GMR
The Original

A HAEMATOLOGICAL AND AETIOLOGICAL PROFILE OF ANAEMIA AMONG CHILDREN AGED 6 MONTHS TO 5 YEARS: A RETROSPECTIVE STUDY AT A TERTIARY CARE CENTRE IN TAMIL NADU

Dr Mythili B[1]*, Dr. Karthika Rajendran[2]

[1]Department of Pathology, Saveetha Medical College and Hospital, Chennai, Tamil Nadu, India
[2]Postgraduate, Department of Pathology, Saveetha Medical College and Hospital, Chennai, Tamil Nadu, India
*Corresponding Author: Dr Mythili B

ABSTRACT

Background: Paediatric anaemia remains an important public health and clinical concern, particularly during early childhood when iron requirements are high. Childhood anaemia is predominantly caused by iron deficiency, which should be differentiated from other nutritional and haematological causes when assessed by haemoglobin (Hb) alone. The haematological profile, severity, and aetiology of anaemia, with a focus on iron deficiency, in children aged 6 months to 5 years were examined.

Methods: A retrospective observational study has been carried out in the Department of Pathology at a tertiary-care centre in Chennai, Tamil Nadu, using medical records from March 2023 to March 2024. Children aged 6 months to 5 years with anaemia and appropriate records were included. Red cell indices such as MCHC, MCV, MCH, RDW, serum iron, ferritin, TIBC, transferrin saturation, and reticulocyte count were assessed. The severity of anaemia was categorised according to the age-specific WHO 2024 Hb cut-offs. Data were analysed using IBM SPSS version 24. Student's *t*-test and Pearson's correlation were used, with $p<0.05$ considered statistically significant. The study included 100 children.

Results: Among the 100 children, 63% were male, and 38% were aged 6 months to <1 year. Moderate anaemia was the predominant severity category (61%), followed by severe (25%) and mild anaemia (14%). Iron deficiency anaemia was the most common aetiology, accounting for 70% of cases. The mean Hb was 7.74±1.58 g/dL, with a predominantly microcytic hypochromic pattern (MCV 64.43±8.11 fL; MCH 17.99±4.11 pg) and elevated RDW (20.44±4.49%). Hb, MCV, MCH, MCHC and RDW varied significantly across severity categories. Serum iron, ferritin, TIBC and transferrin saturation differed significantly between iron-deficient and non-iron-deficient groups (all $p<0.001$), whereas Hb and RDW did not. No significant correlations were observed between the assessed iron parameters and Hb or reticulocyte count.

Conclusion: Iron deficiency anaemia was the predominant cause of paediatric anaemia in this cohort, with a predominantly microcytic hypochromic haematological pattern. Although routine red-cell indices provided useful information regarding morphology and severity, they did not reliably distinguish iron-deficient from non-iron-deficient anaemia. The findings support the use of appropriate iron-profile investigations alongside the routine haemogram for a more reliable and practical evaluation of paediatric anaemia.

KEYWORDS: Paediatric anaemia; iron deficiency anaemia; haemogram; red-cell indices; iron profile; ferritin; RDW; children

INTRODUCTION

Anaemia is one of the most common nutritional and haematological disorders in childhood and remains an important global public health problem. Young children are especially susceptible due to rapid development and heightened iron needs in the first years of life [1]. Long-term anaemia, especially in early childhood, can impact physical development, cognitive and overall well-being [2]. According to estimates from the "World Health Organisation (WHO)," one in every 40 children aged 659 months globally has anaemia, indicating its persistence worldwide [3].

In India, the burden remains significantly high [4]. The "National Family Health Survey-5 (NFHS-5)" indicates that 67.1% of children aged 6-59 months were anaemic in India in 2019-2021. The prevalence in Tamil Nadu was 57.4% [5]. The infancy and early childhood period is of special concern due to the high burden, as it is a period of rapid

growth and high nutritional requirements [1]. These results indicate that childhood anaemia is a child-health and nutritional challenge of concern even in states that have relatively better health indicators.

Paediatric anaemia is a multifactorial aetiology. The most prevalent nutritional cause is iron deficiency, especially in infancy and early childhood, but vitamin B12 and folate deficiencies, haemoglobinopathies, chronic inflammation, haemolytic disorders and other conditions may also contribute. Iron deficiency can be present prior to the onset of anaemia, and it is therefore necessary to identify the cause to ensure it is managed and prevented [6].

Diagnosis has conventionally commenced with estimation of Hb and measurement of red-cell indices and relevant biochemical studies. The 2024 WHO guideline describes anaemia among children aged 6 to 23 months as Hb under <10.5 g/dL and anaemia among children aged 24-59 months as Hb under <11.0 g/dL, with the severity being determined by age-specific Hb concentrations [7]. The potential etiology can be determined by complete blood count parameters like mean corpuscular haemoglobin (MCH), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC) and red-cell distribution width (RDW), as well as reticulocyte count and iron-profile parameters like serum ferritin, serum iron, total iron-binding capacity (TIBC) and transferrin saturation [8]. The recent India and Southeast Asia consensus similarly recommends combining the haemogram with iron-profile investigations when evaluating anaemic children [9].

Previous Indian studies have reported iron deficiency as the predominant cause of paediatric anaemia, with microcytic and hypochromic red-cell changes frequently observed [10,11]. However, much of the available evidence has focused either on population-level prevalence or on specific hospital-based populations, with relatively limited integrated data combining clinical, haematological and biochemical findings in young children [12,13].

Although bone-marrow iron staining is considered a reference standard for assessing iron stores, its invasive nature limits its routine use in children. Serum ferritin and other iron-profile parameters therefore provide more practical approaches to assessing iron status in clinical settings [9].

Despite the substantial burden of childhood anaemia, region-specific studies integrating severity, haematological indices and biochemical iron parameters remain limited in the South Indian setting. The current research evaluated the hematological and aetiological profile of pediatric anemia, with emphasis on iron deficiency, utilizing routinely available investigations in Tamil Nadu tertiary-care children.

MATERIALS AND METHODS

Study design and setting

A retrospective observational study has been carried out in a Chennai, Tamil Nadu, tertiary care pathology department. Data was collected from eligible pediatric patients' medical records from March 2023 to March 2024.

Study population and Selection criteria

Children aged 6 months to 5 years with anemia who were hospital inpatients or outpatients were studied. Children aged six months to five years with adequate clinical and hematological records and reported anemia were included.

Children admitted to “Pediatric Intensive Care Unit (PICU)” who were younger than six months or older than five years, had incomplete medical records or insufficient laboratory findings, or had a history of prior blood transfusions were all excluded.

Sample size and methodology

Based on a comparative study by Mukhija G et al., 2025 [14], the sample size of 100 was determined. With a precision of 10%, the expected prevalence of anaemia in children is 61.9%. The significance level was determined at 5%. The calculation formula utilised was

$$n \geq \frac{Z_{1-\frac{\alpha}{2}}^2 p(1-p)}{d^2}$$

Where p is the expected proportion or prevalence of event of interest for the study

d is the absolute precision

$Z_{1-\frac{\alpha}{2}}$ is normal deviate at a level of significance

Variables and data sources

The medical records of the patients were used to get demographic data. Hb, red blood cell (RBC) count, packed cell volume (PCV), MCV, MCH, red cell distribution width (RDW), mean corpuscular haemoglobin concentration (MCHC), platelet count, total leucocyte count (TLC), absolute neutrophil count (ANC) were measured utilising a Sysmex XN-1000 automated hematology analyzer. Reticulocyte count, iron-profile parameters (serum iron, ferritin, TIBC), and LDH and transferrin had been reported if available.

Definition and classification of anaemia
Age-specific Hb cut-offs were used to define and grade anaemia.

Table 1: WHO 2024 haemoglobin cut-offs for diagnosis and severity of anaemia in children [7]

Age group	No anaemia (g/dL)	Mild anaemia (g/dL)	Moderate anaemia (g/dL)	Severe anaemia (g/dL)
6–23 months	≥ 10.5	9.5–10.4	7.0–9.4	<7.0
24–59 months	≥11.0	10.0–10.9	7.0–9.9	<7.0

Children below 6 months of age were excluded from the analytical population because the age-specific WHO Hb cut-offs used for this study begin at 6 months.

Assessment of Aetiology
The probable cause of anaemia was determined by the red-cell indices, complete blood count, peripheral blood smear, and related biochemical analyses in the medical records.
Serum ferritin was used in combination with other iron profile measures to evaluate iron deficiency. Less than 12µg/L of serum ferritin in children under the age of 5 indicates iron deficiency. Serum iron, transferrin saturation, and TIBC were also assessed.
A serum vitamin B12 concentration of <200 pg/mL was considered a vitamin B12 deficiency. Folate deficiency, haemoglobinopathies, anaemia of chronic disease and other causes were classified based on the available laboratory findings and relevant clinical documentation.

Statistical methods
IBM SPSS Statistics, version 24, was used to process the data that was collected in Microsoft Excel 2021. To summarise continuous variables, the mean ± standard deviation was utilised. The Student's t-test has been utilised for group comparisons, and Pearson's correlation coefficient (r) was used for examining correlations between hemogram and iron-profile data (e.g., age and Hb; serum iron and reticulocyte count; serum ferritin and Hb). Statistical significance was considered at <0.05.

Bias and data completeness
As this was a retrospective, records-based study, the analysis depended on the availability and completeness of information in the medical records. Participants with insufficient records or inadequate investigations were excluded according to the predefined criteria. Since specialised investigations such as serum ferritin, serum iron, TIBC, reticulocyte count and other tests were not necessarily available for every patient, analyses involving these parameters were based on the number of participants with available results, and the relevant denominator was reported where applicable.

Ethical considerations
When authorized by the Ethics Committee, informed consent was waived because this was a retrospective study utilizing pre-existing medical records without further research or interventions. Patient confidentiality was maintained by excluding identifying information from the study database and ensuring that all collected data were securely stored and used only for research purposes.

RESULTS

Table 2: Demographic characteristics of study participants (n=100)

Sr No.	Variables		Frequency(n)	%
1.	Age	6 months to <1 year	38	38.0
		1 to <2 years	28	28.0
		2 to <3 years	17	17.0
		3 to <4 years	10	10.0

		4 to 5 years	7	7.0
2.	Sex	Female	37	37.0
		Male	63	63.0

Table 2 describes the demographic characteristics of study participants(n=100). The majority of participants were aged 6 months–<1 year, comprising 38 (38.0%), followed by those aged 1–<2 years, 28 (28.0%), and 2–<3 years, 17 (17.0%). Participants aged 3–<4 years accounted for 10 (10.0%), while those aged 4–5 years constituted the smallest age group, with 7 (7.0%). Regarding sex distribution, 63 (63.0%) participants were male, and 37 (37.0%) were female, indicating a predominance of male participants in the study.

Figure 1: Distribution of study participants according to anaemia severity (n=100)

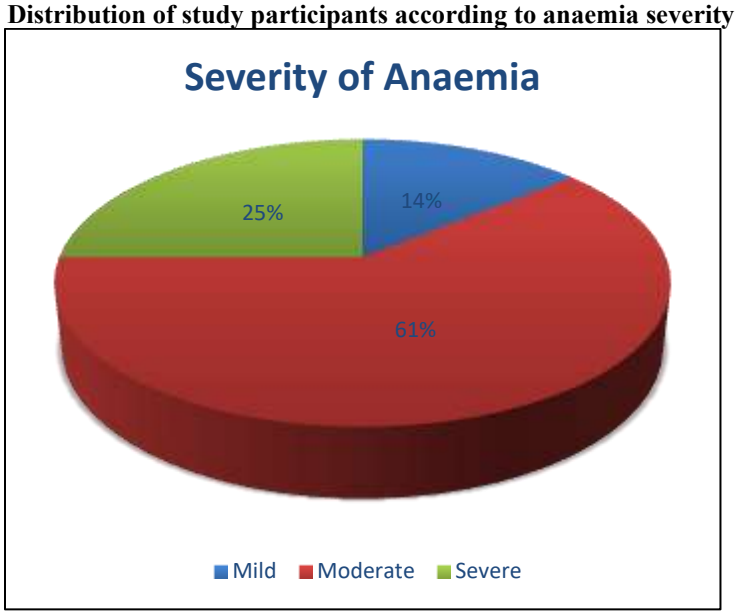

Figure 1 depicts the distribution of study participants according to the severity of anaemia among the 100 participants. The most prevalent severity category was moderate anaemia, with 61(61.0%) participants, and severe anaemia, with 25(25.0%) participants. The least frequent category was mild anaemia, which was found in 14 (14.0%) participants.

Table 3: Distribution of study participants based on Etiological profile of anaemia (n=100)

Etiology	n	%
Iron deficiency anaemia	70	70
Vitamin B12/folate deficiency	8	8
Hemoglobinopathy	7	7
Mixed nutritional deficiency	6	6
Anaemia of chronic disease	5	5
Other/undetermined causes	4	4

Table 3 presents the etiological profile of anaemia in the study participants (n=100). The predominant etiology was iron deficiency anaemia, which was present in 70(70.0%) participants. This was followed by vitamin B12/folate deficiency in 8 (8.0%), hemoglobinopathy in 7 (7.0%), and mixed nutritional deficiency in 6 (6.0%) participants. Anaemia of chronic disease was identified in 5 (5.0%), while other or undetermined causes accounted for 4 (4.0%) participants.

Table 4: Haematological and iron profile of study participants (n=100)

Parameter	Mean ± SD
Haemoglobin(g/dL)	7.74 ± 1.58
RBC (million/µL)	4.43 ± 0.89
PCV (%)	28.54 ± 5.09
MCV (fL)	64.43 ± 8.11

MCH (pg)	17.99 ± 4.11
MCHC (g/dL)	27.91 ± 2.89
RDW (%)	20.44 ± 4.49
Platelet count (×10³/µL)	432.28 ± 120.79
TLC (/µL)	11987.80 ± 3556.10
ANC (/µL)	4568.51 ± 2088.24
Serum ferritin (ng/mL)	22.84 ± 19.01
Serum iron (µg/dL)	36.11 ± 21.67
TIBC (µg/dL)	494.58 ± 78.59
Transferrin saturation (%)	7.87 ± 5.40
Reticulocyte count (%)	1.03 ± 0.51

The study participants' (n=100) haematological and iron profiles are shown in Table 4 as mean ± standard deviation. Mean Hb was 7.74 ± 1.58g/Dl, RBC count was 4.43 ± 0.89 million/µL, and PCV was 28.54 ± 5.09%. The red cell indices showed a mean MCV of 64.43 ± 8.11 Fl, MCH of 17.99 ± 4.11 pg, and MCHC of 27.91 ± 2.89 g/Dl, indicating a predominantly microcytic, hypochromic pattern. The mean RDW was 20.44 ± 4.49**%**, while the mean platelet count was 432.28 ± 120.79 ×10³/µL. The mean TLC and ANC were 11,987.80 ± 3,556.10/µL and 4,568.51 ± 2,088.24/µL, respectively. Regarding the iron profile, the mean serum ferritin was 22.84 ± 19.01 ng/Ml, serum iron was 36.11 ± 21.67µg/Dl, TIBC was 494.58 ± 78.59 µg/Dl, and transferrin saturation was 7.87 ± 5.40**%**, demonstrating a pattern consistent with depleted iron availability. The mean reticulocyte count was 1.03 ± 0.51**%**.

Figure 2: Distribution of anaemia severity according to age group

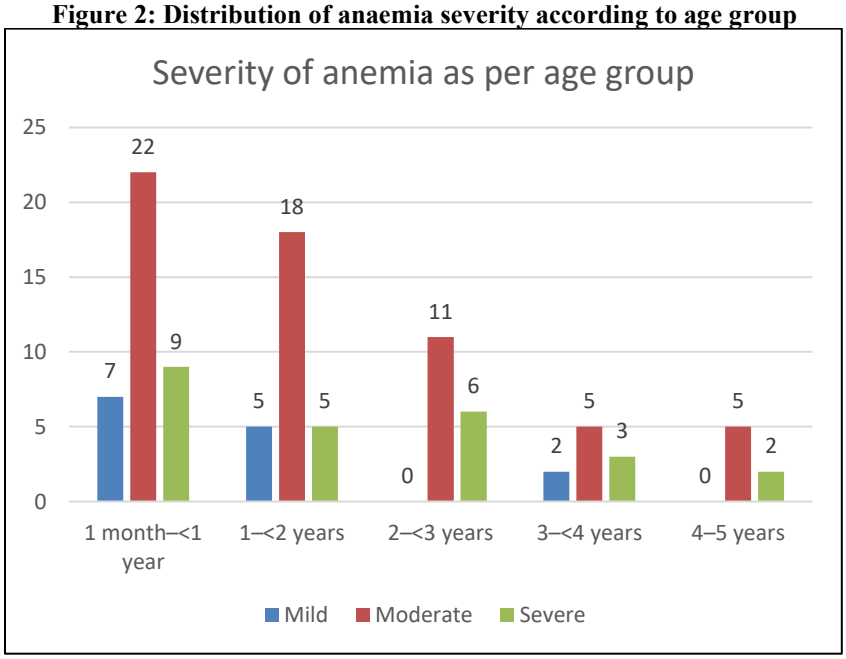

Figure 2 illustrates the distribution of anaemia severity by age group among the study participants. In the 1 month–<1 year age group, moderate anaemia was most frequent, 22 (57.9%), followed by severe anaemia, 9 (23.7%) and mild anaemia, 7 (18.4%). Similarly, moderate anaemia predominated among participants aged 1–<2 years [18 (64.3%)], 2–<3 years [11 (64.7%)], 3–<4 years [5 (50.0%)], and 4–5 years [5 (71.4%)]. Severe anaemia was relatively more frequent in the 2–<3 years age group 6 (35.3%), while mild anaemia was absent in the 2–<3 years and 4–5 years groups. The distribution of anaemia severity did not significantly vary among the age groups, as seen by the absence of a statistically significant correlation between age group and anaemia severity (p=0.606).

Table 5: Comparison of haematological parameters according to anaemia severity

Parameter	**Mild(n=14)**	**Moderate(n=61)**	**Severe(n=25)**	**P-value**
Haemoglobin (g/Dl)	10.24 ± 0.32	7.99 ± 0.84	5.74 ± 0.70	<0.001
RBC (million/µL)	4.57±0.99	4.45±0.93	4.30±0.76	0.639
PCV (%)	28.92 ± 4.92	28.95 ± 5.23	27.33 ± 4.85	0.394

MCV (Fl)	69.84 ± 4.72	64.58 ± 6.08	61.01 ± 11.73	0.004
MCH (pg)	20.97 ± 1.64	19.20 ± 3.12	13.38 ± 3.59	<0.001
MCHC (g/Dl)	29.90 ± 1.32	28.22 ± 2.63	26.03 ± 3.17	<0.001
RDW (%)	18.53 ± 2.14	19.99 ± 4.10	22.62 ± 5.58	0.010

Table 5 compares haematological parameters across different anaemia severity groups. Hb, MCV, MCH, MCHC, and RDW showed statistically significant differences among the mild, moderate, and severe anaemia groups ($p<0.001$, $p=0.004$, $p<0.001$, $p<0.001$, and $p=0.010$, respectively). Increasing anaemia severity lowered Hb, MCV, MCH, and MCHC while increasing RDW. Both groups had similar RBC counts and PCV ($p=0.639$ and $p=0.394$).

Table 6: Comparison of selected parameters between iron-deficiency and non-iron-deficiency groups

Parameter	Iron deficiency	Non-iron deficiency	P-value
Hemoglobin (g/dL)	7.72 ± 1.62	7.80 ± 1.49	0.797
Serum iron (µg/dL)	26.77 ± 11.87	60.18 ± 22.86	<0.001
Serum ferritin (ng/mL)	13.67 ± 6.73	48.41 ± 18.89	<0.001
TIBC (µg/dL)	518.61 ± 70.69	427.55 ± 59.03	<0.001
Transferrin saturation (%)	5.35 ± 2.46	14.37 ± 5.54	<0.001
RDW (%)	20.69 ± 4.48	19.86 ± 4.54	0.405
Severity of anaemia			
Mild	10 (71.4)	4 (28.6)	
Moderate	41 (67.2)	20 (32.8)	
Severe	19 (76.0)	6 (24.0)	

The haematological and iron parameters of iron-deficiency and non-iron-deficiency groups are compared in Table 6. Significant differences in serum iron, ferritin, TIBC, and transferrin saturation were seen between groups ($p<0.001$), with the iron-deficiency group exhibiting higher TIBC and lower serum iron, ferritin, and saturation. Hb and RDW have not benn significantly different ($p=0.797$ and $p=0.405$). Iron deficiency was noted in 71.4% of mild, 67.2% of moderate, and 76.0% of severe anaemia cases.

Table 7: Correlation between haematological and iron parameters

Variables	Pearson r	P-value
Serum iron vs Haemoglobin	-0.11	0.384
Serum ferritin vs Haemoglobin	-0.06	0.588
TIBC vs Haemoglobin	0.09	0.443
Serum iron vs Reticulocyte count	-0.06	0.694
RDW vs MCV	0.02	0.812

Table 7 presents the correlation between haematological and iron parameters among the study participants. None of the assessed variables showed a statistically significant correlation, as all p-values were >0.05**.** Serum iron, serum ferritin, and TIBC showed weak correlations with Hb, while serum iron showed a weak negative correlation with reticulocyte count ($r = -0.06$, $p=0.694$). RDW and MCV also revealed negligible positive correlation ($r=0.02$, $p=0.812$).

DISCUSSION

Iron deficiency is still a significant nutritional cause of pediatric anaemia, as demonstrated by the current study of children below five years old. Children below one year constituted the largest age group (38%), with a male predominance (63%). This concentration of cases in infancy may reflect the increased iron requirements associated with rapid growth during this period [1]. A similar pattern of younger age predominance and male preponderance was reported by Dos Santos RF et al [15]. Moderate anaemia was the most frequent severity category (61%), followed by severe (25%) and mild anaemia (14%), broadly comparable with the patterns reported by Indian studies like Choudhary P et al. and Madoori S et al. [16,17].

70% of patients in this study had iron-deficiency anaemia. This result is aligned with Özdemir N et al.'s finding that the primary cause of childhood anaemia is iron deficiency [18]. Similarly, Modey SR et al. reported iron deficiency in 76% of children with nutritional anaemia [10]. Thus, the predominance of IDA in the present study is broadly comparable with existing studies, although variations may reflect differences in age groups and study populations.

The red-cell indices demonstrated a predominantly microcytic and hypochromic pattern, with an elevated RDW (20.44 ± 4.49%), consistent with iron-restricted erythropoiesis and findings reported in earlier Indian paediatric studies [19-

21]. With increasing severity of anaemia, Hb, MCV, MCH, MCHC and RDW showed significant changes, whereas RBC count and PCV did not. This indicates that increasing anaemia severity was more closely reflected by changes in red-cell size, Hb content and size variability than by the red-cell count itself.

Hb and RDW didn't differ significantly between iron-deficient and non-iron-deficient groups (p=0.797 and p=0.405), despite significant differences in serum iron, ferritin, TIBC, and transferrin saturation (all p<0.001). Iron deficiency was also present across mild (71.4%), moderate (67.2%) and severe (76.0%) anaemia, indicating that the severity of anaemia alone may not reliably predict iron deficiency. In contrast, Aulakh R et al. found significantly higher RDW among children with IDA compared with non-IDA [22]. In children aged 1–3 years, RDW, especially when combined with Hb, may help identify iron deficiency, according to Sazawal S et al. [23]. The difference may partly reflect the mixed aetiological profile of the present cohort, in which RDW can also be influenced by other nutritional and haematological disorders.

In contrast, the iron-profile parameters clearly distinguished the iron-deficient group, with lower serum iron, ferritin and transferrin saturation and higher TIBC. These findings are comparable with those of Modey SR et al., who reported low serum iron and ferritin with increased TIBC in children with nutritional anaemia and identified serum ferritin as a useful marker of iron deficiency [10]. Ratnesh PK et al. similarly emphasised the value of combining haematological and biochemical parameters for differentiating nutritional anaemias [8]. Thus, these findings suggest that while the haemogram provides important clues regarding the morphological pattern and severity of anaemia, iron studies provide additional information for identifying iron deficiency and should not be replaced by Hb or RDW alone.

Although the selected iron parameters did not show significant correlations with Hb or reticulocyte count in the present study, the overall findings support a predominantly iron-deficient, microcytic pattern. Due to developmental consequences of childhood iron deficiency, early recognition and treatment are essential. Early detection of iron deficiency may help prevent the development of more severe anaemia and reduce its potential long-term effects when combined with interventions such as appropriate breastfeeding practices and iron-rich complementary feeding.

Regardless of statistical analyses, this retrospective study at a single tertiary care centre may not be broadly applicable because of a small sample size. This was also challenging to compare with age-matched children who did not have anaemia due to the absence of a healthy control group. Because it was a retrospective study, the results also depended on the completeness and accessibility of the information in the medical records.

CONCLUSION

Anaemia in young children remains an important clinical concern, with iron deficiency anaemia emerging as the predominant aetiology in this study. A predominantly microcytic, hypochromic pattern with increased RDW was observed, and several red-cell indices varied significantly with anaemia severity. Iron-profile parameters effectively differentiated iron-deficiency from non-iron-deficiency anaemia. These findings support the value of combining routine haemogram parameters with appropriate iron studies for early, practical and minimally invasive evaluation of paediatric anaemia.

REFERENCES

1. World Health Organization. Iron supplementation in infants and young children aged 6–23 months [Internet]. Geneva: World Health Organization; [cited 2026 Aug 18]. Available from: https://www.who.int/tools/elena/interventions/iron-children-6to23
2. Kliegman RM, St Geme JW, Blum NJ, Shah SS, Tasker RC, Wilson KM, editors. Nelson Textbook of Pediatrics. 21st ed. Philadelphia: Elsevier; 2020. Vol 2, chap 474, The anaemias. p. 2505-2508.
3. World Health Organization. Anaemia [Internet]. Geneva: World Health Organization; [cited 2026 Aug 18]. Available from: https://www.who.int/health-topics/anaemia
4. Singh RK, Patra S. Extent of anaemia among preschool children in EAG states, India: a challenge to policy makers. Anemia. 2014; 2014:868752. doi:10.1155/2014/868752.
5. Press Information Bureau, Government of India. [Press release] [Internet]. New Delhi: Government of India; 2022 [cited 2026 Aug 18]. Available from: https://www.pib.gov.in/PressReleasePage.aspx?PRID=1795421
6. Kumar A. National nutritional anaemia control programme in India. Indian J Public Health. 1999;43(1):3-5.
7. World Health Organization. Guideline on haemoglobin cutoffs to define anaemia in individuals and populations. Geneva: World Health Organization; 2024. Available from: https://iris.who.int/server/api/core/bitstreams/f9f74397-1440-478d-a63c-26f29a01552f/contentpulations. Geneva: World Health Organization; 2020.
8. Ratnesh PK, Kumar D, Verma BK, Kumar S, Kumar D, Deep V. Clinicohaematological and biochemical profile of anaemia in paediatric age group. Int J Curr Pharm Rev Res. 2026;18(3):1805-1810.
9. Jalaludin MY, Mohamed HJJ, Taher SW, Ang K, Pechkethia L, Saengnipanthkul S, Phrasisombath K, Phengsavanh A, Bora R, Agarwalla SK. Iron Deficiency Anaemia Screening and Management in Young Children:

India and Southeast Asia Consensus. Anemia. 2025 Nov 17; 2025:6347066. doi: 10.1155/anem/6347066. PMID: 41262174; PMCID: PMC12623154.
10. Modey SR, Kanigiri L, Pettem V. Clinical and Haematological Evaluation of Nutritional Anemias in Pediatric Age Group (1–14 years) in Correlation with Biochemical Studies. *Indian J Public Health Res Dev*. 2025;16(1). The
11. Ramana Sastry C.P.V. Study on clinical and hematological profile of Anemia in children aged 5 t0 12 years in rural Telangana. J Pediatr Res. 2017; 4(07): 488-493.].
12. Agrawal S, Jain KK, Sharma M, Verma N, Gupta SA, Gaikwad M. Assessment of Anaemia status among school going adolescent of Raipur and Jashpur district of Chhattisgarh. International Journal of Community Medicine and Public Health. 2019;6(7):2905-09. DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20192823.
13. Varoda A, Chakravarty M, Venugopal R, Kumar A. Prevalence of Anaemia among
Adolescent girls of Baiga (PVTGs) of Chhattisgarh, India. Human Biology Review.
2021;10(2):129-39.
14. Mukhija G, Bhatia Y. Clinico-hematological profile of nutritional anemia in children: correlation of peripheral smear and RBC indices with iron studies. Int J Acad Med Pharm. 2025;7(5):495-501. doi:10.47009/jamp.2025.7.5.98.
15. Dos Santos RF, Gonzalez ES, de Albuquerque EC, de Arruda IK, Diniz Ada S, Figueroa JN, Pereira AP. Prevalence of anemia in under five-year-old children in a children's hospital in Recife, Brazil. Rev Bras Hematol Hemoter. 2011;33(2):100-4. doi: 10.5581/1516-8484.20110028. PMID: 23284255; PMCID: PMC3520632.
16. Choudhary P, Kumar S, Ambhore J. Clinical and hematological profile of anemia in children aged 6 months to 12 years at tertiary care hospital in central India. Int J Contemp Pediatr. 2021;8(10):1704-1708.
17. Madoori S, Ramya C, Valugula S, Sandeep G, Kotla S. Clinico hematological profile and outcome of anemia in children at tertiary care hospital, Karimnagar, Telangana, India. Int J Res Med Sci. 2015;3(12):3567-3571
18. Özdemir N. Iron deficiency anemia from diagnosis to treatment in children. Turk Pediatri Ars. 2015;50(1):11-19.
19. Nerune SM, Rao HRS, Pallavi K, Lavate AP, Das SK, Pagi S. Optimizing the diagnosis of microcytic hypochromic anemia: a comparative evaluation of erythrocyte and reticulocyte parameters. Cureus. 2024;16(9):e69244. doi:10.7759/cureus.69244.
20. Viswanath D, Hegde R, Murthy V, Nagashree S, Shah R. Red cell distribution width in the diagnosis of iron deficiency anemia. Indian J Pediatr. 2001;68(12):1117-1119. doi:10.1007/BF02722922.
21. Maiti D, Acharya S, Basu S. Recognizing missed opportunities to diagnose and treat iron deficiency anemia: a study based on prevalence of anemia among children in a teaching hospital. J Family Med Prim Care. 2019;8(3):899-903. doi: 10.4103/jfmpc.jfmpc_81_19.
22. Aulakh R, Sohi I, Singh T, Kakkar N. Red cell distribution width (RDW) in the diagnosis of iron deficiency with microcytic hypochromic anemia. Indian J Pediatr. 2009;76(3):265-268. doi:10.1007/s12098-009-0014-4.
23. Sazawal S, Dhingra U, Dhingra P, Dutta A, Shabir H, Menon VP, et al. Efficiency of red cell distribution width in identification of children aged 1-3 years with iron deficiency anemia against traditional hematological markers. BMC Pediatr. 2014; 14:8. doi:10.1186/1471-2431-14-8.