

Nutritional Status and Prevalence of Anemia among Adolescent Girls Attending the Outpatient Department of a Tertiary Care Hospital in Northern Bihar: A Hospital-Based Cross-Sectional Study

Tanisha Choudhary¹, Hem Kant Jha²

¹Tutor, Department of Community Medicine, Government Medical College and Hospital, Purnea, Bihar, India

²Professor, Department of Community Medicine, Madhubani Medical College and Hospital, Madhubani, Bihar, India

Received: 01-06-2026 / Revised: 15-07-2026 / Accepted: 21-08-2026

Corresponding author: Dr. Tanisha Choudhary

Conflict of interest: Nil

Abstract

Background: Adolescence is a critical period of rapid physical growth and increased nutritional requirements. Adolescent girls are particularly vulnerable to anemia because of increased iron requirements, menstrual blood loss, inadequate dietary intake and poor adherence to iron-folic acid supplementation. In Bihar, anemia among adolescent girls continues to represent an important public health concern.

Objective: To assess the nutritional status and determine the prevalence and severity of anemia among adolescent girls attending the outpatient department of a tertiary care hospital in northern Bihar.

Methods: A hospital-based cross-sectional study was conducted among 500 adolescent girls aged 10–19 years attending the outpatient department of a tertiary care hospital in northern Bihar from September 2022 to February 2023. Sociodemographic information, dietary history, menstrual characteristics and iron-folic acid supplementation were recorded. Anthropometric measurements including height and weight were obtained, and body mass index (BMI) was calculated. Hemoglobin concentration was measured using a standardized method. Anemia was classified according to WHO criteria. Data were analysed using SPSS version 26.0. Categorical variables were expressed as frequency and percentage, and associations were assessed using the chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Results: Among 500 adolescent girls, 276 (55.2%) were anemic. Mild, moderate and severe anemia were observed in 161 (32.2%), 101 (20.2%) and 14 (2.8%), respectively. Underweight was present in 126 (25.2%), normal nutritional status in 299 (59.8%), overweight in 53 (10.6%) and obesity in 22 (4.4%). Anemia was significantly associated with older age, underweight status, inadequate dietary iron intake, heavy menstrual bleeding and poor adherence to iron-folic acid supplementation (p<0.05).

Conclusion: Anemia and nutritional abnormalities were common among adolescent girls attending the tertiary-care hospital. The findings emphasize the importance of routine nutritional assessment, hemoglobin screening, dietary counselling and strengthening of iron-folic acid supplementation among adolescent girls.

Keywords: Adolescent girls; anemia; nutritional status; hemoglobin; BMI; iron deficiency; Bihar; adolescent nutrition.

DOI: 10.25258/ijcpr.18.9.187

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Introduction

Adolescence, defined as the period between 10 and 19 years, is characterized by rapid physical growth, hormonal changes and substantial increases in nutritional requirements. Adequate nutrition during this period is essential for achieving optimal growth, maintaining reproductive health and preventing nutrition-related disorders in adulthood. Adolescent girls face heightened vulnerability to anemia due to accelerated growth patterns, elevated iron demands, and menstrual blood loss. Additional

risk factors include inadequate dietary intake, food insecurity, infectious diseases, parasitic infections, and insufficient adherence to iron-folic acid supplementation regimens. The World Health Organization recognizes menstruating adolescent girls and women as significant population groups affected by anemia, with particularly elevated burden observed in low- and middle-income countries. Anemia constitutes a substantial public health concern throughout India. The National

Family Health Survey-5 documented anemia prevalence of 59.1% among girls aged 15–19 years at the national level, with Bihar demonstrating even higher prevalence rates [1,2]. National research has revealed considerable geographic variation and disproportionately higher prevalence among adolescent girls compared to boys. A comprehensive systematic review identified a pooled anemia prevalence of approximately 65% among Indian adolescent girls, with the most significant burden concentrated in eastern India. Adolescent anemia can negatively impact physical development, intellectual functioning, educational engagement, work productivity, and subsequent maternal health outcomes. Although nutritional status demonstrates close association with anemia, the condition can manifest across the entire body mass index spectrum. Insufficient dietary diversity and inadequate consumption of iron-rich foods may coincide with malnutrition, whereas overweight and obesity may also emerge in populations experiencing nutritional transition [3].

The Government of India has established the Anemia Mukht Bharat initiative, incorporating iron-folic acid supplementation, deworming interventions, anemia screening, clinical treatment, and behavior-change communication strategies. The adolescent-focused component encompasses weekly iron-folic acid supplementation and periodic deworming protocols. Notwithstanding these efforts, persistent anemia prevalence underscores the necessity for sustained screening activities and identification of context-specific risk factors. Recent evidence from Bihar is particularly relevant. A tertiary-care study conducted in Bihar reported hospital anemia prevalence of 47.9% among adolescent girls and highlighted the importance of early screening for iron deficiency [4]. However, local hospital-based information on the relationship between nutritional status, dietary factors, menstrual characteristics and anemia remains limited in northern Bihar. Therefore, the present study was undertaken to assess nutritional status and determine the prevalence and severity of anemia among adolescent girls attending the outpatient department of a tertiary care hospital in northern Bihar during 2023 [5].

Objectives

1. To determine the prevalence and severity of anemia among adolescent girls.
2. To assess their nutritional status using BMI.
3. To evaluate the association between nutritional status and anemia.
4. To identify selected dietary, menstrual and supplementation-related factors associated with anemia.

Materials and Methods

Study design and setting: The study was conducted in the urban field practice area of Darbhanga Medical College, Laheriasarai, Darbhanga, and Bihar.

Study period: The study was conducted from September 2022 to February 2023.

Study population: The study included adolescent girls aged 10–19 years attending the outpatient department during the study period.

Sample size: A total of 500 adolescent girls were included.

Sampling technique: Eligible participants attending the OPD were recruited using a systematic/consecutive sampling approach until the required sample size was achieved.

Inclusion criteria

- Adolescent girls aged 10–19 years.
- Participants attending the OPD during the study period.
- Girls willing to participate.
- Participants whose parent/guardian provided consent where applicable and who provided assent according to institutional requirements.

Exclusion criteria

- Girls with known hematological disorders.
- Those receiving treatment for chronic systemic disease likely to affect hemoglobin.
- Participants with acute severe illness requiring emergency management.
- Those unwilling to participate.

Data collection: A pretested structured questionnaire was used to collect information regarding:

- Age and residence.
- Socioeconomic characteristics.
- Dietary pattern.
- Consumption of iron-rich foods.
- Fruit and vegetable intake.
- Menstrual characteristics.
- Duration and amount of menstrual bleeding.
- History of worm infestation.
- Iron-folic acid supplementation.
- History of chronic illness.

Anthropometric assessment: Height was measured using a standardized stadiometer and weight using a calibrated weighing scale. BMI was calculated as:

$$\text{BMI} = \text{Weight (kg)} / \text{Height}^2 (\text{m}^2)$$

Nutritional status was categorized according to age-appropriate BMI criteria for adolescents.

Hemoglobin assessment: Venous/capillary blood was collected using standard aseptic precautions and hemoglobin was estimated using a standardized

hematological method. Anemia was classified according to age-appropriate WHO criteria. The 2024 WHO guideline provides updated recommendations for the use of hemoglobin concentrations to define anemia.

Statistical analysis: Data were entered into Microsoft Excel and analysed using SPSS version

26.0. Continuous variables were presented as mean $\pm$ SD and categorical variables as frequency and percentage. Associations between categorical variables were assessed using the chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Results

Table 1: Sociodemographic characteristics of study participants (n=500)

Variable	Category	n	%
Age	10–12 years	126	25.2
	13–15 years	182	36.4
	16–19 years	192	38.4
Residence	Urban	312	62.4
	Rural	188	37.6
Religion	Hindu	446	89.2
	Muslim	48	9.6
	Other	6	1.2
Socioeconomic status	Lower	154	30.8
	Lower-middle	198	39.6
	Upper-middle	108	21.6
	Upper	40	8.0

The majority of participants were aged 16–19 years (38.4%), followed by 13–15 years (36.4%).

Table 2: Nutritional status of adolescent girls according to BMI (n=500)

Nutritional status	n	%
Underweight	126	25.2
Normal nutritional status	299	59.8
Overweight	53	10.6
Obesity	22	4.4
Total	500	100.0

Overall, 126 (25.2%) participants were underweight, while 75 (15.0%) were overweight or obese.

Table 3. Prevalence and severity of anemia among study participants (n=500)

Hemoglobin status	n	%
Non-anemic	224	44.8
Mild anemia	161	32.2
Moderate anemia	101	20.2
Severe anemia	14	2.8
Any anemia	276	55.2

The overall prevalence of anemia was 55.2%. Mild anemia constituted the largest proportion of anemia cases, followed by moderate anemia.

Table 4: Association between nutritional status and anemia (n=500)

Nutritional status	Anemic n (%)	Non-anemic n (%)	Total	p-value
Underweight	84 (66.7)	42 (33.3)	126	
Normal	153 (51.2)	146 (48.8)	299	
Overweight	28 (52.8)	25 (47.2)	53	
Obese	11 (50.0)	11 (50.0)	22	0.018

There was a statistically significant association between nutritional status and anemia, with the highest prevalence among underweight participants (66.7%).

Table 5: Selected dietary, menstrual and supplementation factors associated with anemia

Risk factor	Anemic n (%)	Non-anemic n (%)	p-value
Inadequate intake of iron-rich foods	153 (65.7)	80 (34.3)	<0.001
Adequate intake of iron-rich foods	123 (45.9)	145 (54.1)	
Heavy menstrual bleeding	92 (67.6)	44 (32.4)	<0.001
Normal menstrual bleeding	184 (50.6)	180 (49.4)	
Irregular/no IFA supplementation	178 (64.0)	100 (36.0)	<0.001
Regular IFA supplementation	98 (44.1)	124 (55.9)	
History of frequent worm infestation	66 (67.3)	32 (32.7)	0.006
No history of frequent worm infestation	210 (52.3)	192 (47.7)	

Inadequate intake of iron-rich foods, heavy menstrual bleeding, poor adherence to iron-folic acid supplementation and a history of frequent worm infestation were significantly associated with anemia.

Overall findings: Of the 500 adolescent girls evaluated, 276 (55.2%) were anemic. The prevalence was higher among older adolescents and those who were underweight. Dietary inadequacy and menstrual blood loss were important correlates of anemia. Regular iron-folic acid supplementation was associated with a lower proportion of anemia.

Discussion

The present study found that 55.2% of adolescent girls were anemic, indicating a substantial burden of anemia among girls attending the tertiary-care OPD in northern Bihar. This finding is consistent with the continuing high burden of adolescent anemia documented nationally. NFHS-5 reported anemia among 59.1% of Indian girls aged 15–19 years, while Bihar has been reported to have a particularly high burden [6]. Contemporary national investigations have revealed that anemia prevalence among adolescents exhibits considerable variation according to age, sex, and geographic location. Female adolescents have consistently demonstrated elevated prevalence rates compared to their male counterparts, with older adolescent females facing heightened vulnerability due to menstrual blood loss and escalating nutritional demands. A recent systematic review focused on Indian adolescent females calculated pooled anemia prevalence at approximately 65%, with the most significant regional burden identified in eastern India. The prevalence documented in the current study therefore aligns with the range established by recent Indian research [7,8].

The current study identified a noteworthy correlation between nutritional status and anemia. Anemia occurred most frequently among underweight participants (66.7%), indicating that insufficient overall nutritional consumption may coincide with inadequate iron consumption. Nevertheless, anemia was also documented among participants with normal or elevated BMI. This underscores that BMI alone cannot serve as a reliable indicator for identifying iron deficiency or

anemia, as micronutrient deficiencies may manifest even in individuals with seemingly adequate or excessive body weight [9]. Dietary components demonstrated significant association with anemia. Adolescent girls reporting insufficient consumption of iron-rich foods exhibited substantially elevated anemia prevalence. The adolescent period is characterized by heightened iron requirements, and dietary patterns centered on cereals with minimal consumption of iron-rich animal or plant-based foods may fail to satisfy these requirements adequately. Comparable systematic reviews have similarly identified limited dietary variety, reduced socioeconomic status, and insufficient micronutrient supplementation as critical factors influencing nutritional anemia [10].

Heavy menstrual bleeding was another significant factor. Menstrual blood loss increases iron requirements and may contribute to depletion of iron stores, particularly when dietary replacement is inadequate. The association observed in this study supports the need to include menstrual history in routine adolescent anemia screening. Consistent administration of iron-folic acid supplements demonstrated a correlation with diminished prevalence of anemia. This observation validates India's comprehensive adolescent anemia-mitigation framework, which integrates iron-folic acid supplementation, parasitic infection treatment, hemoglobin assessment, and educational communication initiatives aimed at behavioral modification [11,12].

Contemporary research conducted in Bihar has further underscored the significance of timely detection of iron insufficiency and targeted nutritional interventions specifically for adolescent females.

The investigation highlights that adolescent anemia represents a multifaceted health condition. Optimal therapeutic outcomes necessitate the coordinated implementation of hemoglobin assessment alongside nutritional evaluation, dietary guidance, menstrual health support services, parasitic infection management, and compliance facilitation for iron-folic acid supplementation [13].

Conclusion:

Anemia was highly prevalent among adolescent girls attending the outpatient department of a tertiary care hospital in northern Bihar, with more than half of the participants affected.

Insufficient body weight, inadequate dietary intake of iron-containing foods, excessive menstrual blood loss, recurrent parasitic infections, and inconsistent adherence to iron-folic acid supplementation demonstrated statistically significant associations with anemia. The majority of documented cases presented with mild to moderate severity of anemia. These results underscore the importance of implementing systematic hemoglobin screening protocols and conducting comprehensive nutritional evaluations as integral components of adolescent healthcare services.

Strengthening iron-folic acid supplementation, dietary counselling, menstrual-health education, deworming and early treatment of anemia should be prioritized to improve the health and nutritional well-being of adolescent girls.

Recommendations

- Routine hemoglobin screening should be incorporated into adolescent OPD services.
- Nutritional assessment should include both BMI and dietary evaluation.
- Adolescent girls should receive counselling regarding iron-rich foods and dietary diversity.
- Adherence to weekly iron-folic acid supplementation should be actively monitored.
- Menstrual history, including heavy menstrual bleeding, should be routinely assessed.
- Deworming and treatment of identified infections should be strengthened.
- Parents and adolescents should receive education regarding anemia prevention.
- Girls with moderate or severe anemia should undergo appropriate clinical evaluation to determine the underlying cause.

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