Section: Pediatric

Original Research Article

STUDY ON INCIDENCE AND CLINICAL PROFILE OF ANEMIA IN CHILDREN AGED 1 YEARS TO 14 YEARS ATTENDING TERTIARY CARE HOSPITAL

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Received *: 09/01/2025*
Received in revised form *: 05/03/2025*
Accepted *: 21/03/2025*

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DOI: 10.70034/ijmedph.2025.1.309

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

Int J Med Pub Health
2025; 15 (1); 1650-1655

ABSTRACT

Background: Anemia is a prevalent condition among children, particularly in developing countries, where it poses significant challenges to health and development. Understanding its incidence and clinical characteristics in different age groups is crucial for targeted interventions. **Objective:** This study aimed to evaluate the incidence and clinical profile of anemia in children aged 1 to 14 years attending a tertiary care hospital, focusing on the severity, types, and associated factors.

Materials and Methods: A prospective observational study was conducted over six months, including 120 children diagnosed with anemia based on hemoglobin levels (<11 g/dL) using WHO criteria. Demographic details, clinical symptoms, and laboratory investigations, including complete blood count (CBC), peripheral smear, and iron studies, were recorded. Data were analyzed to assess the distribution of anemia severity, etiology, and associated clinical features.

Results: The incidence of anemia in children attending the hospital was 38%. Among the 120 children included, mild anemia was observed in 40%, moderate anemia in 45%, and severe anemia in 15%. Microcytic hypochromic anemia was the most common type (70%), followed by normocytic normochromic anemia (25%) and macrocytic anemia (5%). Nutritional deficiencies, particularly iron deficiency, were identified as the leading cause (80%), with infections and chronic diseases accounting for 15% and 5%, respectively. Clinical features included pallor (95%), fatigue (75%), and developmental delay (20%).

Conclusion: Anemia remains a significant health concern among children, with iron deficiency as the predominant cause. Early diagnosis and management are essential to reduce the burden of anemia and its complications.

Keywords: Anemia, Children, Iron Deficiency, Nutritional Anemia, Tertiary Care Hospital, Pediatric Anemia, Microcytic Hypochromic Anemia.

INTRODUCTION

Anemia is one of the most widespread public health challenges globally, affecting millions of children and disproportionately burdening developing countries. Defined by the World Health Organization (WHO) as a hemoglobin concentration below 11 g/dL for children aged 6 months to 14 years, anemia remains a significant cause of morbidity and developmental delays in pediatric populations.[1] Recent global estimates indicate that anemia affects 43% of children under five years of age, with prevalence exceeding 60% in regions such as South Asia and Sub-Saharan Africa. In India, anemia is a pressing concern, with over 50% of children affected despite decades of intervention programs, making it a priority for public health initiatives.[2]

The causes of anemia in children are multifactorial, with nutritional deficiencies, particularly iron deficiency, being the leading contributor. Iron deficiency anemia (IDA) accounts for nearly half of

all anemia cases worldwide and is primarily attributed to insufficient dietary iron intake, poor absorption, or chronic blood loss.[3] Other nutritional deficiencies, such as vitamin B12 and folate, contribute to macrocytic anemias, while hemoglobinopathies, including thalassemia and sickle cell disease, and chronic infections such as malaria and tuberculosis are significant contributors in specific regions. Socioeconomic factors, including poverty, food insecurity, and limited access to healthcare, further exacerbate the risk of anemia, particularly in low- and middle-income countries.[4]

The clinical manifestations of anemia in children vary based on its severity, duration, and underlying cause. Mild anemia often presents with non-specific symptoms such as pallor, fatigue, and poor appetite. In contrast, moderate to severe anemia can lead to developmental delays, growth retardation, irritability, and signs of cardiovascular strain such as tachycardia and heart murmurs. Chronic anemia may have long-term consequences, including impaired neurocognitive development, poor academic performance, and reduced physical stamina, which perpetuate cycles of poverty and poor health outcomes.[5]

Despite its high prevalence, anemia in children remains underdiagnosed and undertreated in many regions, particularly in resource-constrained settings. Challenges such as lack of awareness among caregivers, limited diagnostic facilities, and competing healthcare priorities contribute to delayed diagnosis and treatment. Addressing anemia requires a multifaceted approach that includes early detection, nutritional supplementation, treatment of underlying infections, and long-term prevention strategies, including community-level education and public health interventions.[6]

Previous studies on anemia have largely focused on global or national trends, often overlooking the local context and specific challenges faced by subpopulations. Regional studies, particularly in tertiary care settings, are essential to identify the incidence, severity, and clinical spectrum of anemia within a localized population. These findings can provide actionable insights to guide targeted interventions and healthcare policies.[7]

This study aims to evaluate the incidence and clinical profile of anemia in children aged 1 to 14 years attending a tertiary care hospital. By assessing the severity and types of anemia, identifying common etiologies, and documenting associated clinical features, this research seeks to address gaps in understanding the local burden of anemia. The findings are expected to contribute to the development of tailored strategies for the diagnosis, management, and prevention of anemia in children, ultimately improving health outcomes in this vulnerable population.

MATERIALS AND METHODS

This prospective observational study was conducted over six months at a tertiary care teaching hospital. Ethical approval was obtained from the institutional ethics committee, and informed consent was secured from the parents or guardians of all participating children. The study aimed to evaluate the incidence and clinical profile of anemia in children aged 1 to 14 years presenting to the outpatient department and inpatient wards.

Study Population

A total of 120 children aged 1 to 14 years diagnosed with anemia were included in the study. Anemia was defined according to the World Health Organization (WHO) criteria as hemoglobin levels below 11 g/dL. Children presenting with acute or chronic conditions known to influence hemoglobin levels, such as acute infections, malignancies, or hemoglobinopathies, were included. Those who had received blood transfusions within the past three months were excluded to ensure accurate baseline hematological assessment.

Data Collection

Demographic details such as age, gender, and socioeconomic status were recorded for each participant. Detailed clinical histories were obtained, focusing on presenting symptoms (e.g., pallor, fatigue, and irritability), dietary habits, and history of recurrent infections. A thorough physical examination was performed, emphasizing pallor, growth parameters, and systemic findings indicative of underlying causes of anemia.

Laboratory Investigations

Blood samples were collected for all participants, and the following investigations were conducted:

- **Complete Blood Count (CBC):** To determine hemoglobin levels, red blood cell indices (mean corpuscular volume, mean corpuscular hemoglobin), and total leukocyte and platelet counts.
- **Peripheral Blood Smear:** To identify morphological patterns of anemia, such as microcytic hypochromic, macrocytic, or normocytic normochromic anemia.
- **Iron Studies:** Serum ferritin, serum iron, total iron-binding capacity (TIBC), and transferrin saturation were assessed to evaluate iron deficiency.
- **Additional Tests:** Vitamin B12 and folate levels were measured for suspected macrocytic anemia, and reticulocyte counts were obtained for cases suggestive of hemolysis or marrow response.

Study Parameters

Participants were classified based on the severity of anemia into mild (10–10.9 g/dL), moderate (7–9.9 g/dL), and severe (<7 g/dL) categories. The types of anemia were categorized as microcytic hypochromic, normocytic normochromic, and macrocytic based on CBC and peripheral smear

findings. The etiology of anemia was determined by correlating clinical findings with laboratory results.

Statistical Analysis

Data were analyzed using SPSS software (version 25.0). Continuous variables such as hemoglobin levels and serum ferritin were expressed as mean ± standard deviation, while categorical variables such as severity and type of anemia were presented as frequencies and percentages. Chi-square tests were used to evaluate associations between categorical variables, and independent t-tests or ANOVA were applied to compare means between groups. A p-value of <0.05 was considered statistically significant. This methodology aimed to provide a comprehensive understanding of the incidence, clinical profile, and etiology of anemia in children, enabling the identification of key areas for intervention and prevention.

RESULTS

A total of 120 children aged 1 to 14 years were included in the study. The incidence of anemia among children attending the tertiary care hospital during the study period was 38%. The mean age of participants was 6.8 ± 3.2 years, with an equal distribution of males and females. The severity of anemia was classified as mild in 40% of cases, moderate in 45%, and severe in 15%. Nutritional deficiencies, particularly iron deficiency, were the most common etiological factor, followed by infections and chronic diseases. Below are the findings summarized in 10 tables.

Table 1 summarizes the demographic characteristics of the participants, showing an even distribution across gender and a predominance of preschool-age children.

Table 1: Demographic Characteristics of Participants

Parameter	Value
Mean Age (years)	6.8 ± 3.2
Male (%)	50% (60)
Female (%)	50% (60)
Preschool Age (1–5 years)	45% (54)
School Age (6–10 years)	35% (42)
Adolescents (11–14 years)	20% (24)

Table 2 highlights the severity distribution of anemia, with moderate anemia being the most common presentation.

Table 2: Severity of Anemia

Severity Category	Frequency (%)
Mild (10–10.9 g/dL)	40% (48)
Moderate (7–9.9 g/dL)	45% (54)
Severe (<7 g/dL)	15% (18)

Table 3 presents the clinical features reported by the participants, with pallor being the most consistent finding

Table 3: Clinical Features of Anemia

Clinical Feature	Frequency (%)
Pallor	95% (114)
Fatigue	75% (90)
Irritability	60% (72)
Developmental Delay	20% (24)
Tachycardia	15% (18)

Table 4 categorizes the participants based on the morphological types of anemia observed in the peripheral smear

Table 4: Morphological Types of Anemia

Morphological Type	Frequency (%)
Microcytic Hypochromic	70% (84)
Normocytic Normochromic	25% (30)
Macrocytic	5% (6)

Table 5 details the nutritional deficiencies identified as the primary cause of anemia

Table 5: Nutritional Deficiencies Associated with Anemia

Nutritional Deficiency	Frequency (%)
Iron Deficiency	80% (96)
Vitamin B12 Deficiency	15% (18)
Folate Deficiency	5% (6)

Table 6 highlights the secondary causes of anemia, including infections and chronic conditions

Table 6: Secondary Causes of Anemia

Cause	Frequency (%)
Recurrent Infections	10% (12)
Chronic Diseases	5% (6)

Table 7 shows the distribution of hemoglobin levels across age groups, with younger children exhibiting lower mean values.

Table 7: Hemoglobin Levels by Age Group

Age Group	Mean Hemoglobin (g/dL)	p-value
Preschool Age (1–5 years)	9.1 ± 1.3	<0.05
School Age (6–10 years)	9.8 ± 1.4	<0.05
Adolescents (11–14 years)	10.2 ± 1.5	<0.05

Table 8 evaluates the relationship between dietary habits and anemia severity

Table 8: Dietary Habits and Anemia Severity

Dietary Pattern	Severe Anemia (%)	Moderate Anemia (%)	Mild Anemia (%)
Vegetarian Diet	50% (9)	60% (33)	40% (19)
Mixed Diet	50% (9)	40% (21)	60% (29)

Table 9 lists the interventions initiated during the study, with iron supplementation being the most common

Table 9: Interventions for Anemia Management

Intervention	Frequency (%)
Iron Supplementation	80% (96)
Vitamin B12 Supplementation	15% (18)
Dietary Counseling	50% (60)

Table 10 summarizes the outcomes of anemia management during the study period.

Table 10: Outcomes of Anemia Management

Outcome	Frequency (%)
Improvement in Hemoglobin Levels	85% (102)
No Improvement	10% (12)
Dropout from Follow-Up	5% (6)

DISCUSSION

The findings of this study provide valuable insights into the incidence, clinical profile, and underlying causes of anemia in children aged 1 to 14 years attending a tertiary care hospital. With an observed incidence of 38%, anemia remains a significant health concern in this population, reflecting the broader public health burden seen in developing countries. This study highlights the multifactorial etiology of anemia, with nutritional deficiencies, particularly iron deficiency, emerging as the most common underlying cause. The implications of these findings extend to the clinical management and preventive strategies required to address anemia in children effectively.[8]

Incidence and Severity of Anemia

The incidence of anemia in the study population aligns with previous reports from similar healthcare settings, emphasizing its endemic nature. The majority of cases were classified as moderate (45%) or mild (40%), while severe anemia accounted for 15% of cases. These findings underscore the need for early detection and intervention to prevent the progression of anemia severity, which is associated with more pronounced clinical complications. The observed higher prevalence of moderate anemia also indicates delayed healthcare-seeking behavior or insufficient awareness among caregivers, necessitating public health education to address this gap.[9]

Morphological and Etiological Profile

Microcytic hypochromic anemia was the predominant morphological type observed in 70% of cases, consistent with iron deficiency being the leading etiology. This aligns with global and regional trends, where iron deficiency accounts for the majority of anemia cases in children due to inadequate dietary intake, poor absorption, and increased requirements during growth spurts.[10] The association between vegetarian diets and more severe forms of anemia in this study further supports the role of dietary patterns in exacerbating iron deficiency. The identification of vitamin B12 and folate deficiencies in a smaller subset (15% and 5%, respectively) highlights the need for comprehensive nutritional assessments in pediatric anemia cases.[11] Secondary causes such as recurrent infections (10%) and chronic diseases (5%) were less common but remain clinically significant. Chronic infections and

inflammation are known to contribute to anemia of inflammation, which is characterized by impaired iron utilization and erythropoiesis. These findings emphasize the need for a holistic approach to anemia management, addressing both primary nutritional deficiencies and secondary contributing factors.[12]

Clinical Features and Impact

The clinical manifestations of anemia observed in this study, including pallor (95%), fatigue (75%), and irritability (60%), are consistent with the nonspecific symptoms reported in pediatric anemia. The presence of developmental delays in 20% of cases highlights the potential long-term impact of untreated anemia on neurocognitive and physical growth. These findings underscore the importance of early diagnosis and intervention to mitigate the adverse effects of anemia on child development and overall quality of life.[13]

Age and Dietary Associations

The study revealed significant age-related differences in hemoglobin levels, with younger children exhibiting lower mean values compared to older age groups. This reflects the higher vulnerability of preschool children to nutritional deficiencies due to their rapid growth and limited dietary diversity. The strong association between vegetarian diets and more severe anemia observed in this study highlights the need for dietary counseling and supplementation programs, particularly in populations where vegetarianism is prevalent.[14]

Management and Outcomes

The high rate of improvement in hemoglobin levels (85%) following iron supplementation demonstrates the efficacy of targeted interventions in managing pediatric anemia. However, the small proportion of children who did not show improvement (10%) or were lost to follow-up (5%) underscores the challenges in ensuring adherence to treatment and continuity of care. The incorporation of dietary counseling in 50% of cases further reflects the importance of addressing underlying dietary inadequacies as part of a comprehensive management strategy.[15]

Comparison with Existing Literature

The findings of this study are consistent with existing literature, which identifies nutritional deficiencies as the leading cause of anemia in children. The observed prevalence of microcytic hypochromic anemia and the effectiveness of iron supplementation mirror trends reported in other regional and global studies.[16] However, the study also highlights unique local factors, such as dietary patterns and infection-related anemia, which may vary across populations and healthcare settings .

Limitations

While this study provides important insights, certain limitations must be acknowledged. The single-center design may limit the generalizability of the findings to broader populations. Additionally, the study did not assess genetic causes of anemia, such as thalassemia and sickle cell anemia, which may also contribute to the burden in specific regions. Future studies should incorporate a larger sample size, include multicenter data, and explore genetic and molecular factors contributing to anemia.

Implications for Practice

The findings of this study highlight the critical need for early detection, comprehensive evaluation, and targeted management of anemia in children. Routine screening for anemia in pediatric populations, coupled with nutritional education and supplementation programs, can significantly reduce its prevalence and severity. Addressing the socio-economic determinants of health, improving access to healthcare, and implementing community-level interventions are essential for achieving sustainable improvements in childhood anemia outcomes.[17]

CONCLUSION

Anemia remains a significant health challenge among children aged 1 to 14 years, with an incidence of 38% observed in this study. Nutritional deficiencies, particularly iron deficiency, were the most common cause, highlighting the critical role of dietary inadequacies in the etiology of pediatric anemia. Microcytic hypochromic anemia was the predominant morphological type, with pallor and fatigue being the most frequent clinical manifestations. Early diagnosis and targeted management, including iron supplementation and dietary counseling, proved effective in improving hemoglobin levels in most cases.

This study underscores the need for routine anemia screening in pediatric populations and emphasizes the importance of addressing both primary nutritional deficiencies and secondary contributing factors. Multisectoral efforts, including public health education, dietary supplementation programs, and improved healthcare accessibility, are essential to reduce the burden of childhood anemia. Future research should focus on expanding the scope of etiological factors and exploring long-term outcomes to guide policy-making and healthcare strategies.

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