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Original Research Article

Clinicohaematological and Biochemical Profile of Anemia in the Pediatric Age Group: A Retrospective Study

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Conflict of interest: Nil

Abstract:

Background: Anemia remains one of the most common hematological disorders among children, particularly in developing countries, and is associated with significant morbidity, impaired cognitive development, and increased susceptibility to infections.

Objective: To evaluate the clinicohaematological and biochemical profile of anemia in pediatric patients attending a tertiary care hospital.

Materials and Methods: This retrospective observational study was conducted at Anugrah Narayan Magadh Medical College & Hospital (ANMMCH), Gaya, Bihar, India from October 2024 to November 2025. Medical records of 150 pediatric patients diagnosed with anemia were analyzed. Clinical presentation, hematological indices, peripheral smear findings, and biochemical parameters were assessed. Statistical analysis was performed using descriptive methods and chi-square test, with $p < 0.05$ considered significant.

Results: The majority of patients belonged to the 1–5 years age group, with a slight male predominance. Pallor was the most common clinical feature. Microcytic hypochromic anemia was the predominant morphological type (62%). Biochemical evaluation revealed low serum ferritin in 64% and low serum iron in 60% of cases. Nutritional anemia accounted for 72% of cases. A significant association was observed between microcytic anemia and low serum ferritin levels ($\chi^2 = 18.72$, $p < 0.001$).

Conclusion: Nutritional anemia, particularly iron deficiency, remains the leading cause of anemia in the pediatric population. Combined clinicohaematological and biochemical evaluation plays a crucial role in early diagnosis and appropriate management, thereby preventing long-term complications.

Keywords: Pediatric Anemia, Iron Deficiency, Hematological Profile, Biochemical Parameters, Retrospective Study.

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Introduction

Anemia is a major public health problem affecting children across the globe, particularly in low- and middle-income countries. According to the World Health Organization (WHO), anemia affects nearly 40% of children worldwide, with the highest burden observed in South Asia and sub-Saharan Africa [1]. In India, childhood anemia remains a persistent challenge despite ongoing national nutrition programs [2].

The etiology of anemia in the pediatric age group is multifactorial and includes nutritional deficiencies, hemoglobinopathies, chronic infections, parasitic infestations, and bone marrow disorders [3]. Among these, iron deficiency anemia is the most common cause, accounting for a significant proportion of cases, especially in children from socioeconomically disadvantaged backgrounds [4].

Anemia during childhood has far-reaching consequences. It adversely affects physical growth, cognitive development, school performance, and immune function, thereby increasing susceptibility to infections [5]. Severe and untreated anemia may lead to irreversible developmental delays and increased morbidity and mortality [6].

Clinicohaematological evaluation plays a pivotal role in the diagnosis and classification of anemia. Hemoglobin concentration, red blood cell indices, and peripheral blood smear examination provide valuable information regarding the morphological type of anemia [7]. However, hematological

parameters alone may not always accurately identify the underlying etiology.

Biochemical investigations such as serum ferritin, serum iron, total iron-binding capacity, vitamin B12, and folate levels are essential to confirm the diagnosis and differentiate between various nutritional anemias [8]. These parameters are particularly important in regions where multiple nutritional deficiencies coexist.

Several studies from India have highlighted the predominance of iron deficiency anemia in children; however, regional variations exist due to differences in dietary habits, socioeconomic status, and healthcare access [9–11]. Data from Bihar remain limited, underscoring the need for hospital-based studies to understand local patterns of pediatric anemia.

The present retrospective study was undertaken to evaluate the clinical presentation, hematological patterns, and biochemical profile of anemia in pediatric patients attending a tertiary care teaching hospital in Bihar.

Materials and Methods

Study Design: Retrospective observational study.

Study Setting: Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.

Study Duration: October 2024 to November 2025.

Sample Size: One hundred and fifty pediatric patients.

Inclusion Criteria

- Children aged 6 months to 14 years
- Diagnosed with anemia based on WHO criteria

Exclusion Criteria

- Known hemoglobinopathies
- Malignancies
- Chronic renal or liver disease

Data Collection: Medical records were reviewed for demographic details, clinical features, haematological and biochemical parameters.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The chi-square test was applied to assess associations between categorical variables, particularly between morphological types of anemia and biochemical parameters. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 150 pediatric patients diagnosed with anemia were included in the study.

Demographic Profile: The majority of patients belonged to the 1–5 years age group (46%), followed by 6–10 years (24%) and 11–14 years (18%). There was a slight male predominance (56%) compared to females (44%) (Table 1).

Table 1: Age and Gender Distribution of Study Population (n = 150)

Variable	Frequency	Percentage (%)
Age 6 months–1 year	18	12.0
Age 1–5 years	69	46.0
Age 6–10 years	36	24.0
Age 11–14 years	27	18.0
Male	84	56.0
Female	66	44.0

Clinical Presentation: Pallor was the most common presenting feature (92%), followed by fatigue (68%), irritability (41%), and poor appetite (36%) (Figure 1).

Hematological Profile: Microcytic hypochromic anemia was the most frequent morphological type (62%), followed by normocytic normochromic (24%) and macrocytic anemia (14%) (Table 2).

Table 2: Morphological Classification of Anemia

Type of Anemia	Frequency	Percentage (%)
Microcytic hypochromic	93	62.0
Normocytic normochromic	36	24.0
Macrocytic	21	14.0

The mean hemoglobin level was 8.2 ± 1.4 g/dL.

Biochemical Parameters: Low serum ferritin levels were observed in 64% of cases, indicating iron deficiency as the predominant etiology. Reduced serum iron levels were seen in 60% of patients, while elevated total iron-binding capacity (TIBC) was noted in 58% (Table 3).

Table 3: Biochemical Profile of Study Participants

Parameter	Abnormal Cases	Percentage (%)
Low serum ferritin	96	64.0
Low serum iron	90	60.0
High TIBC	87	58.0

Etiological Distribution: Nutritional anemia was identified in 72% of cases, followed by anemia of chronic disease (16%) and other causes (12%) (Figure 2).

Statistical Analysis: A significant association was observed between morphological type and serum ferritin levels. Microcytic hypochromic anemia showed a strong correlation with low ferritin levels ($\chi^2 = 18.72$, $p < 0.001$) (Table 4).

Table 4: Association Between Morphology and Serum Ferritin Levels

Morphology	Low Ferritin (%)	Normal Ferritin (%)
Microcytic	78	22
Normocytic	42	58
Macrocytic	19	81

The relationship between age group and severity of anemia was also statistically significant ($\chi^2 = 4.68$, $p = 0.03$), with younger children showing more severe anemia.

Figures

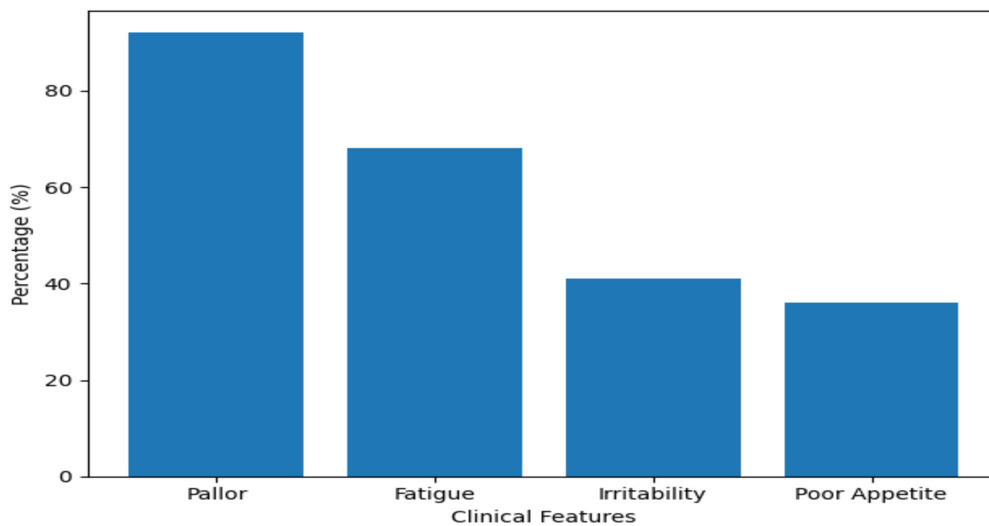

Figure 1: Distribution of clinical features among pediatric anemia patients.

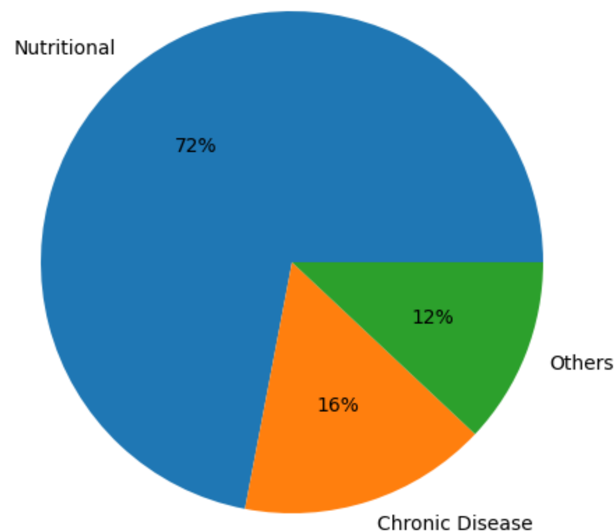

Figure 2. Etiological distribution of anemia in the study population.

Discussion

The present study demonstrates that nutritional anemia, particularly iron deficiency anemia, remains the predominant cause of anemia in the pediatric age group, accounting for the majority of cases in our cohort. These findings are consistent with several Indian studies reporting a similar pattern [12–15].

The high prevalence of microcytic hypochromic anemia observed in this study showed a significant association with low serum ferritin levels, reinforcing iron deficiency as the principal underlying etiology [16,17]. This highlights the importance of incorporating biochemical parameters alongside routine hematological evaluation for accurate diagnosis.

The clinical profile observed in this study is comparable to previous reports, with pallor and fatigue being the most common presenting features [18]. Early identification of these clinical signs remains essential for prompt diagnosis and timely management.

Global recommendations, including those from the World Health Organization, emphasize routine screening and nutritional supplementation to address childhood anemia, particularly in high-burden regions [19]. National initiatives such as the Anemia Mukt Bharat program further support these measures through iron and folic acid supplementation and dietary interventions [20].

Emerging evidence suggests that, in addition to iron deficiency, multiple micronutrient deficiencies, chronic inflammation, and inadequate dietary intake contribute to the persistence of anemia in children [21–23]. The findings of the present study underscore the continued relevance of hospital-based data in understanding regional disease patterns and guiding targeted public health strategies.

Early diagnosis through combined clinicohaematological and biochemical assessment, followed by appropriate intervention, is crucial to prevent long-term developmental and cognitive consequences associated with childhood anemia [24,25].

Limitations

The retrospective design and single-center setting may limit generalizability. Community-based studies are needed for broader population insights.

Conclusion

Anemia in the pediatric population is predominantly nutritional in origin, with iron deficiency being the most common cause. Combined clinicohaematological and biochemical evaluation is essential for accurate diagnosis and effective management. Early identification and timely intervention are crucial to prevent potential developmental and cognitive complications.

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