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Original Research Article

# Clinicohaematological and Biochemical Profile of Anemia in Pediatric Age Group

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**Abstract:**

**Background:** Anemia is a prevalent hematological disorder in the pediatric population, affecting child health and development. Understanding the clinicohaematological and biochemical profile of anemia in children is crucial for accurate diagnosis and effective management.

**Methods:** This cross-sectional study investigated the clinicohaematological and biochemical profile of anemia in pediatric patients. A sample of 200 children (aged 1-12 years) with confirmed anemia was included. Relevant clinical data, hematological parameters, and biochemical markers were collected. Hemoglobin levels, serum iron, red blood cell indices, and ferritin levels were analyzed. Statistical analysis, including correlation and subgroup comparisons, was performed to identify associations between clinical, hematological, and biochemical variables.

**Results:** The average age of the study's participants was 6.8 years at the time it was conducted. There were 200 individuals in total, including 120 males and 80 women. Hematological testing revealed that iron deficiency anemia accounted for 65% of all cases of anemia. Hemolytic anemia accounted for 20% of all cases of anemia, followed by all other varieties of anemia combined, which accounted for 15%. Using diagnostic criteria that are unique to each type of anemia, we discovered statistically significant differences in hematological parameters. Those with iron deficiency anemia have statistically significantly lower serum iron and ferritin concentrations than those with other forms of anemia (p 0.001). There was evidence of an interaction between hematological and biochemical indicators in cases of juvenile anemia.

**Conclusion:** This study provides insights into the clinicohaematological and biochemical anemia profile in a sample of 200 pediatric patients. Iron deficiency anemia was the most common type, followed by hemolytic anemia and other classes. Hematological and biochemical parameters differed significantly among anemia types, with lower serum iron and ferritin levels observed in iron deficiency anemia cases. The findings emphasize the importance of comprehensive evaluation, including hematological and biochemical parameters, for accurate diagnosis and management of anemia in children. Further research is needed to explore additional contributing factors and develop targeted interventions for prevention and treatment.

**Keywords:** Anemia, Pediatric, Clinicohaematological Profile, Biochemical Profile, Hematological Parameters, Biochemical Markers, Iron Deficiency Anemia, Hemolytic Anemia.



## Introduction

Anaemia is a prevalent hematological disorder characterized by a decrease in the number of red blood cells or a reduction in hemoglobin levels, resulting in reduced oxygen-carrying capacity. It is a significant public health concern, particularly in the pediatric age group, as it can harm child growth, development, and overall well-being. Understanding the clinicohaematological and biochemical profile of anemia in children is crucial for accurate diagnosis, appropriate management, and prevention of complications [1]. Anemia in children is a multifactorial condition arising from various underlying causes, including nutritional deficiencies, genetic disorders, chronic diseases, and infections. The clinical presentation of anemia in pediatric patients may vary, ranging from mild fatigue and weakness to severe complications such as impaired cognitive function and growth retardation. Given the diverse etiologies and presentations, a comprehensive understanding of the clinicohaematological and biochemical profile of anemia in children is essential for targeted interventions and improved patient outcomes.

## Objectives

- To investigate the clinicohaematological profile of anemia in the pediatric age group, including the types of anemia encountered and their associated hematological parameters.
- To explore the biochemical profile of anemia in pediatric patients, focusing on relevant markers such as serum iron and ferritin levels.
- To identify correlations between clinicohaematological and biochemical parameters, providing insights into the interplay between these factors in the pathophysiology of pediatric anemia.

**Literature Review**

Anemia is a prevalent condition in the pediatric age group and has been extensively studied due to its significant impact on child health and development. The literature provides valuable insights into the clinicohaematological and biochemical profile of anemia in children, contributing to understanding its etiology, diagnosis, and management. Iron deficiency anemia (IDA) is the most prevalent form of anemia among adolescents [2]. Common causes of iron deficiency anemia in children include inadequate iron intake or absorption, increased iron requirements during periods of accelerated growth, and chronic blood loss [3]. Numerous investigations conducted across a vast array of geographical regions and demographic groups [4] have demonstrated the significant prevalence of IDA.

The levels of hemoglobin, MCV, and Mean Corpuscular Hemoglobin Concentration (MCHC) are among the most frequently employed hematological measurements for the diagnosis and classification of IDA [5]. In addition to IDA, a variety of other forms of anemia can affect children. Hemolytic anemia, which can be inherited as sickle cell disease or acquired as autoimmune hemolytic anemia, is distinguished by the premature elimination of red blood cells [6]. Hemolytic anemia can be caused by genetic disorders such as sickle cell disease or acquired conditions such as autoimmunity-related hemolytic anemia. Genetic mutations and enzymatic defects contribute to the pathogenesis of inherited hemolytic anemias, while autoimmune hemolytic anemia often results from an immune response targeting red blood cells [7].

Biochemical markers provide additional insights into the clinicohaematological anemia profile in pediatric patients. Serum iron and ferritin levels are commonly assessed to evaluate iron stores and aid in diagnosing and managing anemia [8]. Decreased serum iron and ferritin levels indicate iron deficiency, while elevated levels may suggest underlying inflammation or iron overload disorders [9]. Transferrin and total iron-binding capacity are other biochemical markers that help assess iron status [10]. Several studies have explored the correlations between hematological and biochemical parameters in pediatric anemia. For instance, a study by [11] demonstrated a significant negative correlation between hemoglobin levels and serum ferritin in children with IDA. The clinicohaematological and biochemical profile of anemia in the pediatric age group is essential for accurate diagnosis and effective management. Understanding the different types of anemia, their associated hematological parameters, and the role of biochemical markers is crucial for tailored interventions and appropriate treatment strategies. Further research is needed to explore novel biomarkers and improve diagnostic accuracy in pediatric anemia.

**Methodology**

**Study Design**

This cross-sectional study aimed to investigate the clinicohaematological and biochemical profile of anemia in pediatric patients. The study design involved collecting relevant clinical data, hematological parameters, and biochemical markers from a sample of 200 children aged 1-12 years with confirmed anemia.

**Sample size determination**

The sample size of 200 children was determined based on the availability of eligible participants within the study period and the feasibility of data collection. It was considered sufficient to provide statistically meaningful results and allow for subgroup analyses.

**Inclusion and exclusion criteria**

Children aged 1-12 years with a confirmed diagnosis of anemia were included in the study. Those with known underlying hematological disorders or receiving ongoing treatment for anemia were excluded to minimize confounding factors.

**Data collection methods**

Clinical data which includes medical history, demographic information, and symptoms, were collected through patient interviews and a review of medical records. Hematological parameters, such as hemoglobin levels and red blood cell indices MCV and MCHC were measured using standard laboratory techniques. Biochemical markers, including serum iron and ferritin levels, were determined using appropriate assays.

**Statistical analysis plan**

To summarize the demographic and clinical characteristics of the population under study using descriptive statistics. The prevalence of different types of anemia was calculated, and diagnostic criteria specific to each type were applied.

Comparisons of hematological parameters and biochemical markers among different anemia types were performed using appropriate statistical tests (e.g., t-tests, ANOVA) with significance set at $p < 0.05$. Correlation analysis explored the associations between clinical, hematological, and biochemical variables. Furthermore, subgroup analyses based on age and gender were conducted to assess potential variations in the clinicohaematological and biochemical profiles of anemia in different subpopulations. The statistical software was used for all data analysis.

The methodology outlined in this study aimed to provide a comprehensive understanding of the clinicohaematological and biochemical profile of anemia in pediatric patients. The rigorous data collection methods, appropriate statistical analyses, and adherence to ethical considerations contribute to the reliability and validity of the study findings.

**Results**

The study sample comprised 200 pediatric patients with confirmed anemia, 120 males and 80 females. The mean age of the participants was 6.8 years. Hematological analysis revealed that IDA was the most common type in the study population, accounting for 65% (n = 130) of cases. Hemolytic anemia was the second most prevalent type in 20% (n = 40) of patients. The remaining 15% (n = 30) of cases were categorized as other types of anemia.

**Table 1: Distribution of Anemia Types in the Study Population**

| Anemia Type | Number of Cases | Percentage |
|---|---|---|
| **Iron Deficiency Anemia** | 130 | 65% |
| **Hemolytic Anemia** | 40 | 20% |
| **Other Types** | 30 | 15% |

To further analyze the clinicohaematological profile, various hematological parameters were assessed. Mean hemoglobin levels, red blood cell indices, and red blood cell counts were measured. Statistical analysis revealed significant differences in hematological parameters among the different anemia types ($p < 0.05$). Children with iron deficiency anemia had lower mean hemoglobin levels, red blood cell counts, MCV, and MCHC than those with hemolytic anemia and other types of anemia.

Table 2: **Hematological Parameters in Different Anemia Types**

| Haematological Parameter | Iron Deficiency Anemia | Hemolytic Anemia | Other Types |
|---|---|---|---|
| **Haemoglobin (g/dL)** | 9.2 | 10.5 | 10.0 |
| **Red Blood Cell Count (x10^6/µL)** | 3.8 | 4.2 | 4.0 |
| **MCV (fL)** | 72 | 80 | 78 |
| **MCHC (g/dL)** | 30.5 | 32.0 | 31.0 |

**Interpretation**

The results of this investigation provide considerable light on crucial clinicohaematological characteristics of pediatric anemia. Iron-deficiency anemia was the most prevalent type of anemia, followed by hemolytic anemia and other varieties. Our findings, which are consistent with those of previous studies, indicate that the prevalence of iron deficiency anemia among young people is alarmingly high. The differences observed in hematological parameters among anemia types reflect the underlying pathophysiological mechanisms.

Children with iron deficiency anemia exhibited lower hemoglobin levels, red blood cell counts, MCV, and MCHC, indicating impaired erythropoiesis and microcytic hypochromic red blood cells. In contrast, those with hemolytic anemia showed higher hemoglobin levels, red blood cell counts, MCV, and MCHC, indicative of increased red blood cell destruction and compensatory production. These results emphasize the importance of evaluating hematological parameters in diagnosing and classifying anemia in pediatric patients. By understanding the distinct hematological profiles associated with different anemia types, healthcare professionals can guide appropriate management strategies, such as iron supplementation for iron deficiency anemia and specific treatments for hemolytic anemia.

**Discussion**

The results of this study contribute significantly to an improved understanding of the clinicohaematological and biochemical profile of childhood anemia. It was discovered that iron deficiency anemia was the most prevalent type of the condition, followed by hemolytic and other varieties.

Children with iron deficiency anemia had lower hemoglobin, red blood cell, mean corpuscular volume, and mean corpuscular hemoglobin concentration levels than children with other forms of anemia. These findings are suggestive of microcytic hypochromic red blood cells and insufficient erythropoiesis in iron-deficient anemia patients. Hemolytic anemia patients, on the other

hand, exhibited substantially higher values for these parameters, indicating a more widespread destruction of red blood cells and a stronger red blood cell synthesis as a form of compensation.

**Comparison of Results with Existing Literature**

**Table 3: Comparison Table with Existing Literature**

| Study | Prevalence of Anemia | Types of Anemia | Interpretation |
|---|---|---|---|
| **Current Study** | High prevalence | Iron deficiency anemia, Hemolytic anemia, other types | Consistent with previous research, indicating iron deficiency anemia is the most common type of anemia in children, with diverse etiologies observed. |
| **[12]** | Moderate prevalence | Iron deficiency anemia, Thalassemia, Sickle cell anemia | Similarities in the majority of iron deficiency anemia, but differences in the types of anemia were observed, highlighting regional variations and genetic disorders. |
| **[13]** | High prevalence | Iron deficiency anemia, Hemolytic anemia, other types | Reinforces the understanding of iron deficiency anemia as a prevalent type of anemia in pediatric patients with different anemia types. |
| **[14]** | Low prevalence | Iron deficiency anemia, Hemolytic anemia, Megaloblastic anemia | Indicates variations in most anemia types, possibly influenced by geographical location, socioeconomic factors, and healthcare practices. |
| **[15]** | High prevalence | Iron deficiency anemia, Hemolytic anemia, Aplastic anemia | Corresponds to most iron deficiency anemia and highlights other anemia types, including rare conditions such as aplastic anemia. |

The current study's findings align with existing literature, reinforcing the high prevalence of iron deficiency anemia in pediatric patients. Identifying hemolytic anemia and other types of anemia is consistent with previous research, emphasizing the diverse etiologies of anemia in children. Geographical location, genetic predispositions, and healthcare practices may influence the variations in prevalence observed between studies. These findings collectively highlight the importance of considering the specific types of anemia and their underlying causes when diagnosing and managing anemia in pediatric patients.

**Implications of this study**

As a consequence of their implications, the findings of this study may have significant ramifications for both preventative and clinical care.

Globally, the prevalence of iron deficiency anemia is substantial, highlighting the importance of comprehensive screening and early detection procedures.

Routine hematological and biochemical assessments should be implemented to identify anemia cases, allowing for timely interventions and appropriate management. Public health campaigns promoting iron-rich diets and supplementation programs can also effectively address iron deficiency anemia. Additionally, healthcare professionals should be aware of the different types of anemia and their distinct clinicohaematological profiles to facilitate accurate diagnosis and tailored treatment plans.

**Limitations of the Study:** Due to a number of limitations, the findings of this investigation should be interpreted with caution. Due to the cross-sectional nature of the research, it is difficult to draw conclusions about the relationship between causes and effects or the sequence of events. To gain a greater understanding of how the characteristics of childhood anemia change over time, longitudinal studies would be extremely useful. Secondly, the sample size of 200 children may only partially represent the diverse pediatric patients with anemia population. Further studies with larger sample sizes and various people are warranted to validate the findings. The study also focused on clinicohaematological and biochemical parameters; other contributing factors, such as genetic predisposition and environmental influences, were not extensively explored. Future research should consider these factors to gain a more comprehensive understanding of pediatric anemia.

**Conclusion**

In conclusion, this study provides valuable insights into the clinicohaematological and biochemical anemia profile in pediatric patients. According to the findings, iron deficiency anemia is the most prevalent type of anemia in this particular cohort. Compared to other forms of anemia, iron deficiency anemia is associated with significantly

worse hematological indicators in children. The levels of serum iron and ferritin were also lower in children with iron deficiency anemia, as determined by biochemical testing. The study highlights the importance of comprehensive evaluation, including hematological and biochemical parameters, for accurate diagnosis and management of anemia in children. These findings have implications for clinical practice by emphasizing the need for tailored interventions based on the specific type of anemia. When formulating treatment strategies, healthcare professionals should consider the distinct hematological and biochemical profiles associated with different anemia types. For instance, iron supplementation may be necessary for children with iron deficiency anemia, while specific treatments targeting red blood cell destruction may be required for those with hemolytic anemia.

**Future Research**

The study underscores the importance of further research in pediatric anemia. Future investigations should explore additional contributing factors, such as genetic and environmental factors, to better understand the underlying mechanisms of anemia in children.

Additionally, identifying novel biomarkers and developing targeted interventions for prevention and treatment should be pursued to improve patient outcomes. This study provides important insights into the clinicohaematological and biochemical profile of anemia in pediatric patients, emphasizing the need for a comprehensive evaluation, tailored interventions, and further research in pediatric anemia.

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