Section: Physiology

Original Research Article

BURDEN OF ANAEMIA AND GENDER DISPARITIES AMONG SCHOOL-GOING CHILDREN (10–14 YEARS) ATTENDING A COMMUNITY HEALTH CENTRE IN WESTERN INDIA: A RETROSPECTIVE STUDY

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Received *: 28/11/2025*
Received in revised form *: 10/01/2026*
Accepted *: 30/01/2026*

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DOI:10.70034/ijmedph.2026.1.206

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (1); 1171-1176

ABSTRACT

Background: Anaemia remains a major public health concern among school-going children in India, with important implications for growth, cognitive development, and future health outcomes. Facility-based evidence on gender-specific patterns in early adolescence is limited. The present study evaluates the burden of anaemia and gender disparities among children aged 10–14 years attending a Community Health Centre in Western India.

Materials and Methods: This retrospective record-based observational study included 173 school-going children who attended outpatient services between July and October 2025. Haemoglobin values were extracted from medical records and classified according to World Health Organization criteria. Age-wise haemoglobin levels were analysed using descriptive statistics, and gender differences were assessed using the chi-square test.

Results: Females constituted 62.4% of participants and males 37.6%. The overall prevalence of anaemia was 41.0%. Anaemia was more frequent among females (46.3%) than males (32.3%), with a statistically significant association between gender and anaemia status ($\chi^2 = 4.12$, $p = 0.04$). Mean haemoglobin levels demonstrated a gradual increase with age, from 11.78 g/dL at 10 years to 12.56 g/dL at 14 years.

Conclusion: The findings indicate that anaemia remains highly prevalent in early adolescence, with a disproportionately higher burden among female children. Strengthening routine haemoglobin screening, nutritional counselling, and gender-sensitive iron supplementation strategies at community and school levels is essential to address this persistent public health problem.

Keywords: Anaemia; School-going children; Community health centre; Gender disparities; Public health; Retrospective study.

INTRODUCTION

Anaemia remains one of the most widespread public health problems globally,[1,2] particularly affecting children and adolescents in low- and middle-income countries.[3,4] The World Health Organization (WHO),[5] defines anaemia as a condition in which the haemoglobin concentration in the blood is lower than normal for age, sex, and physiological status, resulting in reduced oxygen-carrying capacity of the blood. According to WHO criteria,[5,6] anaemia in children aged 10–14 years is defined as a haemoglobin concentration of less than 12 g/dL, with further classification into mild, moderate, and severe forms based on haemoglobin levels.

Globally1,2, anaemia affects an estimated 1.9 billion people, with school-aged children and adolescents constituting a substantial proportion of this burden. The condition is associated with impaired cognitive development, reduced physical capacity, poor academic performance, and increased susceptibility to infections. During early adolescence,[7,8] rapid

growth, increased nutritional requirements, and the onset of puberty contribute to heightened vulnerability to anaemia. Gender disparities often emerge in this age group, with adolescent girls being disproportionately affected due to menstrual blood loss, dietary inadequacies, and sociocultural factors influencing nutrition and healthcare access.[9]

India carries a disproportionate share of the global anaemia burden.[10] National data from the National Family Health Survey (NFHS-5, 2019–21),[11] indicate that anaemia remains highly prevalent among children and adolescents,[12,13] with a significantly higher prevalence among girls compared to boys. Despite decades of public health interventions, iron deficiency,[7,14,15] continues to be the leading cause of anaemia in India, compounded by factors,[16] such as poor dietary iron intake, parasitic infestations, infections, and limited bioavailability of iron from predominantly plant-based diets. The persistence of anaemia reflects underlying socioeconomic inequalities and gaps in preventive and promotive healthcare services.

In recognition of the magnitude of the problem, the Government of India has implemented several national programs,[17,18] targeting iron deficiency anaemia. The National Iron Plus Initiative (NIPI),[19] provides age- and gender-specific iron and folic acid supplementation across the life cycle, including school-going children and adolescents. More recently, the Anaemia Mukt Bharat (AMB),[20] strategy, launched under the National Health Mission, aims to reduce anaemia prevalence through a comprehensive 6×6×6 approach encompassing prophylactic supplementation, deworming, behaviour change communication, testing and treatment, and addressing non-nutritional causes of anaemia. Schools and community health centres play a crucial role in the delivery of these interventions and in early identification of at-risk children.

Despite these initiatives, facility-based data on anaemia prevalence and gender-wise distribution among school-going children remain limited, particularly in urban and semi-urban settings.[21-24] Understanding local patterns of anaemia is essential for tailoring gender-sensitive screening and intervention strategies. Therefore, the present study was undertaken to assess the burden of anaemia and gender disparities among school-going children aged 10–14 years attending a community health centre in Western India using retrospective health records.

Aim: To assess the burden of anaemia and gender disparities among school-going children aged 10–14 years attending a community health centre in Western India.

Objectives

1. To estimate the prevalence of anaemia among school-going children aged 10–14 years using the WHO haemoglobin criteria attending the community health centre.
2. To analyse mean haemoglobin levels across different age groups (10–14 years).
3. To compare anaemia prevalence between male and female children attending the community health centre.
4. To generate facility-based evidence that may support gender-sensitive screening and anaemia control strategies under national programs.

MATERIALS AND METHODS

Study Design: This study was a retrospective record-based observational study.

Study Setting: The study was conducted at a Community Health Centre (CHC) in Ahmedabad, Gujarat, India, which provides outpatient healthcare services to the surrounding population, including school-going children.

Study Period: Medical records from 15 July 2025 to 18 October 2025 were reviewed for this study.

Study Population: The study population comprised school-going children aged 10–14 years who attended the outpatient department of the selected Community Health Centre during the study period.

Inclusion Criteria

- School-going children aged 10–14 years
- Children who attended the outpatient department of the Community Health Centre during the study period
- Medical records with documented haemoglobin values
- Records containing complete information on age and gender

Exclusion Criteria

- Children below 10 years or above 14 years of age
- Non–school–going children
- Records with missing or incomplete haemoglobin data
- Records lacking age or gender details
- Children with documented chronic illnesses or known haematological disorders (e.g., thalassemia, sickle cell disease), as mentioned in records
- Records of children who were acutely ill, hospitalized, or receiving blood transfusions at the time of haemoglobin estimation, if documented

Data Collection: Data was collected retrospectively from outpatient medical records using a structured data extraction format. The variables extracted included age, gender, and haemoglobin concentration. All data were anonymized to ensure confidentiality.

Outcome Measure: Anaemia was defined according to World Health Organization (WHO) criteria5 as a haemoglobin concentration of less than 12 g/dL for children aged 10–14 years. Based on haemoglobin levels, children were categorized as anaemic or non-anaemic.

Statistical Analysis: Data was entered into Microsoft Excel and analysed using appropriate statistical software. Descriptive statistics were used to summarize the data. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Gender-wise and age-wise distributions of haemoglobin levels and anaemia prevalence were analysed.

Ethical Considerations: As study was conducted as a retrospective, record-based analysis of routinely collected outpatient data from a Community Health Centre, individual informed consent was not required. Institutional permission was obtained before data collection, and confidentiality of patient information was strictly maintained. All data were anonymized prior to extraction and analysis, and no personally identifiable information was accessed. As the study involved secondary analysis of de-identified records with no direct patient contact or intervention, formal approval from an Institutional Ethics Committee was not required, in accordance with institutional policy and national ethical guidelines. Administrative permission to access medical records was obtained from the CHC authorities. The study was conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS

A total of 173 children were included. Overall, anaemia prevalence was 41.0%.

Table 1: Demographic characteristics of study participants

Gender	n (%)
Female	108 (62.4)
Male	65 (37.6)

Table 2: Age-wise distribution of hemoglobin levels

Age (years)	Number of children	Mean Hemoglobin (g/dL)
10	34	11.78
11	36	12.31
12	32	12.05
13	38	12.18
14	33	12.56

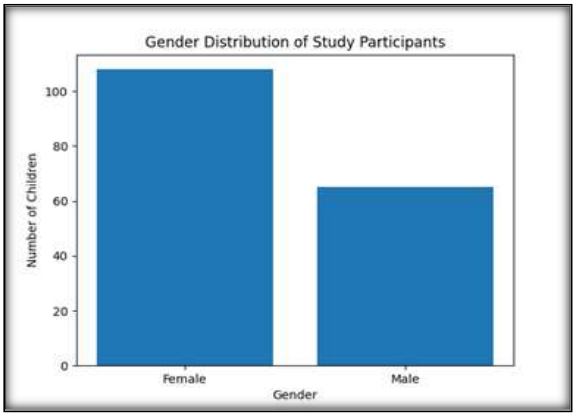

Figure 1: Gender Distribution of Study Participants

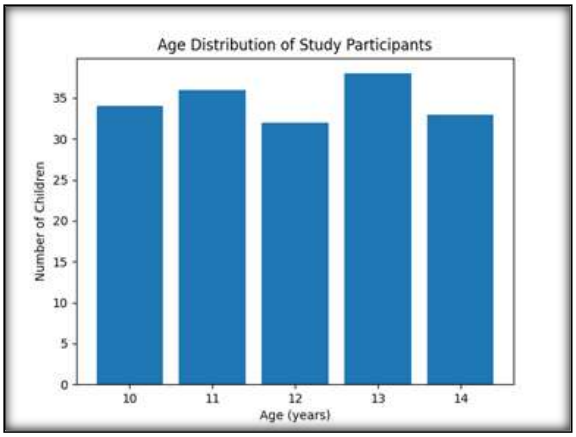

Figure 2: Age distribution of study participants

Table 2.0 demonstrates the age-wise haemoglobin levels. Results show the prevalence of mild anaemia among children aged 10 years, while adolescents above 11 years have borderline haemoglobin levels.

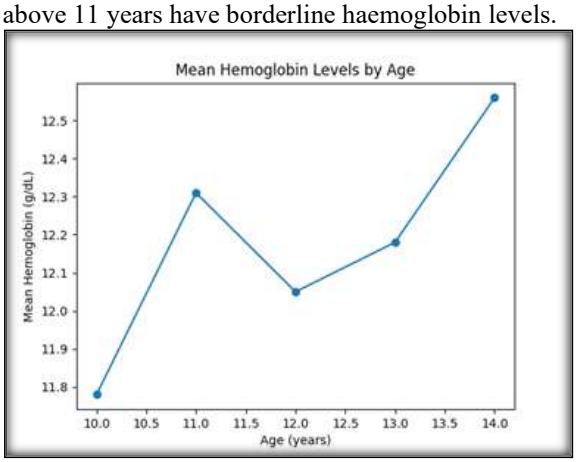

Figure 3: Mean Hemoglobin Levels by Age

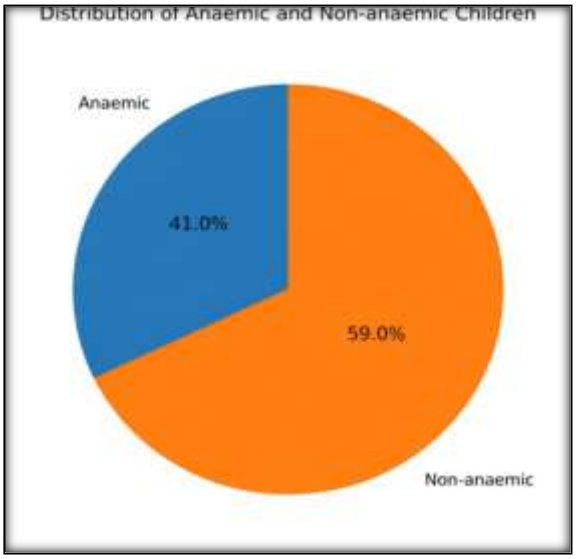

Figure 4: prevalence of anaemia and non-anaemia in the study population

Table 3: Gender wise prevalence of Anaemia

Gender	Non-anaemic (n)	Anaemic (n)	Total (n)	Prevalence of Anaemia (%)
Female	58	50	108	46.3
Male	44	21	65	32.3

Table 4. Gender-wise prevalence of anemia and Chi-square test

Gender	Anaemic n (%)	Non-anaemic n (%)	Total (n)
Female	50 (46.3)	58 (53.7)	108
Male	21 (32.3)	44 (67.7)	65
Total	71 (41.0)	102 (59.0)	173

Chi-square test (χ^2) = 4.12
Degrees of freedom (df) = 1
p-value = 0.04

A total of 173 school-going children aged 10–14 years were included in the present study. The overall prevalence of anaemia was 41.0% in the study population.

Demographic Characteristics: Of the total participants, 108 (62.4%) were females, and 65 (37.6%) were males, as shown in Table 1 and Figure 1, indicating a higher representation of female children in the study population.

Age-wise Distribution and Haemoglobin Levels

The age-wise distribution of participants and their corresponding mean haemoglobin levels are presented in [Table 2, Figure 2 and 3]. The highest number of participants were aged 13 years (n = 38), followed by 11 years (n = 36). The mean haemoglobin levels increased progressively with age, from 11.78 g/dL at 10 years to 12.56 g/dL at 14 years.

Children aged 10 years exhibited mean haemoglobin levels in the mild anaemic range, whereas children aged 11 years and above demonstrated borderline haemoglobin values, suggesting gradual improvement in haemoglobin status with increasing age.

Prevalence of Anaemia: The prevalence of anaemia and non-anaemia in the study population is depicted in Figure 4. Gender-wise prevalence of anaemia is detailed in Table 3. Among female participants, 50 out of 108 (46.3%) were anaemic, whereas among males, 21 out of 65 (32.3%) were anaemic, indicating a higher burden of anaemia among females.

Association Between Gender and Anaemia

[Table 4] presents the gender-wise distribution of anaemia along with the Chi-square test. A statistically significant association was observed between gender and anaemia status (χ^2 = 4.12, df = 1, p = 0.04), suggesting that female children were significantly more likely to be anaemic compared to male children.

DISCUSSION

The present study assessed the burden of anaemia and its association with age and gender among school-going children16 aged 10–14 years attending a community health centre in Western India. The overall prevalence of anaemia was 41.0%, indicating that anaemia remains a significant public health concern in early adolescence.[10-13]

Age-wise analysis,[12,13] demonstrated that children aged 10 years had mean haemoglobin levels in the mild anaemic range, whereas children aged 11 years and above exhibited haemoglobin values closer to

the WHO5 cut-off for anaemia. This trend suggests a gradual improvement in haemoglobin levels with increasing age, which may be attributed to physiological maturation, improved dietary intake, and increasing iron stores as children progress through adolescence. Nevertheless, haemoglobin values close to the diagnostic threshold indicate ongoing vulnerability, particularly during early adolescence when growth-related iron requirements are high.

A key finding of this study was the significantly higher prevalence of anaemia among female children,[9,21] compared to males. Nearly half of the female participants were anaemic, whereas approximately one-third of male participants were affected. The observed gender disparity is consistent with findings from national surveys and previous studies conducted in India. Adolescent girls are biologically more vulnerable to anaemia due to increased iron requirements during puberty and the onset of menstruation. In addition, dietary inadequacies, limited intake of iron-rich foods, and sociocultural factors influencing nutrition and healthcare access may further contribute to the higher anaemia burden among females.[8-23]

The statistically significant association between gender and anaemia status reinforces the need for gender-sensitive screening and intervention strategies18. Community health centres and school-based platforms25 provide valuable opportunities for early detection, counselling, iron–folic acid supplementation, and nutrition education, particularly for adolescent girls who are at increased risk.

The findings of this study also underscore the continued relevance of national initiatives such as the National Iron Plus Initiative1 and Anaemia Mukt Bharat.[9,20] However, the persistence of a substantial anaemia burden in this facility-based population suggests that challenges related to program coverage, adherence, early identification, and follow-up may remain at the community level.

This study has certain limitations. Being a single-centre, retrospective, record-based study, the findings may not be generalizable to the wider population. Additionally, data on dietary intake, socioeconomic status, pubertal status, parasitic infestations, and compliance with iron supplementation were not available, limiting the ability to explore causal factors. Despite these limitations, CHCs represent a critical point of care for underserved populations, and the data provide valuable insight into anemia burden at the primary healthcare level that complements large-scale survey data and highlights groups at increased risk of anaemia.

CONCLUSION

The present study demonstrates that anaemia remains highly prevalent among school-going children aged 10–14 years, with an overall prevalence of 41.0%. A significant gender disparity was observed, with female children being more frequently affected than males. Younger children, particularly those aged 10 years, exhibited lower mean haemoglobin levels, indicating increased vulnerability during early adolescence.

These findings emphasize the need for early, targeted, and gender-sensitive interventions, particularly focusing on adolescent girls. Strengthening routine haemoglobin screening, improving nutritional education, and ensuring effective implementation of iron supplementation programs at community health centres and schools may play a crucial role in reducing the burden of anaemia during this critical developmental period.

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