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Original Research Article

Clinicohematological and Biochemical Profile of Anemia in Pediatric Age Group

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Abstract:

Background: Anemia is a prevalent condition in the pediatric age group, significantly impacting growth and development. Understanding the clinicohaematological and biochemical profiles is essential for accurate diagnosis and effective management.

Aim: This reserch intends to evaluate the clinicohaematological and biochemical profiles of anemia in children aged between 1 -14 years, identifying patterns and correlating findings to guide treatment protocols.

Methods: The study was a cross-sectional observational study conducted in 100 pediatric patients aged 1 to 12 years diagnosed with anemia. Inclusion criteria were based on hemoglobin levels, while exclusion criteria ruled out chronic illnesses and recent treatments affecting anemia. Data collection included structured interviews, clinical examinations, and laboratory investigations.

Results: The study included 100 pediatric patients (52 males, 48 females) with a mean age of 6.5 years. Hematological analysis showed a mean hemoglobin level of 8.5 g/dL, with younger children (1-3 years) having significantly lower hemoglobin levels ($p = 0.03$). Biochemical parameters indicated low serum iron (45.8 µg/dL) and ferritin (22.5 ng/mL), suggesting iron deficiency anemia. A strong positive correlation was found between serum ferritin and hemoglobin levels ($r = 0.62$, $p < 0.001$). These results underscore the need for targeted nutritional interventions to combat iron deficiency in young children.

Conclusion: Anemia in the pediatric age group predominantly manifests as microcytic hypochromic anemia due to iron deficiency. Early identification through comprehensive clinicohaematological and biochemical profiling is crucial for effective management.

Recommendations: Routine screening for anemia in children, especially in high-risk groups, is recommended. Nutritional interventions and iron supplementation programs should be prioritized to address iron deficiency. Further research is needed to explore genetic factors and other underlying causes of anemia in this population.

Keywords: Pediatric anemia, iron deficiency, hematological profile, biochemical profile, microcytic hypochromic anemia.

Introduction

Anemia is a widespread hematological disorder affecting a noteworthy share of the global pediatric population. It is highlighted by a reduction in the number of RBCs or the hemoglobin concentration, which impairs the oxygen-carrying capacity of the blood. This condition manifests in various clinical symptoms, ranging from mild fatigue and pallor to severe developmental delays and cardiovascular complications. Understanding the clinicohaematological and biochemical profiles of anemia in children is vital for early diagnosis, effective management, and prevention of long-term adverse outcomes [1].

The etiology of anemia in the pediatric age group is multifactorial, encompassing nutritional deficiencies, genetic disorders, infections, and chronic diseases. Nutritional anemia, particularly iron deficiency anemia, often resulting from inadequate dietary intake, malabsorption, or increased physiological demands. In contrast, hemolytic anemias, including sickle cell disease and thalassemia, are inherited disorders that

significantly impact the pediatric population in specific geographical regions. Each type of anemia presents with distinct hematological and biochemical profiles, necessitating tailored diagnostic and therapeutic approaches [2]

Clinicohaematological evaluation involves a detailed analysis of the complete blood count (CBC), peripheral blood smear, and reticulocyte count. These investigations provide insights into the severity, morphology, and regenerative capacity of the bone marrow. Biochemical assessments, such as serum ferritin, vitamin B12, folate levels, and hemoglobin electrophoresis, further elucidate the underlying causes of anemia. Together, these diagnostic tools enable clinicians to classify anemia accurately and identify the specific etiological factors, thereby guiding appropriate treatment strategies [3].

Despite advancements in diagnostic techniques and therapeutic interventions, anemia remains a significant public health challenge, particularly in low- and middle-income countries. The burden of anemia in children is exacerbated by socio-economic factors, including poverty, food insecurity, and limited access to healthcare. Addressing these disparities requires comprehensive public health initiatives aimed at improving nutrition, enhancing healthcare infrastructure, and promoting education and awareness about anemia and its consequences [4].

The aim of this study is to analyze the clinicohaematological and biochemical profiles of anemia in the pediatric age group. By examining a cohort of anemic children, the study seeks to identify the predominant types and causes of anemia, understand the clinical presentations, and evaluate the effectiveness of current diagnostic and therapeutic practices.

Methodology

Study Design: The study was designed as a cross-sectional observational study.

Study Setting: The research was conducted at B. S. M. C. H., Bankura, from February 2015 to January 2016.

Participants: A total of 100 pediatric patients diagnosed with anemia were included in the study. Participants were selected from those attending the pediatric outpatient department and inpatient wards during the study period.

Inclusion Criteria

- Pediatric patients aged 1 to 12 years.
- Confirmed diagnosis of anemia based on hemoglobin levels (Hb < 11 g/dL).
- Patients whose guardians provided informed consent for participation in the study.

Exclusion Criteria

- Patients with chronic illnesses such as malignancies, renal, or hepatic disorders.
- Patients who had received blood transfusions or iron supplements in the past three months.
- Patients with known hematological disorders other than anemia.

Bias: To minimize selection bias, consecutive sampling was employed. Data collectors were trained to ensure consistency and accuracy in data collection.

Variables

- Independent variables: Age, sex, dietary habits, socioeconomic status, and clinical history.
- Dependent variables: Hematological parameters include hemoglobin levels, mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC). Biochemical parameters encompass serum iron, total iron-binding capacity (TIBC), and serum ferritin.

Data Collection: Data were collected through structured interviews with guardians, clinical examinations, and laboratory investigations. A pre-designed data collection form was used to record the information.

Procedure: Blood samples were collected from each participant under aseptic conditions. Hematological parameters were measured using an automated hematology analyzer. Biochemical parameters were assessed using standard laboratory techniques.

Statistical Analysis: Data were entered into SPSS version 21.0 for analysis.

Results

Demographic and Clinical Characteristics: Out of the 100 pediatric patients included in the study, 52 were male and 48 were female. The mean age of the participants was 6.5 ± 3.1 years. The distribution of participants across different age groups is shown in Table 1.

Table 1: Age Distribution of Participants

Age Group (years)	Number of Participants	Percentage (%)
1-3	25	25
4-6	28	28
7-9	22	22
10-12	25	25

Hematological Parameters: The mean hemoglobin level among participants was 8.5 ± 1.2 g/dL. The mean corpuscular volume (MCV) was 70.2 ± 8.5 fL, and the mean corpuscular hemoglobin concentration (MCHC) was 31.5 ± 2.8 g/dL. The distribution of hematological parameters is summarized in Table 2.

Table 2: Hematological Parameters of Participants

Parameter	Mean ± SD	Range
Hemoglobin (g/dL)	8.5 ± 1.2	6.2 - 10.9
MCV (fL)	70.2 ± 8.5	55.1 - 89.3
MCHC (g/dL)	31.5 ± 2.8	26.2 - 35.7

Biochemical Parameters: The mean serum iron level was 45.8 ± 18.4 µg/dL, the total iron-binding capacity (TIBC) was 410.3 ± 45.7 µg/dL, and the mean serum ferritin level was 22.5 ± 10.9 ng/mL. The biochemical parameters are detailed in Table 3.

Table 3: Biochemical Parameters of Participants

Parameter	Mean ± SD	Range
Serum Iron (µg/dL)	45.8 ± 18.4	15.0 - 85.0
TIBC (µg/dL)	410.3 ± 45.7	350.0 - 495.0
Serum Ferritin (ng/mL)	22.5 ± 10.9	5.0 - 50.0

Statistical Analysis: A significant association was found between age groups and hemoglobin levels ($p = 0.03$). Children aged 1-3 years had significantly lower mean hemoglobin levels compared to older age groups. Additionally, a significant correlation was observed between serum ferritin levels and hemoglobin levels ($r = 0.62$, $p < 0.001$), indicating that lower ferritin levels were associated with lower hemoglobin levels.

Table 4: Association Between Age Group and Hemoglobin Levels

Age Group (years)	Mean Hemoglobin (g/dL) ± SD	p-value
1-3	7.9 ± 1.1	
4-6	8.7 ± 1.0	0.03*
7-9	8.9 ± 1.3	
10-12	8.8 ± 1.2	

*Significant at $p < 0.05$

The study evaluated the clinicohaematological and biochemical profile of anemia in 100 pediatric patients. The mean hemoglobin level was 8.5 g/dL, with younger children (1-3 years) showing significantly lower levels compared to older age groups. Hematological parameters such as MCV and MCHC were within expected ranges for anemic patients. Biochemical analysis revealed low serum iron and ferritin levels, indicating iron deficiency as a common cause of anemia in this cohort. A significant positive correlation between serum ferritin and hemoglobin levels further supports this finding. These results highlight the need for targeted interventions to address iron deficiency in young children to improve overall hematological health.

Discussion

The study aimed to evaluate the clinicohematological and biochemical profile of anemia in a pediatric age group. Our results showed a significant prevalence of iron deficiency anemia (IDA), especially among younger children. These findings are consistent with recent studies, which highlight the multifactorial etiology of pediatric anemia, with nutritional deficiencies being the predominant cause.

Hematological and Biochemical Profiles

Our study found that the mean hemoglobin level was 8.5 g/dL, with younger children (1-3 years) exhibiting significantly lower levels compared to older age groups. This aligns with a study, which found a high prevalence of microcytic hypochromic anemia and noted that 30.68% of cases were within the 1-5 year age group [5]. Similarly, a research reported that 41.6% of pediatric patients were diag-

nosed with IDA, with the majority being in the 1-6 year age group [6].

The mean serum iron and ferritin levels in our study were 45.8 µg/dL and 22.5 ng/mL, respectively. This finding is consistent with the study which also highlighted low serum iron and ferritin levels as indicators of IDA in children under five years of age [7]

Our study observed a slightly higher prevalence of anemia in males (52%) compared to females (48%). This is in line with findings from a research who reported a higher prevalence of anemia in males in the pediatric population [8].

A significant association was found between age groups and hemoglobin levels ($p = 0.03$). This suggests that younger children are more vulnerable to anemia, which is corroborated by resercher who found nutritional anemia to be the most common cause in children under 14 years [9]. Additionally, our study showed a significant positive correlation between serum ferritin and hemoglobin levels ($r = 0.62$, $p < 0.001$), supporting the role of iron deficiency in anemia. The findings underscore the critical need for targeted nutritional interventions, particularly focusing on iron supplementation. This is supported by a study which emphasized the importance of early diagnosis and intervention to prevent the cognitive and developmental delays associated with pediatric anemia [10].

Conclusion

The study highlights iron deficiency as the predominant cause of anemia in pediatric patients. The significant correlation between serum ferritin and hemoglobin levels reinforces the importance of early detection and nutritional intervention to mitigate the adverse effects of anemia on child development.

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