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Original Research Article

ASSESSMENT OF ANAEMIA AND ITS ASSOCIATED FACTORS AMONG ADOLESCENT GIRLS IN AN URBAN POPULATION: A COMMUNITY-BASED CROSS-SECTIONAL OBSERVATIONAL STUDY

Karmakonda Anil Kumar[1], Rama Kranthi Tumu[2], Singirikonda Srikanth[3]

[1]Assistant Professor, Department of Community Medicine, Government Medical College, Wanaparthy, Telangana, India.
[2]Assistant Professor, Department of Physiology, Government Medical College, Suryapet, Telangana, India.
[3]Assistant professor, Department of Community Medicine, Government Medical College, Mahbubnagar, Telangana, India.

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Corresponding Author:
Dr. Rama Kranthi Tumu,
Assistant Professor, Department of Physiology, Government Medical College, Suryapet, Telangana, India.
Email: ramakranthy@gmail.com

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ABSTRACT

Background: Anaemia during adolescence can impair physical growth, learning capacity, immunity, and future reproductive health. Adolescent girls are particularly vulnerable because rapid growth, inadequate dietary intake, and menstrual blood loss increase their iron requirements. **Objectives:** To estimate the prevalence and severity of anaemia and assess its association with sociodemographic, nutritional, and menstrual factors among adolescent girls in an urban population.

Materials and Methods: A community-based cross-sectional observational study was conducted among 100 adolescent girls aged 10-19 years in the urban field practice area of the Department of Community Medicine, Government Medical College, Wanaparthy, Telangana, India, from August 2025 to January 2026. Sociodemographic, dietary, anthropometric, menstrual, and haemoglobin data were collected. Anaemia was classified using age-appropriate haemoglobin thresholds. Associations were examined using the Pearson χ^2 test, with $p<0.05$ considered statistically significant.

Results: The mean age was 15.3 ± 2.4 years, and the mean haemoglobin concentration was 11.55 ± 1.43 g/dL. Anaemia was present in 46.0% of participants; 26.0% had mild, 17.0% moderate, and 3.0% severe anaemia. Anaemia was significantly associated with low intake of iron-rich foods, frequent meal skipping, underweight status, lower socioeconomic category, a history suggestive of worm infestation, and heavy menstrual bleeding. Vegetarian dietary pattern, age group, and menstrual duration exceeding five days were not significantly associated with anaemia.

Conclusion: Anaemia affected nearly half of the adolescent girls studied and was linked to modifiable nutritional, socioeconomic, parasitic, and menstrual factors. Community-level screening should be integrated with nutrition counselling, regular iron-folic acid supplementation, deworming, and evaluation of heavy menstrual bleeding.

Keywords: adolescent girls; anaemia; haemoglobin; nutrition; heavy menstrual bleeding; urban health.

INTRODUCTION

Anaemia is a reduction in the haemoglobin concentration below the level required to meet physiological oxygen demands. It remains a persistent public health concern in India, where adolescent girls carry a substantial burden. Multicentre Indian data have documented anaemia in more than half of adolescent girls in several districts, although the magnitude varies markedly across geographic and socioeconomic groups.[1] National analyses have similarly demonstrated that anaemia is distributed unequally, with a greater burden among girls from disadvantaged households

and communities.[2] This pattern is important because adolescence is a period of rapid somatic growth, expansion of blood volume, and increasing micronutrient requirements.

The aetiology of anaemia in adolescent girls is multifactorial. Inadequate consumption of iron-rich foods, low dietary diversity, meal skipping, and poor intake of micronutrients can restrict haemoglobin synthesis. Adolescent girls often have dietary iron intake below physiological requirements, particularly when diets contain few animal-source foods or are dominated by inhibitors of iron absorption.[3] Menarche introduces recurrent blood loss, while heavy or prolonged menstrual bleeding further depletes iron stores. Menstrual characteristics and related symptoms also influence school participation, daily functioning, and health-seeking behaviour among urban Indian adolescents.[4] Parasitic infestation, recurrent infection, chronic inflammation, and nutritional deficiencies involving folate or vitamin B12 can add to the burden.

Anaemia during adolescence is associated with fatigue, reduced exercise tolerance, impaired concentration, lower educational performance, and diminished productivity. It also has intergenerational significance because girls entering pregnancy with depleted iron stores face a higher risk of maternal anaemia and adverse pregnancy outcomes. Population-based research from Bihar and Uttar Pradesh has shown that late adolescence, limited education, poor nutritional status, and social disadvantage are important predictors of anaemia.[5] Programmes providing weekly iron-folic acid supplementation, deworming, nutrition education, and supervised adherence have demonstrated that coordinated public health action can reduce anaemia at scale.[6] Nevertheless, programme effectiveness depends on identifying local risk patterns and reaching both school-going and out-of-school girls.

Urban populations are not uniformly protected from nutritional anaemia. Food insecurity, overcrowding, changing dietary patterns, frequent consumption of low-nutrient snacks, menstrual problems, and limited use of preventive services can coexist within urban communities. Local evidence is therefore required to guide screening, counselling, supplementation, deworming, and referral services through the urban health system. The present study was undertaken to estimate the prevalence and severity of anaemia among adolescent girls residing in the urban field practice area of Government Medical College, Wanaparthy, and to assess its association with sociodemographic characteristics, nutritional status, dietary practices, worm infestation, and menstrual factors.

MATERIALS AND METHODS

Study design and setting: This community-based cross-sectional observational study was conducted in the urban field practice area of the Department of Community Medicine, Government Medical College, Wanaparthy, Telangana, India, from August 2025 to January 2026.

Study population and eligibility: Adolescent girls aged 10-19 years who had resided in the study area for at least six months were eligible. Written informed consent from a parent or guardian and assent from the participant were obtained where applicable. Girls with known haemoglobinopathies, chronic kidney or liver disease, acute febrile illness, active non-menstrual bleeding, or pregnancy were excluded.

Sample size and sampling: The sample size was estimated using an anticipated anaemia prevalence of 50%, a 95% confidence level, and 10% absolute precision. The calculated minimum of 96 was rounded to 100. Adolescent girls were selected by systematic random sampling from household records maintained in the field practice area. When a selected household had more than one eligible girl, one was chosen by lottery.

Data collection: A pretested, interviewer-administered questionnaire recorded age, family type, socioeconomic category, dietary pattern, intake of iron-rich foods, meal skipping, history suggestive of worm infestation, menarche, menstrual duration, and heavy menstrual bleeding. Low intake of iron-rich foods was defined as consumption on fewer than three days per week, while frequent meal skipping indicated omission of a main meal on at least three days per week. Heavy menstrual bleeding was identified through excessive flow, frequent pad changes, passage of clots, or interference with routine activities. Structured questionnaires and haemoglobin assessment have been used in comparable adolescent screening studies.[7]

Anthropometry and haemoglobin assessment: Weight was measured with a calibrated digital scale to the nearest 0.1 kg, and height with a portable stadiometer to the nearest 0.1 cm. Body mass index was calculated as weight in kilograms divided by height in metres squared and classified using age-appropriate categories. Capillary haemoglobin was measured under aseptic precautions using a calibrated HemoCue Hb 201+ analyser. Anaemia and severity were classified using age-appropriate haemoglobin thresholds.

Case definition of anaemia: According to the World Health Organization 2024 criteria, anaemia was defined as a haemoglobin concentration <11.5 g/dL in girls aged 10–11 years and <12.0 g/dL in non-pregnant girls aged 12–19 years. Among girls aged 10–11 years, mild, moderate, and severe anaemia were defined as haemoglobin concentrations of 11.0–11.4 g/dL, 8.0–10.9 g/dL, and <8.0 g/dL, respectively. Among girls aged 12–19 years, mild, moderate, and severe anaemia were defined as 11.0–11.9 g/dL, 8.0–10.9 g/dL, and <8.0 g/dL, respectively.15

Bias control and data quality: Data collectors received standardised training, and the questionnaire was pretested outside the study area. Equipment was checked daily, identical operational definitions were applied, and completed forms were reviewed on the day of collection. No participant had missing haemoglobin or key exposure data.

Statistical Analysis: Data were entered into a spreadsheet, verified, and analysed using IBM SPSS Statistics version 26. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequency and percentage. Associations between anaemia and categorical factors were assessed using the Pearson χ^2 test without continuity correction. A two-sided p-value below 0.05 was considered statistically significant.

Ethical considerations: The study protocol was approved by the Institutional Ethics Committee of Government Medical College, Wanaparthy. Confidentiality was maintained by using coded records. Girls detected with anaemia or heavy menstrual bleeding received counselling and were referred to the appropriate health facility for further evaluation and management.

RESULTS

A total of 100 adolescent girls from the selected urban population were included in the study, and complete sociodemographic, anthropometric, dietary, menstrual, and haemoglobin data were available for all participants. The mean age was 15.3 ± 2.4 years, with an age range of 10-19 years. Most participants were aged 14-16 years (42.0%), followed by 17-19 years (33.0%) and 10-13 years (25.0%). Sixty-eight participants belonged to nuclear families, while 40.0% were from families classified under the low or lower-middle socioeconomic category.

Based on body mass index classification, 28 (28.0%) participants were underweight, 58 (58.0%) had normal body mass index, and 14 (14.0%) were overweight or obese. Menarche had been attained by 78 (78.0%) participants. A predominantly vegetarian diet was reported by 32 (32.0%) girls. Low dietary intake of iron-rich foods was identified in 62 (62.0%) participants, while 48 (48.0%) reported frequently skipping one or more meals. [Table 1]

Table 1: Sociodemographic, nutritional, and menstrual characteristics of the participants (N = 100)

Characteristic	Category	Frequency	Percentage
Age group	10-13 years	25	25.0
	14-16 years	42	42.0
	17-19 years	33	33.0
Family type	Nuclear	68	68.0
	Joint	32	32.0
Socioeconomic category	Low/lower-middle	40	40.0
	Middle/upper	60	60.0
Body mass index	Underweight	28	28.0
	Normal	58	58.0
	Overweight/obese	14	14.0
Dietary pattern	Vegetarian	32	32.0
	Mixed diet	68	68.0
Low intake of iron-rich foods	Present	62	62.0
	Absent	38	38.0
Frequent meal skipping	Present	48	48.0
	Absent	52	52.0
Menarche	Attained	78	78.0
	Not attained	22	22.0
History suggestive of worm infestation	Present	14	14.0
	Absent	86	86.0

The mean haemoglobin concentration was 11.55 ± 1.43 g/dL. Anaemia was detected in 46 participants, giving an overall prevalence of 46.0%. Among the anaemic participants, 26 (56.5%) had mild anaemia, 17 (37.0%) had moderate anaemia, and three (6.5%) had severe anaemia. When calculated for the entire study population, mild, moderate, and severe anaemia were observed in 26.0%, 17.0%, and 3.0% of participants, respectively. [Table 2]

Table 2: Prevalence and severity of anaemia among the participants (N = 100)

Haemoglobin status	Frequency	Percentage of total population	Percentage among anaemic participants
Non-anaemic	54	54.0	-
Anaemic	46	46.0	100.0
Mild anaemia	26	26.0	56.5
Moderate anaemia	17	17.0	37.0
Severe anaemia	3	3.0	6.5

Anaemia was significantly more frequent among girls with low consumption of iron-rich foods than among those with adequate consumption (58.1% versus 26.3%; $\chi^2 = 9.56$, $p = 0.002$). Similarly, 60.4% of participants who frequently skipped meals were anaemic, compared with 32.7% of those who did not skip meals ($\chi^2 = 7.72$, $p = 0.005$).

Underweight participants had a significantly higher prevalence of anaemia than those who were not underweight (67.9% versus 37.5%; $\chi^2 = 7.48$, $p = 0.006$). Anaemia was also more common among girls from the low or lower-middle socioeconomic category than among those from the middle or upper category (62.5% versus 35.0%; $\chi^2 = 7.31$, $p = 0.007$). A history suggestive of worm infestation was associated with a higher prevalence of anaemia (71.4% versus 41.9%; $\chi^2 = 4.24$, $p = 0.040$).

Among the 78 postmenarchal participants, 24 reported heavy menstrual bleeding. Anaemia was identified in 18 (75.0%) girls with heavy menstrual bleeding, compared with 22 (40.7%) of the 54 girls without heavy menstrual bleeding ($\chi^2 = 7.81$, $p = 0.005$). Menstrual duration exceeding five days was associated with a numerically higher prevalence of anaemia; however, the difference was not statistically significant (66.7% versus 44.4%; $\chi^2 = 3.28$, $p = 0.070$).

Although anaemia was more frequent among participants following a vegetarian diet than among those consuming a mixed diet, the difference was not statistically significant (56.3% versus 41.2%; $\chi^2 = 1.99$, $p = 0.158$). No significant association was observed between age group and anaemia status ($\chi^2 = 1.36$, $p = 0.507$). The complete factor-wise analysis is presented in Table 3.

Table 3: Factors associated with anaemia among adolescent girls

Associated factor	Anaemia among exposed participants, n/N (%)	Anaemia among unexposed participants, n/N (%)	Chi-square value	p-value
Low intake of iron-rich foods	36/62 (58.1)	10/38 (26.3)	9.56	0.002
Frequent meal skipping	29/48 (60.4)	17/52 (32.7)	7.72	0.005
Underweight	19/28 (67.9)	27/72 (37.5)	7.48	0.006
Low/lower-middle socioeconomic category	25/40 (62.5)	21/60 (35.0)	7.31	0.007
History suggestive of worm infestation	10/14 (71.4)	36/86 (41.9)	4.24	0.040
Vegetarian dietary pattern	18/32 (56.3)	28/68 (41.2)	1.99	0.158
Heavy menstrual bleeding*	18/24 (75.0)	22/54 (40.7)	7.81	0.005
Menstrual duration >5 days*	16/24 (66.7)	24/54 (44.4)	3.28	0.070

Menstrual factors were analysed among the 78 participants who had attained menarche. Pearson chi-square test was used.

Overall, anaemia affected nearly half of the adolescent girls studied. Low intake of iron-rich foods, frequent meal skipping, underweight status, lower socioeconomic category, a history suggestive of worm infestation, and heavy menstrual bleeding were significantly associated with anaemia.

DISCUSSION

The present community-based study found anaemia in 46.0% of adolescent girls, with mild anaemia forming the largest severity group. This prevalence indicates a substantial urban public health burden despite proximity to health services. The estimate was lower than the 59% reported among girls attending an Anaemia Mukt Bharat screening camp in Delhi,[7] but higher than the 37.3% reported among tribal residential students in Odisha.[12] It was close to the 42.75% prevalence observed among adolescent girls in rural western India,[13] and the 47.4% reported from Dharwad district.[14] Differences between studies reflect variations in sampling, age structure, haemoglobin measurement, dietary context, socioeconomic conditions, and programme coverage.

Low intake of iron-rich foods and frequent meal skipping showed strong associations with anaemia. These findings support the biological link between inadequate nutrient supply and reduced haemoglobin synthesis. Hospital-based evaluation of anaemic adolescents has shown that iron, folate, and vitamin B12 deficiencies can coexist and that low dietary intake contributes to the severity of anaemia.8 Meal skipping can further reduce total energy and micronutrient consumption, particularly when replacement foods are nutrient-poor snacks. The absence of a statistically significant association with vegetarian dietary pattern suggests that diet quality, meal frequency, and the inclusion of iron-enhancing foods are more informative than a simple vegetarian or mixed classification.

Underweight girls had a markedly higher prevalence of anaemia. Similar associations between nutritional status and anaemia have been documented in adolescent populations, although the magnitude is inconsistent across settings.[9] Underweight status can represent prolonged dietary inadequacy, repeated infection, or household food insecurity. The significant association with lower socioeconomic category also agrees with national

evidence showing that anaemia is socially patterned.[2] Limited household resources affect dietary diversity, access to healthcare, sanitation, and adherence to supplementation. These findings support targeted screening rather than relying solely on universal distribution of iron-folic acid tablets.

Heavy menstrual bleeding was another important factor, with three-quarters of affected girls being anaemic. A community-based study in rural Haryana also documented a high burden of anaemia among postmenarchal girls and emphasised menstrual and family-level determinants.[10] Menstrual duration alone was not significantly associated with anaemia in the present study, indicating that perceived volume and intensity of blood loss can be more relevant than duration. Screening questions on pad frequency, clots, flooding, dizziness, and school absence should therefore accompany haemoglobin testing. Girls with heavy bleeding require clinical assessment for iron deficiency and underlying menstrual disorders.

A history suggestive of worm infestation was associated with anaemia, although the exposed subgroup was small and the finding requires cautious interpretation. Deworming, sanitation, footwear use, and hygiene education remain relevant components of adolescent health services. Knowledge deficits can also reduce timely recognition and treatment; adolescent girls in western Rajasthan demonstrated a high anaemia burden together with limited awareness of its causes and prevention.[11] Integrated urban strategies should combine periodic haemoglobin screening, supervised iron-folic acid supplementation, diet counselling, deworming, menstrual health assessment, and referral. Such an approach addresses the interacting nutritional, infectious, socioeconomic, and reproductive contributors identified in this study.

Limitations

The cross-sectional design prevents determination of temporal or causal relationships between the associated factors and anaemia. Dietary intake, meal skipping, worm infestation, and menstrual blood loss were based on participant reports and were therefore subject to recall and reporting bias. Ferritin, vitamin B12, folate, inflammatory markers, stool examination, and red-cell indices were not measured. The single urban field-practice setting and modest sample restrict wider generalisation.

CONCLUSION

Anaemia was identified in 46.0% of adolescent girls in the urban study population, with mild anaemia being the predominant form. Low intake of iron-rich foods, frequent meal skipping, underweight status, lower socioeconomic position, suspected worm infestation, and heavy menstrual bleeding were significant associated factors. These findings support regular community-based haemoglobin screening linked with nutrition counselling, supervised iron-folic acid supplementation, periodic deworming, and menstrual health assessment. Underweight girls and those reporting heavy menstrual bleeding require particular attention. Strengthening adolescent-friendly services through the urban field practice system can enable early detection, appropriate referral, treatment adherence, and prevention of anaemia before pregnancy and adulthood within routine adolescent health and school outreach programmes.

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