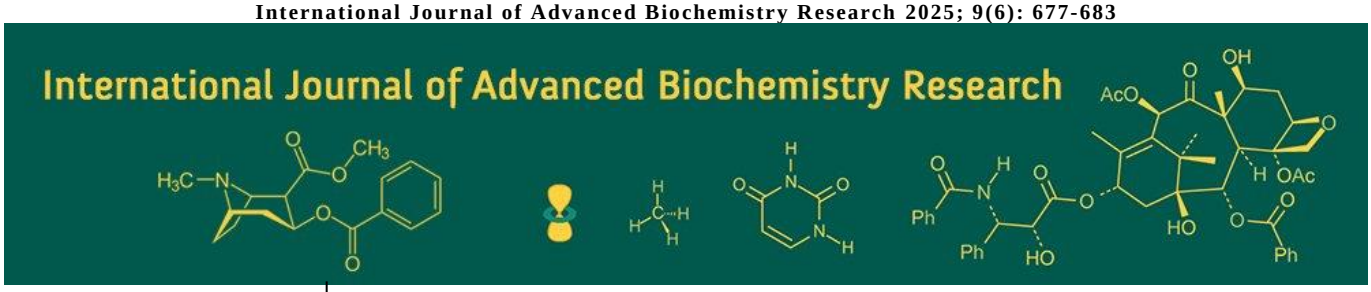


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# Nutritional assessment of adolescents in Raichur district

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**Abstract**
Adolescence is a transitional period from childhood to adulthood through growth spurt in physical and psychological development. Kalyana-Karnataka is categorized as backward with low literacy rate and arid region with agriculture as main occupation, Survey was conducted at Raichur district during two consecutive years during 2020-21 and 2021-22.The present study assessed the demographic profile, anthropometric status, and nutrient intake of 600 adolescents (aged 13-17 years), categorized into rural (n-400) and urban (n-200) adolescents. Rural adolescents showed higher parental illiteracy (fathers: 43%, mothers: 58%) and lower family income levels in 59 percent families. Nutritional disparities were recorded, within both rural and urban adolescent's girls experiencing more severe under nutrition. Compared to Indian Academy of Pediatrics (IAP) standards, both rural and urban adolescents had significantly lower mean height, weight, and BMI, with rural adolescents had lower than urban areas. High prevalence of underweight was observed among adolescent's rural boys and girls aged between 13-15 and 16-17 years. Nutrient intake revealed inadequate consumption of energy, protein, iron, calcium, B-complex vitamins, and folic acid in both regions, with rural adolescents had lower adequacy across most nutrients. Urban adolescents had relatively better, however insufficient, intake levels.

**Keywords:** Adolescents, nutritional status, rural-urban disparity, anthropometry, nutrient intake

## Introduction
Adolescence is a transitional stage of physical and psychological development that generally occurs during the period from puberty to legal adulthood. Biologically, adolescence is marked by the onset of puberty and the termination of physical growth with changes in the sex organs and characteristics including height, weight, and muscle mass, as well as a time for major changes in brain growth and maturation. It is a key phase of human development. Adolescence occurs between twelve to nineteen years of age. Adolescent is the vital bridge between the present and future generation. Therefore adolescent nutrition and health care is a major concern all over world. Under-nutrition and overweight is a global problem, especially overweight and obesity spreading even to developing world, where it is an increasing threat to health. Malnutrition creates lasting effect on the growth, development and physical fitness of a person. Under nutrition in adolescents has a detrimental effect as it affects their ability to learn and work at maximal productivity. The Hyderabad-Karnataka region is officially renamed as Kalyana-Karnataka in September 2019. It comprises of Bidar, Yadgir, Raichur, Koppala, Ballary and Kalaburgi districts. The Kalyana Karnataka region is categorized as backward region with semi arid climate. Agriculture is the mainstay of the population. This region is the second largest arid region in India. It account for 23 percent of state geographical area. As Kalyana Karnataka region is categorized as backward region with low literacy rate and arid region with agriculture as main occupation, there is need to study the health and nutritional status of population.

Material and methods
This was cross sectional study conducted during two consecutive years during 2020-21 and 2021-22. From rural and urban area of Raichur district in kalyana Karnataka region. Samples were selected from random sampling method. A total of N-600 samples from rural (n-400) and Urban (n-200) comprising adolescents boys and girls age range from 13 to 17 willing to participate in the study were considered. Ethical consideration: permission was taken from department of education and department of women and child welfare.

Informed consent for the enrollment of the child was obtained from the school teachers before the commencement of the study.

**Nutritional anthropometry**

The anthropometric measurement viz., height, weight and waist to hip ratio were measured as per the guidelines suggested by ICMR standards. The height was measured by using height scale nearest to 0.1 cm. A portable personal weighing scale was used to measure the weight in kg nearest to 0.5 kg, with ordinary casual clothing and without shoes. Waist and hip circumference were measured by using a fibre glass measuring tape in centimeters. Weight: The weight of the subjects was measured by using calibrated human weighing balance. Subjects were on minimal clothing and without shoes and socks while weighing. The weight was taken before the meal and the accuracy of the weighing machine checked periodically with known weights. Body Mass Index: The BMI was calculated using the formula and respondents were categorized as per WHO classification(Anon., 2004)

Dietary assessment: The information on daily intake of foods consumed by the adolescents were recorded by using structured questionnaire which includes dietary intake and food like, dislikes and frequency of consumption. The information on daily intake of food was collected by 24 hour recall method. To assist the subject to recall better, set of standardized vessels were displayed to quantify identification and asked to indicate vessel number and then nutritive value of food were computed

Randomly selected adolescents in the age group of 13-17 years studying in rural and urban schools of Koppal district were interviewed by using structured questionnaire and data was compiled. Table 1 shows the age and gender-wise distribution of 600 adolescents in Raichur district, classified into rural (n-400) and urban (n-200) populations. The adolescents were grouped into two age categories 13-15 years and 16-17 years. Among the 13-15-year olds, boys constituted 33.5 percent in both rural (n-134) and urban (n-67) areas, totaling 201 individuals (33.5%). Girls in the 13-15-year-olds, group includes 33.25 percent in rural (n-133) and 33.5 percent in urban (n-67) areas, total of 200 (33%) adolescents. In the 16-17 year age group, rural boys accounted for 16.5 percent (n-66) and urban boys for 16.5 percent (n-33), total of 99 boys (16.5%). Girls in 16-17 year age group comprised 16.75 percent in rural (n-67) and 16.5 percent in urban (n-33) areas, with an overall frequency of 100 (17%).

Table 2 shows the demographic profile of 600 adolescents from Raichur district, divided into rural (n-400) and urban (n-200) areas. Parental education of adolescence noticed higher proportion of illiteracy in rural areas. Among fathers, 43 percent in rural areas were illiterate compared to 33 percent in urban areas, while only 7 Percent of rural fathers had degree compared to 9 percent in urban areas. Adolescent mothers showed even higher illiteracy rates, with 58 percent in rural and 42 percent in urban areas, and very few attaining degree (5% in rural, 6% in urban). Caste distribution shows other backward classes had the majority in both regions (42% in rural, 63% in urban), followed by scheduled castes/tribes (29% in rural and 22% in urban area respectively) and General category includes 29 percent in rural and 16 percent in urban area. Family structure indicated that nuclear families were more common, especially in urban areas (70% in urban compared to 61% in rural), while joint families were more prevalent in rural regions (39%). family size indicated most families were of medium size (5-8 members), with 62 percent in rural and 55 percent in urban areas. Small families (1-4 members) were more common in urban areas (35% in urban compared to 21% in rural), while larger families (>8 members) were mostly found in rural areas 17 percent compared to 10 percent in urban area. Dietary habit shows the majority of adolescents in both rural and urban areas followed a non-vegetarian diet (66% in both), while vegetarians constituted about one-third such as 34 Percent in rural and 35 percent in urban. Family income noticed that significant proportion of rural families (59%) earned less than ₹ 20,000 per month, compared to 49 percent in urban areas. Only a small percentage of families in both regions earned more than ₹60,000 monthly (6% in rural, 12% in urban).

Table 3 shows comparison of mean height of adolescents in Raichur district with the Indian academy of pediatrics standards, categorized by age group (13-15 years and 16-17 years), among boys aged 13-15 years, the IAP standard height was 162.00 cm whereas both rural and urban boys showed considerably lower mean heights 150.72 cm in rural areas and 150.53 cm in urban areas. Among boys aged 16-17 years, the IAP standard was 166.50 cm while rural boys had mean height of 159.72 cm and urban boys had slightly higher mean of 161.30 cm. The deviation from the standard was significant in urban areas whereas not in rural areas, both groups showed below the IAP standard. Among girls aged 13-15 years, the IAP standard was 155.50 cm. rural girls had mean height of 147.31 cm and urban girls had 149.87 cm. The deviation was statistically significant in both groups. Among girls aged 16-17 years, the standard height was 156.00 cm. while rural girls recorded mean height of 148.80 cm, whereas urban girls recorded 150.57 cm. both deviations were significantly less than standard and under nutrition prevalence due to inadequate dietary intake among girls in our study table 8. The condition of stunting, as emphasized by Nair *et al.* (2017) [2] who conducted study in rural area of a district of Maharashtra, revealed that the cumulative deficiencies in nutrient intake during early childhood compounded by poor healthcare access, frequent infections and overall low quality of life. Rural adolescents showing lower mean heights than their urban area.

Table 4 shows the comparison between the mean weight of adolescents in Raichur district and the Indian academy of pediatrics standards. Among boys aged 13-15 years, the IAP standard weight was 49.50 kg. The mean weight of rural boys was significantly lower at 36.81 kg and urban boys weighed 38.89 kg. Both differences were statistically significant. Among boys aged 16-17 years, the IAP standard was 54.00 kg. Rural boys had mean weight of 39.70 kg and urban boys weighed slightly more at 42.66 kg, both groups were significantly below the IAP. Girls aged between 13-15 years, the IAP standard was 45.00 kg. Rural girls had mean weight of 37.49 kg and urban girls 38.61 kg. These values were significantly below the IAP standard. Girls aged between 16-17 years, the IAP standard was 47.00 kg. Rural girls had low mean weight of 34.88 kg and urban girls had 35.87 kg. The deviations were highly significant. Adolescents in both rural and urban areas of Raichur district had significantly lower body weights compared to IAP

standards. Rural adolescents, mainly girls, more affected than urban area.

Comparison of mean body mass index among adolescents in Raichur district with Indian academy of pediatrics standards is presented in table 5. Among boys aged between 13-15 years, the IAP standard BMI was 17.50. Rural boys had significantly lower mean BMI of 16.15 and urban boys had slightly higher mean BMI of 16.93. Both values were below the IAP standard, indicating statistically significant deviation for rural and urban boys. Among boys aged between 16-17 years, the IAP standard remains 17.50. Rural boys had mean BMI of 15.49, which is substantially lower and statistically significant, whereas urban boys had slightly improved mean BMI of 16.16, indicating no significant deviation from the standard. Girls aged between 13-15 years, the IAP standard BMI was16.50. Rural girls had mean BMI of 16.18, showing lower values than IAP standard with statistically significant difference. Urban girls had mean BMI of 17.59 above the IAP standard. Among girls aged between 16-17 years, the standard BMI was 16.50. Rural girls recorded mean BMI of 15.82, with statistically significant difference, while urban girls had mean BMI of 16.00, with insignificant mean body mass index. Adolescents in Raichur district, in rural areas, fall short of the IAP standard BMI values due to factors such as age and socio economic status of adolescent girls were significantly associated with their nutritional status in our study table 2. Rural boys and girls in both age groups show more pronounced under nutrition compared to the urban area Similar observation were also reported by Rahman *et al.* (2016) [3] who conducted population based study to assess the nutritional status of the adolescents of hajipur village of Bihar among 400 adolescents, were the result of mean BMI of adolescents shows 63 percent had body mass index less than normal.

Table 6 shows the degree of malnutrition among adolescents in Raichur district based on BMI classifications comparing with IAP standards, among boys aged between 13-15 years, significant proportion were underweight, with 87 Percent of rural boys and 76 percent of urban boys falling below the BMI threshold of 17.5. Only small percentage (11% in rural and 21% in urban) fell within the normal BMI range (17.5-20.5) and minimal representation was observed in the overweight and pre-obese categories. Among girls in the 13-15 years age group noticed high levels of under nutrition, with 87 percent of rural girls and 58 percent of urban girls having BMI below 16.5. Although slightly higher proportion of urban girls (37%) fell into the normal BMI range (16.5-19.5) these findings reveal the nature of under nutrition, indicating systemic deprivation possibly related to socio-economic and in adequate dietary intake in our study table 2&8. Similar observations were made by Rani *et al.* (2018) [4] who conducted study on assessment of nutritional status of teenage adolescent girls in urban slum of Varanasi, reported that the factors such as age and socio economic status of adolescent girls were significantly associated with their nutritional status.

Among boys aged between 16-17 years, under nutrition was higher with 85 percent of rural and 63 percent of urban boys recording BMI values below 17.5. Whereas few boys fell in the normal range (15% in rural and 26% in urban) and only one urban boy (3%) was classified as overweight (BMI >24.6). among girls aged 16-17 years, 85 percent in rural and 79 percent in urban areas were underweight (BMI <16.5) and only small proportion (15% in rural, 18% in urban) fell into the normal BMI range. High prevalence of under nutrition among adolescents in both rural and urban areas of Raichur district, with rural adolescents particularly girls being more severely affected than urban area similar observations were made by Maiti *et al.* 2011 [1] attributed the disparity between rural and urban area inadequate nutrient intake in the rural areas. Very few adolescents achieved BMI levels within the normal.

Nutrient intake of adolescent boys in Raichur district is presented in table 7, comparing rural and urban adolescents against the recommended dietary allowances. Energy consumption shows, the rural boys consumed only 1,054 Kcal, reached 43 Percent adequacy of the RDA (2,450 Kcal), while urban boys had better intake of 1,535 Kcal (62% adequacy). Protein intake where rural adolescents met only 69 Percent of the RDA (31.16 g), compared to 94 Percent among urban boys (42.65 g). Carbohydrate consumption was lower in rural boys (89.81 g, 69% of adequacy) compared to urban area (120.21±40.22 g, 92% of adequacy). Urban boys had higher the RDA for fat, consuming 51.85 g (115%), while rural boys fell slightly short with 38.42 g (85%). Fibre intake was inadequate in both groups however more in rural adolescents (11.65 g, 46%) than urban boys (14.53 g, 58%). both groups showed insufficient iron (Fe) intake, though urban boys had relatively better adequacy (69%) than rural boys (47%). while, calcium (Ca) intake was 70 Percent adequate in rural and 85 percent in urban boys. Phosphorus (P) intake was nearly adequate in rural areas (94%) whereas higher in urban adolescents (140%). Low intake of sodium (Na) was seen in both groups, particularly among rural boys (5% adequacy) and even urban boys met only 6 Percent of the requirement. Intakes of B-complex vitamins such as $B_1$ (thiamine), $B_2$ (riboflavin), niacin, and $B_6$ were low in both groups, with rural boys consuming less than half of the RDA for all and urban boys showing slightly better intake however less than standard. Folic acid intake was 43 percent adequate in rural and 61 Percent in urban boys, while potassium (K) intake remained low in both groups (30% in rural & 40% in urban).

Nutrient intake status of adolescent girls in Raichur district, comparing rural and urban area with the recommended dietary allowances. For energy intake, rural girls consumed average of 1053 Kcal, meeting 51 Percent of the RDA (2060 Kcal), while urban girls had significantly higher intake of 1468 Kcal, meeting 71 Percent of the adequacy. Protein intake was low among rural girls (31.06 g, 71% adequacy), whereas urban girls were close to the RDA (41.26 g, 95% of the adequacy). Carbohydrate intake in rural areas averaged 97.15 g (74% of adequacy), lower than the 113.79 g (87% adequacy) consumed by urban girls. The fat intake showed that rural girls consumed 38.21 g (84%), while urban girls had higher than the RDA at 51.09 g (113%).among rural girls. Iron (Fe) intake was 10.25 mg (34% adequacy) in rural areas, compared to 14.55 mg (50%) in urban girls however still below the RDA (30 mg) in both groups. Calcium intake was marginally better in urban girls (843.03 mg, 84% of adequacy) than in rural girls (703 mg, 70% of adequacy). Phosphorus (P) intake was close to adequate in rural girls (92%) and higher than the requirement in urban girls (137%). potassium (K) intake was below RDA, with rural girls consuming only 30 Percent of the requirement and urban girls 39 percent.

Vitamin intake revealed critical inadequacies. Thiamine ($B_1$) and riboflavin ($B_2$) intake in rural girls was significantly low (52% and 37% adequacy, respectively), while urban girls reached better however still inadequate levels (93% and 48%, respectively). Folic acid intake was 49 percent in rural and 71 percent in urban girls. Niacin and vitamin $B_6$ levels were low in both groups, with rural girls consuming only 39 percent and 7 percent, respectively, and urban girls showing slightly better intakes (61% and 8%). significant nutrient deficiencies among adolescent girls in Raichur district were observed (Table 8).

Nutrient intake of adolescent boys aged between 16-17 years in Raichur district, comparing rural and urban adolescent against recommended dietary allowances is presented in table 9. Energy intake among adolescents, rural boys consumed 1272 Kcal, which is only 38 Percent of the RDA (3320 Kcal), while urban boys consumed more at 1563 Kcal (47%), yet still significantly below recommended levels. Protein intake was inadequate, with rural adolescents consuming 35.88 g (55%) and urban adolescents slightly higher at 44.81 g (69%). Carbohydrate intake was moderate, with rural boys at 98.72 g (75%) and urban boys at 117.72 g (90%). Fat intake showed rural adolescents had 44.36 g (98%), close to the RDA of 45 g, while urban boys had higher than it with 51.65 g (114%). Micronutrient deficiencies were prominent. Iron (Fe) intake among rural boys was 13.12 mg (50%), while urban boys consumed 15.71 mg (60%) both below the RDA of 26 mg. Calcium intake was 791.97 mg (75%) in rural and 824.19 mg (78%) in urban boys, which is insufficient compared to the RDA of 1050 mg. Phosphorus (P) intake was adequate to high in both groups, with rural boys at 1250.23 mg (125%) and urban boys had higher than the RDA with 1398.38 mg (139%). The intake of B vitamins was inadequate. Rural boys consumed only 1.23 mg of Thiamine ($B_1$) (55%) and 0.99 mg of Riboflavin ($B_2$) (31%), while urban boys did marginally better with 1.52 mg of $B_1$ (69%) and 1.05 mg of $B_2$ (33%). Folic acid intake was 163 µg (47%) in rural and 155.59µg (45%) in urban boys notably deficient compared to the RDA of 340 µg. Potassium intake was only 36 Percent adequate in rural and 40 Percent in urban boys, showing consistent shortfalls. Niacin levels were low across both areas, with rural boys at 8.19 mg (37%) and urban at 10.46 mg (47%). Vitamin $B_6$ intake was low at 0.19±0.04 mg (6%) in rural and 0.18 mg (6%) in urban boys, below the RDA of 3 mg.

Table 10 shows the nutrient intake of adolescent girls in Raichur district, comparing rural and urban populations against the recommended dietary allowance). Energy intake among rural girls averaged 1130 Kcal, which is only 45 percent of the RDA (2500 Kcal), while urban girls consumed slightly more (1393 Kcal, 55% of adequacy). Protein intake was inadequate, with rural girls consuming 32.9 g (59% of RDA) and urban girl's 39.69 g (71%). Carbohydrate intake was better, with rural girls at 96.42 g (74%) and urban girls at 113.50 g (86%). Fat intake was close to recommended levels, particularly in urban girls (49.97 g, 111% of RDA) compared to rural girls (39.99 g, 88%). Intake of dietary fiber and essential micronutrients like iron (Fe), calcium (Ca), and phosphorus (P) was low, especially in rural areas. Rural girls consumed only 11.12 of iron (34% adequacy), while urban girls reached 14.7 mg (45%). Calcium intake was also higher among urban girls (854.5 mg; 81% of adequacy) than rural (731.14 mg; 69% of adequacy). Phosphorus intake had higher than the RDA in both groups, with rural girls at 1040.05 mg (104%) and urban girls significantly higher at 1436.75 mg (143%). Sodium (Na) intake, low in both groups 110.28 mg (5%) in rural and 141.21 mg (7%) in urban areas. Similar deficiencies were seen in vitamins $B_1$ (thiamine), $B_2$ (riboflavin), $B_6$ and folic acid. Rural girls consumed 0.97 mg B1 (57% adequacy) and 0.87 mg B2 (38%), while urban girls had better values at 1.44 mg (84%) and 1.09 mg (47%) respectively. Folic acid intake was 50% of RDA for rural girls (135.44 µg) and 71 Percent for urban girls (193.02 µg). Potassium (K) and niacin intake also remained below adequate levels, though urban girls again fared better. Total studied subjects were having low dietary nutrient intake as compared to RDA recommended by NIN. Similar results were obtained by Twara *et al.* (2015) [5], Yilma *et al.* (2021) [6] were noticed inadequate dietary intake by the subjects as compared to RDA.

**Table 1:** Age and gender wise distribution of adolescents in Raichur district

N-600

| Age (years) | Gender | Rural (n=400) | | Urban (n=200) | | Total | % |
|---|---|---|---|---|---|---|---|
| | | F | (%) | F | (%) | | |
| 13-15 | Boys | 134 | 33.5 | 67 | 33.5 | 201 | 33.5 |
| | Girls | 133 | 33.25 | 67 | 33.5 | 200 | 33 |
| 16-17 | Boys | 66 | 16.5 | 33 | 16.5 | 99 | 16.5 |
| | Girls | 67 | 16.75 | 33 | 16.5 | 100 | 17 |

*Classification according to RDA 2022, F-Frequency,%-Percentage

**Table 2:** Demographic profile of the adolescents in Raichur district

(N-600)

| SL no | Variables | Categories | Raichur district | | | |
|---|---|---|---|---|---|---|
| | | | Rural | | Urban | |
| | | | F | % | F | % |
| 1 | Education of the father | Illiterate | 170 | 43 | 65 | 33 |
| | | Primary | 153 | 38 | 78 | 39 |
| | | Secondary | 48 | 12 | 39 | 20 |
| | | Degree | 29 | 7 | 18 | 9 |
| 2 | Education of the mother | Illiterate | 233 | 58 | 83 | 42 |
| | | Primary | 124 | 31 | 72 | 36 |
| | | Secondary | 24 | 6 | 33 | 17 |
| | | Degree | 19 | 5 | 12 | 6 |
| 3 | Caste | Schedule Caste/Tribe | 118 | 29 | 44 | 22 |
| | | OBC | 168 | 42 | 125 | 63 |
| | | General | 114 | 29 | 31 | 16 |
| 4 | Type of family | Nuclear | 245 | 61 | 140 | 70 |
| | | Joint | 155 | 39 | 60 | 30 |
| 5 | Total family members | Small (1-4) | 84 | 21 | 69 | 35 |
| | | Medium(5-8) | 247 | 62 | 110 | 55 |
| | | Large (>8) | 69 | 17 | 21 | 10 |
| 6 | Food habit | Vegetarian | 137 | 34 | 69 | 35 |
| | | Non vegetarian | 263 | 66 | 131 | 66 |
| 7 | Family income | >Rs.60000 | 22 | 06 | 24 | 12 |
| | | Rs.20,000-Rs.60,000 | 147 | 37 | 78 | 39 |
| | | < Rs.20000 | 230 | 59 | 98 | 49 |

F-frequency, %-Percentage

**Table 3:** Height of adolescents in Raichur district

N=600

| Gender | IAP Standard | 13-15 Yrs (401) | | | | IAP Standard | 16-17 Yrs (199) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rural | t-value | Urban | t-value | | Rural | t-value | Urban | t-value |
| Boys (n=300) | 162.00 | 150.72±6.88 | 07.76 * | 150.53±8.09 | 11.59 * | 166.50 | 159.72±8.05 | 02.64 | 161.30±6.05 | 5.87 * |
| Girls (n=300) | 155.50 | 147.31±7.40 | 10.39 * | 149.87±6.82 | 4.90 * | 156.00 | 148.80±6.53 | 8.98 * | 150.57±9.04 | 3.43 * |

IAP-Indian Academy of Pediatrics
*Indicates significant @ 5 percent
Mean ± standard deviation

**Table 4:** Weight of the adolescent's in Raichur district

| Gender | IAP Standard | 13-15 years (401) | | | | IAP Standard | 16-17 years (199) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rural | t-value | Urban | t-value | | Rural | t-value | Urban | t-value |
| Boys (n=300) | 49.50 | 36.81±8.60 | 17.05 * | 38.89±9.60 | 8.97 * | 54.00 | 39.70±7.00 | 16.61 * | 42.66±9.23 | 7.04 * |
| Girls (n=300) | 45.00 | 37.49±7.46 | 11.49 * | 38.61±6.80 | 7.59 * | 47.00 | 34.88±4.66 | 21.25 * | 35.87±7.17 | 8.91 * |

IAP-Indian Academy of Pediatrics
*Indicates significant @ 5 percent, Mean ± standard deviation

**Table 5:** Body mass index of adolescents in Raichur District

| Gender | IAP Standard | 13-15 years (401) | | | | IAP Standard | 16-17 years (199) | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Rural | t-value | Urban | t-value | | Rural | t-value | Urban | t-value |
| Boys (n=300) | 17.50 | 16.15±3.27 | 4.77 * | 16.93±3.54 | 1.31 * | 17.50 | 15.49±3.07 | 5.31 * | 16.16±4.33 | 0.98 |
| Girls (n=300) | 16.50 | 16.18±3.04 | 2.96 * | 17.59±3.94 | 2.25 * | 16.50 | 15.82±2.42 | 2.28 * | 16.00±3.79 | 0.78 |

IAP-Indian Academy of Pediatrics, Mean ± standard deviation
*Indicates significant @ 5 percent

**Table 6:** Degree of malnutrition among adolescents based on body mass index of Raichur district

| Age (Yrs) | IAP standard | Rural($n_1$-400) Raichur | | Urban Raichur | | IAP standard | Rural Raichur | | Urban Raichur | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | % | F | % | | F | % | F | % |
| 13-15 | >24.6 | 02 | 01 | 00 | 00 | >23.6 | 02 | 01 | 03 | 04 |
| | 20.6-24.5 | 00 | 00 | 02 | 03 | 19.6-23.5 | 00 | 00 | 00 | 00 |
| | 17.5-20.5 | 15 | 11 | 14 | 21 | 16.5-19.5 | 15 | 11 | 25 | 37 |
| | <17.5 | 117 | 87 | 51 | 76 | <16.5 | 117 | 87 | 39 | 58 |
| | Total | 134 | 100 | 67 | 100 | Total | 134 | 100 | 67 | 100 |
| 16-17 | >24.6 | 00 | 00 | 01 | 03 | >23.6 | 00 | 00 | 00 | 00 |
| | 20.6-24.5 | 00 | 00 | 01 | 03 | 19.6-23.5 | 00 | 00 | 01 | 03 |
| | 17.5-20.5 | 10 | 15 | 09 | 26 | 16.5-19.5 | 10 | 15 | 6 | 18 |
| | <17.5 | 56 | 85 | 22 | 63 | <16.5 | 57 | 85 | 26 | 79 |
| | Total | 66 | 100 | 33 | 100 | Total | 67 | 100 | 33 | 100 |

*Indian Academy of Pediatrics classification
F-frequency,%-Percentage

**Table 7:** Nutrient intake of adolescent boys* in Raichur district

| Nutrients | Rural (n=134) | | | t-value | Urban (n=67) | | |
|---|---|---|---|---|---|---|---|
| | RDA | Mean ± SD | Percent adequacy | | Mean ± SD | Percent adequacy | t-value |
| Energy (Kcal) | 2450 | 1054±149 | 43 | 113.61 * | 1535±208 | 62 | 40 * |
| Protein (g) | 45 | 31.16±2.81 | 69 | 60.11 * | 42.65±7.34 | 94 | 2.97 * |
| Carbohydrate (g) | 130 | 89.81±20.33 | 69 | 9.50 * | 120.21±40.22 | 92 | 21.46 * |
| Fat (g) | 45 | 38.42±7.79 | 85 | 10.31 * | 51.85±2.32 | 115 | 27.47 * |
| Fibre (g) | 25 | 11.65±2.02 | 46 | 80.53 * | 14.53±0.51 | 58 | 189.42 * |
| Fe (mg) | 22 | 10.36±1.70 | 47 | 83.75 * | 15.33±2.17 | 69 | 28.56 * |
| Ca (mg) | 1000 | 706.06±99.09 | 70 | 36.21 * | 859.35±108.72 | 85 | 12.07 * |
| P (mg) | 1000 | 946.07±328.16 | 94 | 2.01 * | 1402.83±229.75 | 140 | 16.35 * |
| Na(mg) | 2000 | 102.64±31.73 | 05 | 729.97 * | 139.41±31.04 | 06 | 559.02 * |
| $B_1$(mg) | 1.9 | 0.87±0.37 | 46 | 33.90 * | 1.55±0.26 | 81 | 12.13 * |
| $B_2$(mg) | 2.7 | 0.83±0.22 | 30 | 102.42 * | 1.08±0.14 | 40 | 102.10 * |
| Folic acid(µg) | 285 | 123.88±66.52 | 43 | 29.57 * | 174.57±47.27 | 61 | 21.79 * |
| K(mg) | 3500 | 1079.49±207.90 | 30 | 142.12 * | 1421.05±114.85 | 40 | 168.83 * |
| Vit-C(mg) | 72 | 69.46±26.11 | 96 | 1.18 | 89.39±14.50 | 124 | 11.18 * |
| Niacin(mg) | 19 | 6.27±1.56 | 33 | 99.34 * | 10±1.24 | 52 | 67.66 * |
| $B_6$(mg) | 2.6 | 0.17±0.03 | 06 | 937.46 * | 0.17±0.02 | 06 | 797.22 * |

*Indicates significant @ 5%
*13-15 year
RDA-2022

**Table 8:** Nutrient intake of adolescent girls* in Raichur district

| Nutrients | Rural (n= 133) | | | t-value | Urban (n=67) | | |
|---|---|---|---|---|---|---|---|
| | RDA | Mean ± SD | Percent adequacy | | Mean ± SD | Percent adequacy | t-value |
| Energy (Kcal) | 2060 | 1053±154 | 51 | 50 # | 1468±212 | 71 | 31* |
| Protein (g) | 43.2 | 31.06±2.67 | 71 | 35.38 # | 41.26±7.23 | 95 | 3.06 # |
| Carbohydrate (g) | 130 | 97.15±19.99 | 74 | 5.51 # | 113.79±40.80 | 87 | 23.69 # |
| Fat (g) | 45 | 38.21±7.80 | 84 | 6.78 # | 51.09±3.64 | 113 | 19.07 # |
| Fibre (g) | 25 | 11.52±2.03 | 46 | 51.66 # | 14.45±0.86 | 57 | 138.93 # |
| Fe (mg) | 30 | 10.25±1.69 | 34 | 90.85 # | 14.55±3.85 | 50 | 42.70 # |
| Ca (mg) | 1000 | 703.32±97.62 | 70 | 23.73 # | 843.03±116.11 | 84 | 15.41 # |
| P (mg) | 1000 | 929.42±328.04 | 92 | 1.68 | 1378.51±258.61 | 137 | 16.69 # |
| Na(mg) | 2000 | 100.82±31.61 | 05 | 469.21 # | 135.57±34.25 | 06 | 610.88 # |
| $B_1$(mg) | 1.6 | 0.84±0.36 | 52 | 16.18 # | 1.49±0.29 | 93 | 4.25 # |
| $B_2$(mg) | 2.2 | 0.82±0.22 | 37 | 48.50 # | 1.07±0.16 | 48 | 77.18 # |
| Folic acid(µg) | 245 | 121.03±66.24 | 49 | 14.62 # | 176.15±48.05 | 71 | 16.33 # |
| K(mg) | 3500 | 1063.65±207.46 | 30 | 91.72 # | 1391.47±135.86 | 39 | 176.95 # |
| Vit-C(mg) | 66 | 68.77±25.71 | 104 | 0.84 # | 90.62±14.35 | 137 | 19.56 # |
| Niacin(mg) | 16 | 6.24±1.54 | 39 | 49.39 # | 9.78±1.46 | 61 | 48.39 # |
| B6(mg) | 2.2 | 0.17±0.02 | 07 | 545.76 # | 0.18±0.14 | 08 | 821.44 # |

*Indicates significant @ 5%
*13-15 year, RDA-2022

**Table 9:** Nutrient intake of adolescent boys* in Raichur district

| Nutrients | Rural (n= 66) | | | t-value | Urban (n=33) | | |
|---|---|---|---|---|---|---|---|
| | RDA | Mean ± SD | Percent adequacy | | Mean ± SD | Percent adequacy | t-value |
| Energy (Kcal) | 3320 | 1272±282 | 38 | 16.70 # | 1563±240 | 47 | 15* |
| Protein (g) | 64.4 | 35.88±6.43 | 55 | 5.67 # | 44.81±7.94 | 69 | 0.09 |
| Carbohydrate (g) | 130 | 98.72±47.83 | 75 | 4.33 # | 117.72±42.27 | 90 | 9.82 # |
| Fat (gm) | 45 | 44.36±9.42 | 98 | 0.27 | 51.65±6.71 | 114 | 4.08 # |
| Fibre (g) | 30 | 13.49±2.07 | 44 | 22.16 # | 14.5±1.73 | 48 | 24.96 # |
| Fe (mg) | 26 | 13.12±3.22 | 50 | 11.02 # | 15.71±3.05 | 60 | 8.49 # |
| Ca (mg) | 1050 | 791.97±150.83 | 75 | 5.52 # | 824.19±135.14 | 78 | 5.36 # |
| P (mg) | 1000 | 1250.23±424.16 | 125 | 2.36 # | 1398.38±322.29 | 139 | 5.09 # |
| Na(mg) | 2000 | 124.95±41.62 | 06 | 174.46 # | 132.6±31.14 | 06 | 247.21 # |
| $B_1$(mg) | 2.2 | 1.23±0.46 | 55 | 1.81 | 1.52±0.27 | 69 | 5.66 # |
| $B_2$(mg) | 3.1 | 0.99±0.25 | 31 | 26.99 # | 1.05±0.18 | 33 | 36.95 # |
| Folic acid(µg) | 340 | 163.14±67.78 | 47 | 7.19 # | 155.59±47.34 | 45 | 11.27 # |
| K(mg) | 3500 | 1266.71±232.56 | 36 | 38.41 # | 1410.23±163.74 | 40 | 52.62 # |
| Vit-C(mg) | 80 | 81.99±25.29 | 102 | 1.5 # | 82.35±18.51 | 102 | 2.31 # |
| Niacin(mg) | 22 | 8.19±2.65 | 37 | 16.30 # | 10.46±2.60 | 47 | 13.52 # |
| $B_6$(mg) | 3 | 0.19±0.04 | 06 | 237.24 # | 0.18±0.02 | 06 | 337.14 # |

*Indicates significant @ 5%
Mean ± standard deviation, *16-17 year
RDA-2022

**Table 10:** Nutrient intake adolescent girls* in Raichur district

| Nutrients | Rural (n=67) | | | t-value | Urban (n= 33) | | |
|---|---|---|---|---|---|---|---|
| | RDA | Mean ± SD | Percent adequacy | | Mean ± SD | Percent adequacy | t-value |
| Energy (Kcal) | 2500 | 1130±23 | 45 | 17 # | 1393±210 | 55 | 12* |
| Protein (g) | 55.7 | 032.9±5.24 | 59 | 8.78 # | 39.69±6.20 | 71 | 2.25* |
| Carbohydrate (g) | 130 | 96.42±34.85 | 74 | 3.51 # | 113.50±39.64 | 86 | 7.59* |
| Fat (g) | 45 | 039.99±9.06 | 88 | 2.47 # | 49.97±4.58 | 111 | 4.33* |
| Fibre (g) | 25 | 012.24±2.19 | 48 | 25.95 # | 14.46±1.34 | 57 | 31.38* |
| Fe (mg) | 32 | 011.12±2.42 | 34 | 34.84 # | 14.7±2.71 | 45 | 22.56* |
| Ca (mg) | 1050 | 731.14±128.75 | 69 | 9.34 # | 854.5±119.10 | 81 | 4.88* |
| P (mg) | 1000 | 1040.05±395.40 | 104 | 0.45 | 1436.75±312.70 | 143 | 5.59* |
| Na(mg) | 2000 | 0110.28±36.76 | 05 | 229.87 # | 141.21±34.55 | 07 | 215.18* |
| $B_1$(mg) | 1.7 | 0.97±0.43 | 57 | 6.38 # | 1.44±0.31 | 84 | 1.95 |
| $B_2$(mg) | 2.3 | 0.87±0.24 | 38 | 23.65 # | 1.09±0.18 | 47 | 23.89* |
| Folic acid(µg) | 270 | 135.44±71.41 | 50 | 6.86 # | 193.02±44.73 | 71 | 4.64* |
| K(mg) | 3500 | 1139.8±233.94 | 32 | 45.12 # | 1369.97±153.19 | 39 | 55.61* |
| Vit-C(mg) | 80 | 72.36±27.62 | 90 | 1.03 | 94.42±12.58 | 118 | 9.03* |
| Niacin(mg) | 17 | 6.77±2.14 | 39 | 19.23 # | 9.61±1.68 | 56 | 15.19* |
| $B_6$(mg) | 2.3 | 0.18±0.04 | 08 | 222.16 # | 0.18±0.03 | 08 | 249.14* |

*Indicates significant @ 5%
Mean ± standard deviation,* 16-17 years
RDA-2022

## Conclusion

Rural adolescents, both boys and girls, were more disadvantaged in terms of parental illiteracy, lower family income, larger family sizes, and joint family were prevalence. Anthropometric measurements showed that both rural and urban adolescents had mean height, weight, and BMI values significantly below IAP standards, with rural adolescents had more under nutrition than urban area. Nutrient intake highlighted severe inadequacies in both energy and micronutrient consumption, with rural adolescents consistently consuming less than the urban areas and falling short of RDA standards across all major nutrients, including iron, calcium, and B-complex vitamins.

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