

Clinico - hematological profile of severe anemia in children (6 months – 14 years): A hospital-based prospective observational study.

Dr Tapaswini Samal¹, Dr Priyabhasini Chinmoyee Ray², Dr Subhajit Karan³, Dr Dillip Kumar Dash⁴, Dr Mrunmay Das Mohapatra², Dr Prasant Kumar Saboth⁴

¹Senior resident, Department of Pediatrics, Institute of Medical Science and SUM Hospital, Bhubaneswar

²Associate Professor, Department of Pediatrics, Institute of Medical Science and SUM Hospital, Bhubaneswar

³Assistant Professor, Department of Pediatrics, Institute of Medical Science and SUM Hospital, Bhubaneswar

⁴Professor, Department of Pediatrics, Institute of Medical Science and SUM Hospital, Bhubaneswar

Abstract

Background:

Severe anemia in childhood remains a major public health challenge, particularly in developing nations like India. It significantly impacts growth, cognitive development, and morbidity. Understanding the clinical and hematological spectrum of severe anemia is crucial for early diagnosis and effective management.

Objectives

To assess the clinical presentation, hematological profile, and etiological factors of severe anemia in children aged 6 months to 14 years attending a tertiary care hospital.

Methods

This hospital-based descriptive cross-sectional study was conducted at IMS & SUM Hospital, Bhubaneswar, from December 2022 to June 2024. One hundred children aged 6 months–14 years with severe anemia (Hb <7 g/dL in 6–59 months; <8 g/dL in 5–14 years, as per WHO) were enrolled. Clinical features were recorded, and laboratory investigations, including CBC, peripheral smear, iron profile, vitamin B12/folate levels, and HPLC, were analyzed. Data were statistically examined using IBM SPSS 25.0, with $p < 0.05$ considered significant.

Results

Most patients (57%) belonged to 6–14 years, with a nearly equal sex ratio (M: F = 1.04:1). A majority (86%) were from lower socioeconomic strata, and 68% were from rural areas. Pallor (100%), fatigue (84%), and fever (60%) were predominant symptoms. Microcytic hypochromic anemia (64%) was the most common hematological pattern, followed by normocytic normochromic (18%) and dimorphic (12%). Iron deficiency (52%) was the leading cause, followed by hemoglobinopathies (26%), megaloblastic anemia (12%), and hemolytic anemia (6%).

Conclusion

Iron deficiency remains the principal cause of severe anemia among children in low socioeconomic and rural settings. Routine hematological profiling, nutritional interventions, and community-level screening can significantly reduce disease burden and improve outcomes.

Keywords: Severe anemia, Children, Iron deficiency, Hemoglobinopathies, Clinico -hematological profile.

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Corresponding Author: Dr Tapaswini Samal

Email: tapaswinisamal63@gmail.com

Senior resident, Department of Pediatrics, Institute of Medical Science and SUM Hospital, Bhubaneswar

Introduction

Anemia continues to be a major pediatric health issue worldwide, particularly in developing nations. According to the World Health Organization (WHO), anemia affects nearly 42% of children under five years globally, with the

highest prevalence in South Asia. In India, over 50% of children aged 6 months to 14 years are anemic, with a substantial proportion presenting with severe forms. (1,2,3) Severe anemia, defined as hemoglobin <7 g/dL in children <5 years and <8 g/dL in older children, leads to tissue

hypoxia, growth retardation, cognitive decline, and increased susceptibility to infections. Its multifactorial etiology includes nutritional deficiencies (iron, folate, vitamin B12), infections (malaria, helminthiasis), and hereditary disorders (thalassemia, sickle cell disease). (4)

Understanding the clinico-hematological characteristics of severe anemia assists clinicians in differentiating between nutritional, infectious, and genetic causes, enabling targeted interventions. Despite numerous studies on childhood anemia, limited data exist focusing specifically on severe anemia in the 6-month to 14-year age group in Eastern India. (5)

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Objectives

Primary objectives: To analyze the clinical features and hematological parameters of severe anemia in children.

Secondary objectives: To identify associated etiological

factors and short-term outcomes.

Materials and Methods

A hospital-based cross-sectional study was carried out in the Department of Pediatrics, IMS & SUM Hospital, Bhubaneswar, between December 2022 and June 2024.

Participants

Children aged 6 months–14 years with severe anemia (WHO criteria - (Hb <7 g/dL for 6–59 months and <8 g/dL for 5–14 years) were enrolled. Exclusion criteria included anemia from acute blood loss, malignancy, or prior transfusion.

Clinical evaluation and data collection included

Demographic details, dietary history, presenting symptoms, and family history were recorded. Detailed clinical examination included pallor, icterus, hepatosplenomegaly, lymphadenopathy, and cardiac signs.

Laboratory evaluation included

Complete Blood Count (CBC), Peripheral Smear, Iron Profile, HPLC, Reticulocyte count, and Coombs test when indicated.

Statistical Analysis

Data were analyzed using IBM SPSS v25. Descriptive statistics (mean, SD, frequency) were used for quantitative data; Chi-square and t-tests assessed associations between clinical and hematological findings. $p < 0.05$ was considered statistically significant.

Ethical Considerations

The study received approval from the Institutional Ethics Committee, IMS & SUM Hospital. Written informed consent was obtained from parents or guardians.

Results & Analysis.

TABLE -1: Demographic Profile

Total children	100
Mean age	8.7 ± 3.2 years
Age group distribution	6–14 yrs: 57%, 2–6 yrs: 25%, 6 mo–2 yrs: 18%
Gender	Males: 51%, Females: 49%

A total of 100 children were included. Mean age was 8.7 ± 3.2 years. The largest proportion (57%) was aged 6–14 years, followed by 25% between 2–6 years, and 18% between 6 months and 2 years. Males (51%) and females (49%) were nearly equally represented. (Table

TABLE -2: Socioeconomic and Geographic Distribution

Socioeconomic Class	Lower & Lower-Middle: 86%
Geographic Area	Rural: 68%
Regional Origin	South & Southeast Odisha

Most children (86%) belonged to lower and lower-middle socioeconomic classes, and 68% were from rural areas. The majority hailed from South and Southeast Odisha, reflecting the regional disease burden⁽⁹⁾

TABLE -3: Clinical Presentation

Symptom	Prevalence (%)
Pallor	100
Weakness/Fatigue	84
Fever	60
Breathlessness	32
Edema	18
Hepatosplenomegaly	24
Cardiac Murmurs & frontal bossing	10
Signs of malnutrition (delay mile stones and FTT)	17
Lymphadenopathy & hyperpigmentation	11
Jaundice	15

Common symptoms included pallor (100%), weakness/fatigue (84%), fever (60%), breathlessness (32%), and edema (18%). Hepatosplenomegaly was noted in 24%, and cardiac murmurs in 10%.

TABLE -4: Hematological Findings

Parameter	Value
Mean Hemoglobin	6.3 ± 0.7 g/dL
Mean MCV	68 ± 10 fL
Peripheral Smear	Microcytic hypochromic: 64% Normocytic normochromic:18% Dimorphic: 12% Macrocytic: 6%
Reticulocyte count (>2%)	20% (mainly hemolytic anaemia)

TABLE -5: Etiological Spectrum

Cause	Percentage (%)
Iron Deficiency Anaemia	52
Hemoglobinopathies (Thalassemia/Sickle cell)	26
Megaloblastic Anaemia	12
Haemolytic Anaemia	6
Acute lymphoblastic leukemia	18
Infectious diseases	21

Iron deficiency anaemia: 52%, Hemoglobinopathies (Thalassemia/Sickle cell): 26%, Megaloblastic anaemia: 12%, Haemolytic anaemia: 6%, ALL:18%, Infectious diseases- 21 %

Dietary distribution

This distribution reveals that while vegetarianism (5%) is practiced by a notable portion of the population, the predominant dietary pattern is mixed (60%), reflecting a more flexible and diverse approach to food consumption. The presence of a sizable group consuming non-vegetarian diets (35%) also suggests cultural or regional influences on dietary preferences. (9,10)

Nutritional status of the under-5 age group

The nutritional assessment of children under the age of five in the study revealed the presence of both Severe Acute Malnutrition (SAM) and Moderate Acute Malnutrition (MAM). Among the under-five Participants, 5 children (31%) were classified as suffering from SAM, while 11 children (69%) were identified as having MAM. This indicates that all children assessed in this age group were malnourished to varying degrees, with nearly one-third experiencing severe nutritional deficiencies. (11)

Associated Factors

Nutritional deficiency and poor dietary intake were significant in 60% of cases. Parasitic infestations and chronic infections (malaria, hookworm) were present in 18%. Family history of thalassemia was observed in 10% of participants.

Short-Term Outcomes

Most patients improved following iron or vitamin supplementation and transfusion support. Six cases required repeated transfusions due to hemoglobinopathies & mortality occurred during hospitalization.

Discussion

The present study highlights that severe anaemia continues to affect a substantial proportion of children, predominantly those from lower socioeconomic and rural backgrounds. The mean age of 8.7 years and slight male predominance align with previous Indian and South Asian studies (11,12,13) Iron deficiency remained the predominant cause, consistent with NFHS-5 and WHO findings showing high prevalence of nutritional anemia in India. (14) Poor dietary iron intake,

frequent infections, and inadequate deworming practices were significant contributing factors. (15,16).

The hematological findings—predominance of microcytic hypochromic morphology—are comparable to studies by Mir et al. (2021) (17). and Ramawat et al. (2019) . (18). Hemoglobinopathies (26%) also contributed substantially, reflecting regional genetic patterns in Eastern India. Routine screening by HPLC is therefore recommended, particularly in endemic belts. (19)

Megaloblastic anaemia (12%) underscores the role of folate and vitamin B12 deficiency in undernourished children. Hemolytic anaemia (6%) and infection-associated cases further support the multifactorial etiology of severe anaemia in resource-limited settings.

Clinical manifestations like pallor, fatigue, and fever dominated, aligning with earlier observations (Quratulain et al., 2020). (20). Cardiomegaly and hepatosplenomegaly in a subset indicate chronicity and compensatory hematopoietic stress. (21)

Effective management requires both clinical and laboratory correlation. Nutritional supplementation, early identification of genetic anemias, and preventive strategies such as deworming and food fortification are critical (22)

Conclusion

Severe anemia among children aged 6 months–14 years remains highly prevalent, particularly in socioeconomically disadvantaged and rural populations. Iron deficiency is the leading cause, followed by hemoglobinopathies and megaloblastic anaemia. Comprehensive clinico-hematological evaluation aids in identifying underlying etiologies and optimizing management. Public health initiatives emphasizing iron and folate supplementation, regular screening, and awareness about genetic disorders are essential to reduce the burden of childhood anemia in India.

Limitations

Single-center design with limited sample size. Lack of long-term follow-up for recurrence or chronic complications. Some etiologies (e.g., chronic disease anaemia) may have been underdiagnosed.

Recommendations

Periodic anemia screening in schools and rural health centers. Strengthening nutritional programs (iron-folic acid supplementation, deworming). Genetic counseling and HPLC screening in high-prevalence regions.

Community awareness of balanced nutrition and early health-seeking behavior.

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Conflict of interest and source of fundings

The authors declare that the research was conducted in the absence of any commercial or financial relationships with no conflict of interest.

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