

Clinico Haematological Profile and Outcome of Anaemia in Children at the Tertiary Health Care Centre, Dhauj, Faridabad, India

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Abstract—Background: Anaemia remains a significant public health concern in developing countries, particularly affecting children due to nutritional deficiencies and infections. It is a clinical manifestation rather than a standalone disease, often indicating underlying health issues. This study aimed to evaluate the haematological profile and morphological variants of anaemia in the paediatric population admitted to a tertiary healthcare centre in Dhauj, Faridabad.

Methods:

This hospital-based, retrospective, cross-sectional observational study was conducted over one year (January–December 2024) and included 45 children aged 6 months to 13 years. Detailed clinical evaluations, peripheral smear examinations, and biochemical analyses were performed to determine the type and severity of anaemia, as well as the nutritional status of the patients.

Results:

Anaemia was most prevalent among children aged 0.5–3.5 years (44.4%) and showed a male predominance (66.6%). Moderate anaemia was the most common (40%), followed by mild (37.7%) and severe (22.2%) cases. Microcytic morphology was predominant (66.6%), indicative of iron deficiency. Nutritional assessment revealed that 88.9% of the children had varying grades of protein-energy malnutrition (PEM), with Grade 2 being most common (33.3%). Associated infections, including respiratory and gastrointestinal illnesses, were also noted.

Conclusion:

The study underscores the high prevalence of anaemia and malnutrition in children, particularly in early childhood. Microcytic anaemia and moderate PEM were

the most frequent findings. These results highlight the need for integrated strategies focusing on nutritional supplementation, early diagnosis, and treatment of anaemia and associated illnesses to improve paediatric health outcomes in resource-limited settings.

Index Terms—Anaemia, Haemoglobin, Paediatrics, Malnutrition, Peripheral Smear, Protein-Energy Malnutrition (PEM)

I. INTRODUCTION

Anaemia is one of the most important disorders of blood in infancy and early childhood. These result in significant morbidity and mortality in children and constitute a public health problem of considerable importance [1]. Anaemia remains a significant global public health concern, affecting both developed and developing nations, with a notably higher prevalence in the latter. It is clinically defined as a haemoglobin (Hb) concentration that falls more than two standard deviations below the mean for a given age group, or as a reduction in the blood's oxygen-carrying capacity insufficient to meet physiological demands.

These thresholds may vary depending on factors such as age, altitude, and pregnancy status. Anaemia should not be regarded as a standalone diagnosis but rather as an objective indicator of an underlying pathological condition. In paediatric populations, anaemia often presents with greater severity and tends to develop more rapidly compared to adults, reflecting

differences in physiology and disease progression. According to estimates by the World Health Organization (WHO), approximately 1.62 billion individuals globally are affected by anaemia, with the highest prevalence observed among preschool aged children. Among the estimated 293 million anaemic children in this age group, around 89 million reside in India. Data from the National Family Health Survey (NFHS-3, 2005– 2006) indicate that nearly 80% of Indian children aged 12 to 23 months are anaemic. The etiology of anaemia in the Indian context is multifactorial, including nutritional deficiencies— particularly inadequate intake of iron and vitamin C— as well as parasitic infections such as hookworm and malaria.

In India, Anaemia is an important health problem as well as one of the major social health problems, especially among children. Since anaemic children have reduced exercise capacity, slower rate of growth, impaired cognitive development, reduced behavioural and language development, and scholastic achievement along with delayed wound healing.[2] These children are also at an increased risk of dying due to complications associated with malnutrition and infections.[3] Because of these factors, the study of the etiopathogenesis of anaemia in infancy and childhood has attracted wide attention in the recent years in India.[4] The main objective is to study the haematological profile and variant of anaemia in children aged 2 months to 14 years admitted in tertiary health care centre Dhauj, Faridabad (Haryana), India.

Key Words – Anaemia, Haemoglobin, Malnutrition, Paediatrics, RBC Smear

Objectives – The aim of the study was to study the morphologic and cytometric evaluation of anaemia in paediatric population.

Inclusion Criteria -

1. All Children from 6 Months to 13 Years of Age
2. All Paediatric Patients showing clinical features of Anaemia
3. All Anaemias Included (Mild, Moderate, Severe)
4. Patients with different nutritional status were taken

Exclusion Criteria –

1. Infants less than 6 months and teenagers more than 13 years
2. Outpatients who were not admitted to the hospital
3. Patients diagnosed with communicable diseases like HIV, Tuberculosis & Hepatitis 4.
- Uncooperative Patients were not included

II. MATERIALS AND METHODS

It is hospital-based, retrospective, cross-sectional, observational study was conducted at Al Falah School of Medical Sciences and Research Centre, Dhauj, Faridabad, over a period spanning from January 2024 to December 2024.

All patients underwent a comprehensive evaluation for anaemia and its underlying causes. The diagnostic workup included peripheral blood smear examination, serum vitamin B12 and folic acid levels, and stool analysis for helminthic infestation. Anaemia was classified based on findings from these investigations. Haemoglobin concentration was estimated using Sahli's method and reported in grams per decilitre (g/dL). Peripheral blood smears were prepared and stained using Leishman's stain. Red cell indices— packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and red cell distribution width (RDW)—were measured using an automated haematology analyser. The normal reference ranges were as follows: PCV, 35–45%; MCV, 77–95 fL; MCH, 25–33 pg; MCHC, 31–37 g/dL; and RDW, 14.5–18.5%. Reticulocyte count was performed using the Brilliant Cresyl Blue staining method. Serum iron levels were measured by Ramany's dipyrindyl method, and total iron-binding capacity (TIBC) was assessed using Ramsay's method. Serum vitamin B12 and folic acid concentrations were determined using the Architect immunoassay system.

Place of Study – Department of Pathology, Al Falah School of Medical Sciences and Research Centre, Dhauj, Faridabad (121004)

III. RESULTS

The distribution of 45 cases across different age groups is presented in Table 1. The highest proportion of

cases was observed in the 0.5–3.5 years age group, accounting for 44.4% (n = 20) of the total cases. This was followed by the 3.5–6.5 years group with 24.5% (n = 11), and the 6.5–9.5 years group with 20% (n = 9). The lowest number of cases was recorded in the 9.5–12.5 years age group, representing 11.1% (n = 5).

These findings indicate a decreasing trend in the number of cases with increasing age.

Age	No. of cases	Percentage
0.5-3.5	20	44.4%
3.5-6.5	11	24.5%
6.5-9.5	9	20%
9.5-12.5	5	11.1%
Total	45	100%

Table.1. Age incidence in children studied

Out of the total 45 cases analysed in Table.2. 66.6% (n = 30) were males, while 33.3% (n = 15) were females. This indicates a marked male predominance in the observed population, with a male-to-female ratio of approximately 2:1.

Sex	No. of cases	Percentage
Males	30	66.6%
Females	15	33.3%
Total	45	100%

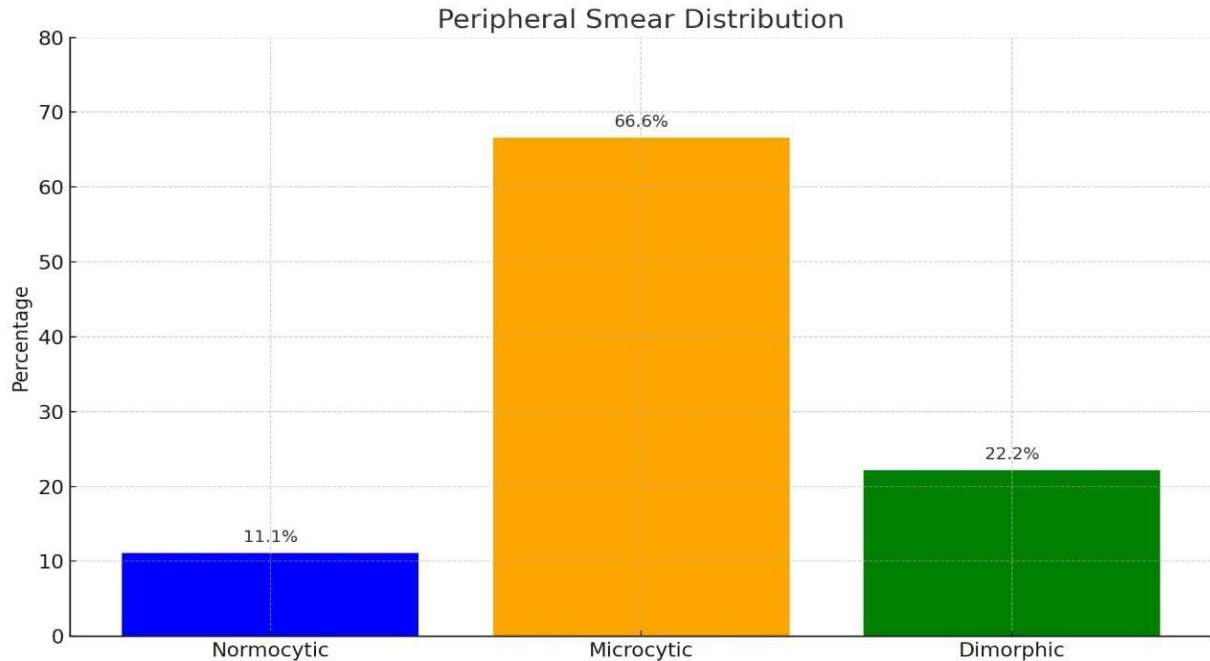
Table.2. Sex incidence of children studied

Out of the total 45 cases analysed in Table 3, anaemia was observed with varying degrees of severity. Among the participants, 37.7% (n=17) were found to have mild anaemia, while 40% (n=18) had moderate anaemia. A smaller proportion, 22.2% (n=10), suffered from severe anaemia. These findings indicate that moderate anaemia was the most prevalent form among the cases studied.

Severity of Anaemia	No. of cases	Percentage
Mild	17	37.7%
Moderate	18	40%
Severe	10	22.2%

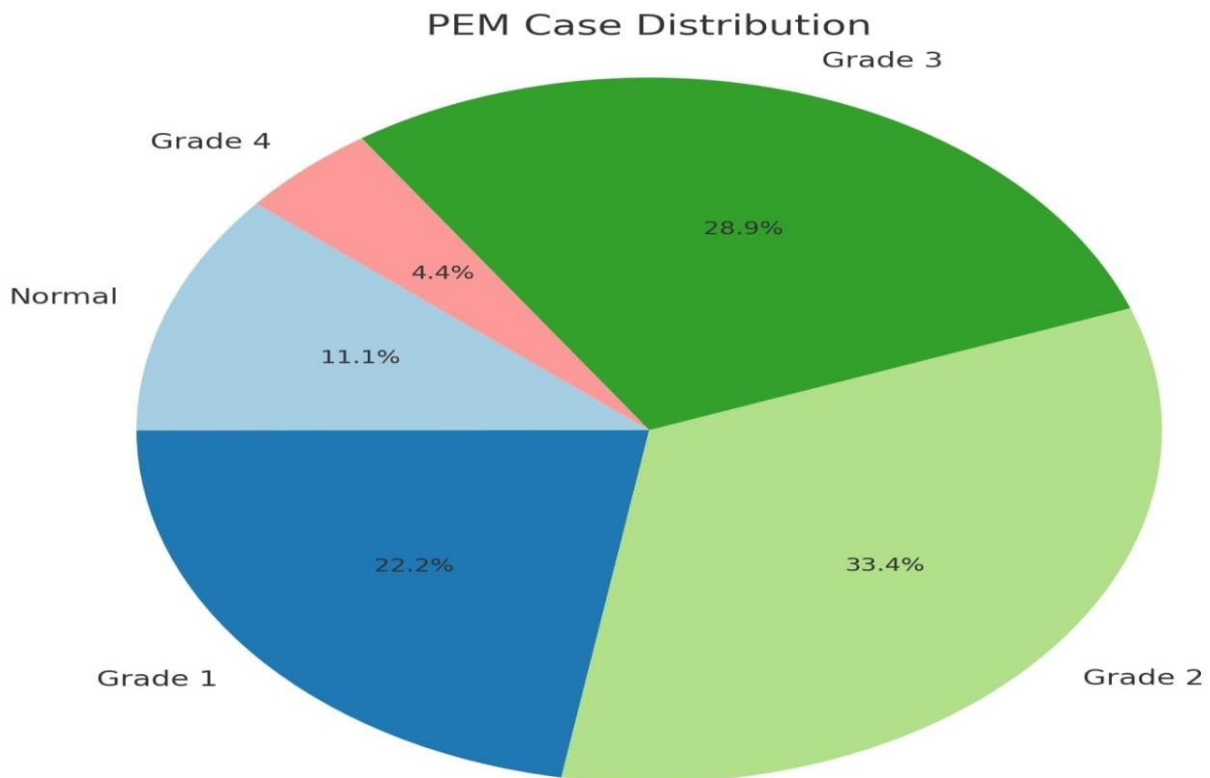
Table.3. Distribution on Basis of Severity of anaemia

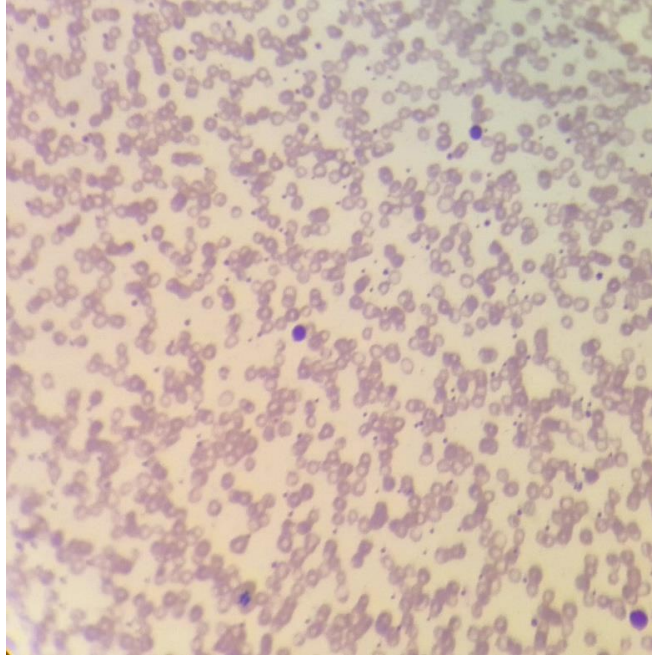
Peripheral smear examination revealed that most of the anaemic cases had microcytic morphology, accounting for 66.6% (n=30) of the total cases. Dimorphic anaemia was observed in 22.2% (n=10) of the cases, while only 11.1% (n=5) showed a normocytic pattern. These findings suggest that microcytic anaemia is the predominant morphological type in the studied population.



A total of 45 children were assessed for Protein-Energy Malnutrition (PEM). Among them, 11.1% (n=5) were found to have normal nutritional status. The remaining 88.9% (n=40) exhibited varying degrees of PEM. Grade 2 PEM was the most prevalent, observed in 33.3%

(n=15) of the cases, followed by Grade 3 at 28.8% (n=13). Grade 1 PEM accounted for 22.2% (n=10), while the most severe form, Grade 4, was identified in 4.4% (n=2) of the children. These findings indicate a significant burden of malnutrition, with most affected children falling into moderate to severe categories.





Peripheral smear shows anisocytosis and microcytic hypochromic RBC {Leishman Stain 40x}

IV. DISCUSSION

Anaemia is clinically defined by a reduction in the haemoglobin (Hb) concentration of the blood. According to the World Health Organization (WHO), anaemia is classified as *severe* when haemoglobin levels fall below or equal to 7 g/dL. Rather than being a singular disease entity, anaemia represents a clinical manifestation that can arise from a wide range of underlying pathological conditions.

Among its clinical features, pallor is the most notable and characteristic sign, often serving as a visible indicator during physical examination. It is typically most evident in the skin, nail beds, mucous membranes, and conjunctivae, where decreased oxygenation becomes readily apparent due to reduced haemoglobin level.

- Age Distribution

In the present study incidence of severe anaemia was more in < 3.5 years age group (44.4%). The lowest age for anaemia recorded in this study was of a 6 month old female child who was suffering from Iron deficiency anaemia. The other age groups showed the following incidence, 3.5-6.5 yrs 11 cases (24.5%), 6.5-9.5 years 9 cases (20%) and 9.5-12.5 years 7 cases (11.1%).

The observed findings may be attributed to the high prevalence of malnutrition, bacterial infections,

commonly seen in this age group, along with underlying constitutional factors such as hereditary anaemia

- Sex Distribution

A higher prevalence of anaemia was noted in male children in this study. Male to female ratio was 2:1. The observed male predominance may be coincidental; however, it could also reflect a gender-based disparity in healthcare-seeking behaviour, with increased parental concern and preferential medical attention given to male children, resulting in higher rates of male admissions

- Nutritional Status

The majority of individuals fall into the malnourished categories (Grades 1 to 4), with only about 11% being classified as normal. This distribution suggests a high burden of malnutrition, especially in the moderate to severe ranges, which may require targeted public health interventions and nutritional support programs.

Grade 2 (33.4%) represents the largest proportion of cases, indicating that moderate malnutrition is the most prevalent.

Grade 3 (28.9%) is the second most common, suggesting a significant number of severe cases.

Grade 1 (22.2%) shows a notable portion with mild malnutrition.

Normal (11.1%) indicates a relatively small group of individuals who are not malnourished.

Grade 4 (4.4%) represents the least common but most critical form of PEM, reflecting very severe malnutrition.

- Associated Diseases

Associated diseases were found in some of the children in the study. Respiratory tract infections like bronchopneumonia and empyema were found. Gastrointestinal infections like Acute gastroenteritis, CNS infections like meningitis, Urinary Tract Infections, Liver Diseases, and septicemia were seen.

V. CONCLUSION

This study highlights the significant burden of anaemia and protein-energy malnutrition (PEM) among paediatric inpatients at a tertiary healthcare centre in Dhauj, Faridabad. The findings reveal that anaemia predominantly affects children below 3.5 years of age, with a marked male predominance and a notable association with varying degrees of malnutrition. Microcytic anaemia emerged as the most common morphological variant, underscoring the role of iron deficiency as a key etiological factor. Moderate anaemia was the most prevalent severity grade, followed by mild and severe forms. The overwhelming prevalence of PEM, particularly in its moderate (Grade 2) and severe (Grade 3) forms, further emphasizes the urgent need for early nutritional assessment and intervention in this vulnerable population.

Moreover, the presence of concurrent infections and systemic illnesses such as respiratory, gastrointestinal, and CNS infections suggests that anaemia in children is often multifactorial, reflecting both nutritional deficits and increased physiological demands due to illness. These insights underline the importance of a multidisciplinary approach in the prevention, early diagnosis, and management of childhood anaemia and malnutrition. Strengthening public health nutrition programs, increasing community awareness, and improving access to early paediatric care are imperative to mitigating the impact of these interlinked conditions on child health outcomes.

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Conflicts of Interest –

There are no conflicts of interest.

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