hinder mental and physical development, limit work capacity and physical fitness, and negatively affect academic achievement (Tesfaye et al., 2015). Anaemic adolescent girls who become pregnant are also more likely to experience maternal morbidity, low birth weight, premature delivery, and perinatal mortality. Anaemia during the first six months of life is also more common in infants born to anaemic mothers (Aguayo et.al. 2013). Due to the regular loss of iron during their menstrual periods, adolescent girls are especially susceptible to anaemia (UNICEF 2002).

Monitoring adolescents' nutritional status during this transition period is crucial because they are the future productive group of society. This study evaluated and compared the nutritional status of adolescents in rural and urban areas of South India.

METHODS

This school-based comparative cross-sectional study was conducted from March 2023 to March 2025 among adolescent girls and boys aged 10–19 years residing in the urban and rural field practice areas of Tertiary Care Teaching Hospital, South India.

Among the 305 schools, four government high schools providing education from 6th to 10th standard are located in the field practice areas of Tertiary Care Teaching Hospital. To maintain uniformity, we included only government schools in both urban and rural areas, as no private schools were available in the rural field practice area. In this study, we included students in standards 7 to 10 from selected schools. Data were collected from two government high schools in the rural field practice area and two government high schools in the urban field practice area of Tertiary Care Teaching Hospital.

The study excluded adolescents who were missing throughout the study period and could not be contacted after three consecutive visits, adolescents who were critically ill, and adolescents who refused to give consent/ assent.

The sample size was calculated using the formula for comparison of two independent proportions. The prevalence of Stunting among rural adolescent girls was reported as 24.2%; it was 16% among urban residents in a previous study by Tewodros Getaneh Alemu et al. 2021 Using $P_1 = 0.24$, $P_2 = 0.16$, $Z_{\alpha/2} = 1.96$, and $Z_\beta = 0.84$, the calculated minimum sample size was approximately 374 participants. Considering a 10% non-response rate, the adjusted sample size was 416. To ensure adequate representation from both study areas, we ultimately selected 208 adolescents from each field practice area, for a total sample size of 416 participants.

$n = Z_{\alpha/2}\sqrt{(2\overline{P}\,(1-\overline{P})}+Z_\beta\sqrt{P_1(1-P_1)+P_2(1-P_2))}]^2 / (P_1-P_2)^2$

$n = [1.96\ \sqrt{2}\ (0.20)\ (0.8) + 0.84\sqrt{}\ (0.24)\ (0.76) + (0.16\ (0.84)]^2/ (0.24-0.16)\ \hat{}^2$

n = 374

Non response rate of 10% = 374/ 1- 0.10 = 416

Since this was a comparative cross-sectional study, 208 participants were selected from the rural field practice area and 208 participants from the urban field practice area under the Department of Community Medicine, Tertiary Care Teaching Hospital.

The Institutional Ethics Committee approved the study (IEC No. 209/2023). The school authorities granted permission before data collection. A date was fixed for interviewing the students after obtaining permission from the respective schools.

We obtained class-wise lists of eligible students from the selected schools. We entered the roll numbers of eligible students into Microsoft Excel. We generated random numbers using the Excel RAND function and sorted the students according to the generated numbers. Next, we selected students one by one without replacement from the randomised list until we reached the required sample size. We used the same process to select students in both urban and rural study regions. From each school, we recruited students in standards 7 to 10, selecting approximately 25–26 students from each standard, for a total of 104 students per school.

We recruited 416 adolescents from four schools, 208 from the urban area and 208 from the rural area. No participant was excluded from the final analysis due of incomplete study information, and all recruited participants were included. We obtained verbal assent from individuals under the age of 12 and written informed assent from adolescents aged 12 years and above. Before enrolling each subject, their parents or legally recognised representatives provided written informed consent.

We collected data using a pretested semi-structured questionnaire. We also collected sociodemographic information and anthropometric measurements (height and weight, BMI) using a stadiometer and a digital weighing machine. We calculated body mass index (BMI) as weight (kg) / height (m)^2.

Body mass index (BMI) was classified according to the World Health Organization (WHO) Asian cut-off values as underweight (<18.50 kg/m²), normal weight (18.50–22.99 kg/m²), overweight (23.00–27.99 kg/m²), and obese (≥28.00 kg/m²). [BMI (Body Mass Index) Classification for Asians, 2013]

Hemoglobin estimation (gm/dl) was done using the digital hemoglobinometer method (Hemocue 201+). This is a point-of-care diagnostic method utilized in field settings that is operated using a battery. It works on the principle of modified azide methaemoglobin determination using a specially designed micro cuvette with dried reagents. The Haemoglobin method is estimated using absorbance levels at two wavelengths of 570 nm and 880 nm for turbidity compensation in the blood sample (HemoCue Hb 201+ System, 2021).

We classified anemia severity according to World Health Organization (WHO) recommendations. Anemia was classified as mild if the haemoglobin level was 11.0-11.4 g/dL for those aged 10 to 11 years and 11.0-11.9 g/dL for those aged 12-19 years. Anemia was classified as moderate when hemoglobin was 8.0-10.9

g/dL, and severe when hemoglobin was < 8 g/dL. (World Health Organization, haemoglobin cutoffs to define anaemia, 2024).

Anemia was diagnosed based on clinical signs such as pallor of the conjunctiva, skin, nails, and palms. Vitamin C deficiency was diagnosed based of spongy, bleeding gums and petechiae. Vitamin B complex deficiency was diagnosed based of nasolabial dyssebaccea, angular stomatitis, and cheilosis. Referral was made for further management.

We performed statistical analyses using IBM SPSS version 21. We presented descriptive statistics as frequencies and proportions. We analysed categorical variables using the chi-square test. We analysed continuous variables using the Mann-Whitney U test. We considered of < 0.05 statistically significant.

RESULTS

The majority of the 208 urban (76.92%) and 208 rural (79.32%) participants in this study were between the ages of 10 to 15. In terms of religion, the majority of participants were Hindus in both the rural (74.51%) and the urban (79.80%) settings. In terms of their fathers' educational background, 24.51% had completed high school, while the largest percentage in the urban areas had completed intermediate/diploma (22.11%). In terms of their mother's educational background, primary school and middle school education were equally common in rural regions (24.51% each); however, middle school education was most common in urban areas (22.59%). In terms of family type, nuclear families made up the majority in both rural (71.63%) and urban (76.44%) areas.

Table 1: Sociodemographic characteristics of the participants (N=416)

Characteristics	Urban (N=208) N (%)	Rural (N=208) N (%)	Total (N=416) N (%)
Age (Years)			
10-15	160 (76.92%)	165 (79.32%)	325 (78.12%)
16-19	48 (23.07%)	43 (20.67%)	91 (21.87%)
Religion			
Hindu	166 (79.80%)	155 (74.51%)	321 (77.16%)
Muslim	31 (14.90%)	28 (13.46%)	59 (14.18%)
Christian	15 (7.21%)	25 (12.01%)	40 (9.61%)
Educational status of the father			
Illiterate	26 (12.5%)	13 (6.25%)	39 (9.37%)
Primary School	45 (21.63%)	55 (26.44%)	100 (24.03%)
Middle School	36 (17.30%)	29 (13.94%)	65 (15.62%)

High School	44 (21.15%)	51 (24.51%)	95 (22.83%)
Intermediate /diploma	46 (22.11%)	48 (23.07%)	94 (22.59%)
Graduate	11 (5.28%)	12 (5.76%)	23 (5.52%)
Professional degree	0 (0%)	0 (0%)	0 (0%)
Educational status of the mother Illiterate	42 (20.19%)	32 (15.38%)	74 (17.78%)
Primary School	43 (20.67%)	51 (24.51%)	94 (22.59%)
Middle School	47 (22.59%)	51 (24.51%)	98 (23.55%)
High School	44 (21.15%)	48 (23.07%)	92 (22.11%)
Intermediate /diploma	25 (12.01%)	17 (8.17%)	42 (10.09%)
Graduate	7 (3.36%)	9 (4.32%)	16 (3.84%)
Professional degree	0 (0%)	0 (0%)	0 (0%)
Type of family Nuclear family	159 (76.44%)	149 (71.63%)	308 (74.03%)
Joint family	37 (17.78%)	42 (20.19%)	79 (18.99%)
Three generation family	12 (5.76%)	17 (8.17%)	29 (6.97%)
Socio-economic Status of the family (Modified B.G. Prasad classification) Class I	0 (0%)	0 (0%)	0 (0%)
Class II	12 (5.76%)	9 (4.32%)	21 (5.04%)
Class III	66 (13.73%)	51 (24.51%)	117 (28.12%)
Class IV	64 (30.76%)	91 (43.75%)	155 (37.25%)
Class V	66 (31.73%)	57 (27.40%)	123 (29.56%)

Table 2 presents the distribution of underweight, normal weight, overweight, and obesity among the adolescents in the urban and rural areas. The prevalence of underweight among adolescents was 12.5% in rural areas and 13.46% in urban areas. In both urban and rural settings, girls were more likely than boys to be underweight. In the urban regions, the prevalence of normal weight was 73.55%, whereas in the rural areas it was 67.30%. While normal weight was evenly distributed among boys and girls in rural regions, it was more prevalent among boys than girls in urban areas. The prevalence of overweight was 7.21% in the urban regions and 13.94% in the rural areas. Overweight was more common among males in the rural areas and among females in the urban areas. Obesity was observed in 5.76% of adolescents in urban areas and 6.25% in rural areas. Similar to overweight, obesity was more common among the girls in the urban areas and among the boys in the rural areas.

Table 2: Distribution of undernutrition, overweight, and Obesity according to WHO-BMI cut-off among rural and urban study participants (N=416)

Nutritional Status	Urban (N=208)			Rural (N=208)		
	Boys N (%)	Girls N (%)	Total N (%)	Boys N (%)	Girls N (%)	Total N (%)
Under weight	11 (5.28%)	17 (8.17%)	28 (13.46%)	6 (2.88%)	20 (9.61%)	26 (12.5%)
Normal weight	88 (42.30%)	65 (31.25%)	153 (73.55%)	70 (33.65%)	70 (33.65%)	140 (67.30%)
Over weight	3 (1.44%)	12 (5.76%)	15 (7.21%)	18 (8.65%)	11 (5.28%)	29 (13.94%)
Obese	2 (0.96%)	10 (4.80%)	12 (5.76%)	10 (4.80%)	3 (1.44%)	13 (6.25%)

Table 3 shows the association between socio-demographic characteristics and nutritional status (underweight, normal weight, overweight, and obesity) among adolescents in the urban area.

The majority of the adolescents with nutritional problems (underweight, overweight, and obesity) belonged to the 10–15 years age group, and the association was found to be statistically significant. Nutritional problems were more common among females than males, and this association was also statistically significant.

The majority of the underweight adolescents belonged to nuclear families, whereas most adolescents who were overweight or obese belonged to joint families. This association was statistically significant. Regarding socio-economic status, the majority of underweight adolescents belonged to Class V, while most overweight and obese adolescents belonged to Class III. This association was also statistically significant.

Table 3: Assessment of association between Socio-demographic characteristics and Nutritional status among urban study participants (N=208)

Parameter	Under weight	Normal weight	Over weight	Obese	Total	χ2	P value
Age (Years)							
10-15	26 (16.3%)	110(68.8%)	13(8.1%)	11(6.9%)	160	8.11^{F}	0.035*
16-19	2 (4.2%)	43 (89.6%)	2 (4.2%)	1 (2.1%)	48		
Total	28	153	15	12	208		
Sex							
Male	11 (10.6%)	88 (84.6%)	3 (2.9%)	2 (1.9%)	104	15.47	0.001*
Female	17 (16.3%)	65 (62.5%)	12 (11.5%)	10 (9.6%)	104		
Total	28	153	15	12	208		
Type of Family							
Nuclear Family	24(15.1%)	122(76.7%)	8 (5.0%)	5 (3.1%)	159	20.02^{F}	<0.001*
Joint Family	3 (8.1%)	20(54.1%)	7 (18.9%)	7(18.9%)	37		
Three Generation Family	1 (8.3%)	11(91.7%)	0 (0%)	0 (0%)	12		
Total	28	153	15	12	208		
Socio-economic status							
Class I	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0	21.89^{F}	0.004*
Class II	0 (0%)	12(100%)	0 (0%)	0 (0%)	12		
Class III	8(12.1%)	39(59.1%)	12(18.2%)	7(10.6%)	66		
Class IV	8 (12.5%)	52 (81.3%)	2 (3.1%)	2 (3.1%)	64		
Class V	12(18.2%)	50 (75.8%)	1 (1.5%)	3 (4.5%)	66		
Total	28	153	15	12	208		

*** p-value < 0.05- statistically significant, ^{F} – Fisher's exact test**

Table 4 shows the association between socio-demographic variables and nutritional status among adolescents in rural areas. The majority of the adolescents with nutritional problems (underweight, overweight, and obesity) belonged to the 10–15 years age group, and this association was found to be statistically significant.

The majority of underweight adolescents were females, whereas overweight and obesity were more common among males. This association was also statistically significant. The majority of the adolescents with nutritional problems (underweight, overweight, and obesity) belonged to nuclear families. This association was statistically significant ($p < 0.001$).

Table 4: Assessment of association between Socio-demographic characteristics and Nutritional status among rural study participants (N=208)

Parameter	Under weight	Normal weight	Over weight	Obese	Total	χ2	P value
Age (Years)							
10-15	24(14.5%)	105(63.6%)	27(16.4%)	9 (5.5%)	165	8.43	0.028*
16-19	2 (4.7%)	35(81.4%)	2(4.7%)	4 (9.3%)	43		
Total	26	140	29	13	208		
Sex							
Male	6 (5.8%)	70(67.3%)	18(17.3%)	10(9.6%)	104	12.9	0.004*
Female	20(19.2%)	70(67.3%)	11(10.6%)	3(2.9%)	104		
Total	26	140	29	13	208		
Type of Family							
Nuclear Family	15(10.1%)	106(71.1%)	20(13.4%)	8 (5.4%)	149		
Joint Family	11(26.2%)	26 (61.9%)	2 (4.8%)	3 (7.1%)	42	20.10 F	<0.001*
Three Generation Family	0 (0%)	8 (47.1%)	7 (41.2%)	2 (11.8%)	17		
Total	26	140	29	13	208		
Socio-economic status							
Class I	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0		
Class II	0 (0%)	5(55.6%)	2(22.2%)	2(22.2%)	9		
Class III	9(17.6%)	36(70.6%)	4 (7.8%)	2 (3.9%)	51	12.35 F	0.149
Class IV	7 (7.7%)	66 (72.5%)	13(14.3%)	5 (5.5%)	91		
Class V	10(17.5%)	33 (57.9%)	10(17.5%)	4 (7.0%)	57		
Total	26	140	29	13	208		

*** p value < 0.05- Statistically significant, F – Fisher's exact test**

Table 5 presents the distribution of anaemia among urban and rural adolescents as assessed by the HemoCue method. The prevalence of anaemia was 48.07% in the urban areas and 57.21% in the rural areas. Mild anaemia was observed in 46.15% of adolescents in urban areas and 53.84% in rural areas, whereas moderate anaemia was reported in 1.92% and 3.36% of adolescents in urban and rural areas, respectively. Overall, anaemia was more prevalent in rural areas than in urban areas. The mean haemoglobin level was 11.9 g/dl in urban areas and 11.4 g/dl in rural areas. The prevalence of anaemia was 48.07% in the urban areas and 57.21% in the rural areas. The overall prevalence of anaemia among adolescents was 52.64%.

Table 5: Distribution of adolescents according to haemoglobin value by Hemocue method (N=416)

Hemoglobin	Urban (n=208) N (%)	Rural (n=208) N (%)	Total (n=416) N (%)
Normal	108 (51.92%)	89 (42.78%)	197 (47.35%)
Mild	96 (46.15%)	112 (53.84%)	208 (50%)
Moderate	4 (1.92%)	7 (3.36%)	11 (2.64%)

Table 6 shows that the median weight, height, and BMI were higher among rural adolescents than urban adolescents, while median haemoglobin was higher among urban adolescents. The differences between urban and rural groups were statistically significant for weight, height, BMI, and haemoglobin values.

Table 6: Comparison of median height, weight, BMI, and haemoglobin values between urban and rural adolescents (N=416)

Variable	Urban (n= 208) Median (IQR)	Rural (n= 208) Median (IQR)	p value
Weight (kg)	43.5 (19.0)	50.0 (20.0)	< 0.001*
Height (cm)	148 (21.3)	155.0 (16.50	< 0.001*
BMI (kg/m^2)	19.6 (5.14)	21.5 (4.59)	< 0.001*
Hemoglobin (g)	12.4 (2.45)	11.1 (2.70)	0.003*

*** p-value < 0.05- statistically significant**

Among the study participants, signs of iron deficiency were observed in 53.36% of urban and 57.69% of rural adolescents. Signs of vitamin B-complex deficiency were present in 14.42% of urban and 9.61% of rural adolescents. Signs suggestive of vitamin C deficiency were observed in 6.25% of urban and 3.36% of rural adolescents.

Table 7: Distribution of adolescents according to signs of Iron and Vitamin C and B complex deficiencies (N=416)

Signs	Urban (n=208) N (%)	Rural (n=208) N (%)	Total (n=416) N (%)
Signs of Iron deficiency Paleness of Skin	19 (9.13%)	7 (3.36%)	26 (6.25%)
Paleness in Nails	47 (22.59%)	56 (26.92%)	103 (24.75%)
Pale Conjunctiva	45 (21.63%)	57 (27.40%)	102 (24.51%)
Total	111 (53.36%)	120 (57.69%)	231 (55.52%)
Signs of Vitamin B complex deficiency Nasolabial Dyssebaccea	10 (4.80%)	7 (3.36%)	17 (4.08%)
Angular Stomatitis	14 (6.73%)	9 (4.32%)	23 (5.52%)
Cheilosis	6 (2.88%)	4 (1.92%)	10 (2.40%)
Total	30 (14.42%)	20 (9.61%)	50 (12.01%)
Vitamin C deficiency Spongy Bleeding Gums	5 (2.40%)	2 (0.96%)	7 (1.68%)
Petechiae	8 (3.84%)	5 (2.40%)	13 (3.12%)
Total	13 (6.25%)	7(3.36%)	20 (4.80%)

DISCUSSION

In the present study, the prevalence of underweight was 13.46% among urban adolescents and 12.50% among rural adolescents. The prevalence of overweight was 7.21% among urban adolescents and 13.94% among rural adolescents, while obesity was observed in 5.76% and 6.25% of urban and rural adolescents, respectively. A study conducted among adolescents in villages of Dev Bhumi, Dwarka district, by Somen Saha et al. (2021) reported a prevalence of 19.6% for underweight, 8.9% for overweight, and 2.6% for obesity. Although the prevalence estimates differed from those of the present study, the findings provide a comparable context for adolescent nutritional status in a rural population. These differences may reflect variations in dietary practices, socioeconomic characteristics, physical activity patterns, and the demographic and geographic characteristics of the study populations.

In both urban and rural settings, girls were more likely than boys to be underweight in the present study. While normal weight was similarly distributed among both sexes in rural regions, it was more prevalent among boys than girls in urban areas. Boys in rural areas and females in urban areas were more likely to be overweight. In a similar vein, obesity was more prevalent among boys in rural areas and girls in urban areas. Unhealthy eating habits, including skipping meals, eating fewer than three meals a day, and consuming insufficient amounts of a balanced diet containing fruits, vegetables, and protein-rich foods such as eggs, may contribute to underweight among adolescents.

Age, sex, family type, and socioeconomic status were statistically significantly associated with nutritional status in both urban and rural adolescents—similarly, Mrigen Kr. Deka et al.'s (2015) study in Uttar Pradesh's Jhansi area reported a statistically significant association between nutritional status and socioeconomic status, age, parental education, and household type.

In the present study, the prevalence of anaemia based on haemoglobin estimation was 48.07% in urban areas and 57.21% in rural areas. For comparison, a study conducted among adolescents in a rural area of Tamil Nadu by Abilash Sasidharannair Chandrakumari et al. (2019) reported a prevalence of anaemia of 48.63%. Differences in prevalence estimates may reflect variations in the characteristics of the study population, geographical setting, dietary practices, and other contextual factors.

Increased iron requirements during growth, menstrual blood loss in girls, worm infestation, insufficient intake of iron-rich foods, irregular eating habits, and poor consumption of green leafy vegetables and other iron-rich foods may contribute of the high prevalence of iron deficiency anaemia among adolescents. One of the main causes of morbidity in adolescents is anaemia, which is linked to poor academic performance, diminished physical labour capacity, impaired cognitive and physical development, greater susceptibility to infections, and a lower quality of life. Additionally, symptoms like fatigue, dizziness, dyspnoea, menorrhagia, and mental health issues have been linked to iron deficiency anaemia. (World Health Organization, 2025).

In the present study, rural adolescents had significantly higher weight, height, and BMI than urban adolescents, whereas urban adolescents had significantly higher haemoglobin levels. Sinha S et al. (2019) reported similar findings, showing significant urban–rural differences in weight, height, and BMI among adolescent boys, although these differences were not observed among girls. These differences may reflect variations in dietary practices, physical activity, socioeconomic conditions, and other environmental factors between urban and rural settings.

The prevalence of vitamin B-complex deficiency in the present study was 9.61% in rural areas and 14.42% in urban areas. The higher prevalence observed among urban adolescents may reflect differences in dietary practices, food choices, and consumption of vitamin-rich foods between the two groups. For comparison, Bhambhani GD et al. (2015), in their study conducted among rural adolescents in the Bhavnagar area of Gujarat, reported a prevalence of vitamin B-complex deficiency of 16.5%.

The prevalence of vitamin C deficiency in the present study was 6.25% in urban areas and 3.36% in rural areas. The higher prevalence in urban adolescents may reflect differences in dietary patterns and consumption of fresh fruits and vegetables. Bhambhani GD et al. (2015), in their study conducted among rural adolescents in the Bhavnagar area of Gujarat, reported a prevalence of vitamin C deficiency of 10%.

CONCLUSION

In the urban areas, undernutrition, overweight, and obesity were more common among females than males. In the rural areas, girls were more likely to be undernourished, whereas boys were more likely to be overweight and obese. These findings highlight the need for comprehensive interventions addressing both undernutrition and overnutrition among adolescents. With the involvement of medical professionals, schools, and non-governmental organisations, school-based nutrition education programmes should be strengthened to promote healthy dietary practices and active lifestyles. At the community level, measures to improve the affordability and accessibility of nutritious foods, along with economic empowerment and adequate employment opportunities for families, may facilitate access to balanced diets. Food fortification, appropriate supplementation, and dietary diversification may also improve adolescent nutritional status.

Conflicts of Interest

The authors declare no conflicts of interest.

Ethics Approval

The Institutional Ethics Committee (IEC NO: 209/2023) approved the study.

Data Availability

All data and master charts are available from the first and corresponding author and can be accessed by writing to the corresponding author.

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