



Original Article

Clinico-Pathological Profile of Anemia in Children in A Tertiary Care Centre in North India: An Observational Study

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ABSTRACT

Introduction: Anemia remain one of the notable health issues among children globally, particularly in developing nations, like, India. The World Health Organization (WHO) has estimated that globally, 1.62 billion people are anemic, with the highest proportion of anemia (47.4%) among pre-school children; of these 293 million children, 89 million live in India.

Aim: Study the clinical and hematological profile of anemia in children age group 6 months - 11 years.

Material & Methods: This is an observational study conducted in 75 children in the Department of Pathology at Rama Medical College, Hospital and research centre. These children included were evaluated and screened for by proper clinical history, physical examinations and relevant investigations.

Result: Among 75 children included in the study, 64% (48) were males and 36% (27) were females, with slight male dominance. Age distribution revealed majority of all participants 45 (60%) were aged 6 months to 2 years, 20 (26.6%) aged 3 years to 5 years and 10 (13.4%) aged 6 years to 11 years. Most common presenting symptom was lethargy followed by easily fatigability, irritability and poor school performance. Moderate anemia was the most prevalent 42 (56%), followed by mild anemia 30 (40 %) and only 03 children (04%) had severe anemia. Peripheral smear examination showed that microcytic hypochromic anemia (MHA) smears were most common 41 (54.6%), followed by normocytic normochromic anemia (NNA) 32 (42.6%). Only 02 (2.8%) cases of dimorphic anemia.

Conclusion: Microcytic anemia was the prominent type of anemia, iron deficiency anemia as the major health problem in pediatric age group. Our study also highlights the importance of simple investigation, like CBC and peripheral blood smear in early diagnosing and categorizing type of anemia.

Keywords: anemia, children, complete blood count, Mentzer index.

INTRODUCTION

Anemia remain one of the notable health issues among children globally, particularly in developing nations, like, India. Though it is largely preventable and easily treatable it is quite prevalent among preschoolers, pregnant women and nursing mothers.^[1] The National Family Health Survey (NFHS-5, 2019-21) in the fifth round registered 67.1 percent of children between 6 and 59 months are anemic, significantly higher than NHFS-4 that had recorded 58.6 percent.^[2] The World Health Organization (WHO) has estimated that globally, 1.62 billion people are anemic, with the highest proportion of anemia (47.4%) among pre-school children; of these 293 million children, 89 million live in India [3]. With respect to Indian population there are several causes like, low socio-economic levels, restricted maternal education, limited access to health care facility, low dietary iron intake, parasitic infections, low birth weight and preterm.^[4]

According to World Health Organization (WHO), the most common causes of include nutritional deficiencies; Iron deficiency anemia accounts for 50% of cases followed by Vitamin B 12 deficiency, hemoglobinopathies, infectious disease like, malaria, HIV, tuberculosis and parasitic infestations. [5,6]

In a limited resource setting, peripheral smear morphology aids in diagnosing and classify anemia. Microcytic hypochromic anemia (MHA) is a strong indicator of Iron deficiency anemia (IDA), though other causes like thalassemia, should be kept in mind. Vitamin B12 and folate deficiency is indicated by macrocytic morphology.[7] Anemia of inflammation or of non-nutritional etiology have normocytic normochromic blood picture while dimorphic pattern represents combine nutritional deficiency. [8]

Microcytic hypochromic morphology is the most common in anemic children in several hospital-based studies in India. [1] There are several consequences of childhood anemia like, suppressed immune system predisposition to infections, poor growth, retarded psychomotor development and poor cognitive performance in the long term. [2,3] As anemia is multifactorial thorough clinical history and physical examination along with laboratory test is important for diagnosis.

The present study aimed to study the clinical and hematological profile of anemia in children age group 6 months - 11 years and to correlate with and demographic factors like, age and sex.

MATERIAL & METHODS:

This is an observational study conducted in 75 children in the Department of Pathology at Rama Medical College, Hospital and research centre over a period of five months (March 2026- July 2026). These children included were evaluated and screened for by proper clinical history, physical examinations and relevant investigations. Informed consent was taken from the parents or the legal guardian.

Inclusion criteria:

1. Children aged between 6 months to 11 years with clinical features of anemia.
2. Children aged between 6 months to 11 years who, in accordance with WHO recommendations had hemoglobin below the age- specific cutoff values.

Exclusion criteria:

1. Children on treatment or already diagnosed with anemia
2. Patients not willing to give consent.

On admission, a detailed history with emphasis on nutritional status of child, socio-economic status, breastfeeding history and physical examination was done. All children underwent demographic and anthropometric measurements including age, sex, weight, height and hematological work up including complete hemogram and peripheral blood smear was done. Under all aseptic precautions venous blood samples were collected. An automated five- part hematology analyzer was used to measure the hollowing parameters: hemoglobin (Hb) red blood cell count, packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), white blood cell count (WBC), platelet count and red cell distribution width (RDW). Mentzer index was calculated by dividing MCV by RBC count. If it is less than 13, thalassemia is more likely. If the result is more than 13, iron -deficiency anemia is are likely. The peripheral blood smear stained with Leishman stain was examined under light microscopy. Reticulocyte count was estimated using supravital stain. The diagnosis of anemia was based on WHO criteria.[9]

HEMOGLOBIN CONCENTRATION (g/L)				
Population	No anemia	Mild anemia	Moderate anemia	Severe anemia
Children, 6- 23 months	≥105	95- 104	70-94	< 70
Children, 24-59 months	≥110	100-109	70-99	<70
Children 5-11 years	≥115	110-114	80-109	<80

[Table 1]- WHO cutoff for diagnosing anemia and degree of anemia.

The data were analyzed in SPSS version 21and presented as frequencies and percentage.

RESULTS:

Among 75 children included in the study, 64% (48) were males and 36% (27) were females, with slight male dominance. Age distribution revealed majority of all participants 45 (60%) were aged 6 months to 2 years, 20 (26.6%) aged 3 years to 5 years and 10 (13.4%) aged 6years to 11 years. [Table 2].

Characteristics	Demographic profile	Frequency	Percentage (%)
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Gender	Male	48	64
	Female	27	36
Age	6 months- 2 years	45	60
	3years- 5 years	20	26.6
	6 years- 11 years	10	13.4

[Table 2]- Demographic profile of study population.

Majority of the children were first born 40 (53.3%), 12 (16.6%) were second born, 08 (11.11%) were third born, 10 (13.8%) were fourth born and 05 were (6.6%) born. Most children were born at term 68 (90.6%) while 07 (9.33%) were born preterm. Majority of the children 70 (93.3%) were exclusively breast fed for 6 months and 05 (6.6%) for less than 6 months. Among the study population, 52 (69.3%) followed mix/non-vegetarian diet pattern and 23 (30.6%) followed vegetarian diet [Table 3].

Characteristics	Socio-Demographic profile	Frequency	Percentage (%)
Birth order	First	40	53.3
	Second	12	16.6
	Third	08	11.11
	Fourth	10	13.8
	Fifth	05	6.6
Gestational Age	Term	68	90.6
	Preterm	07	9.4
Exclusive Breast Feeding	Till 6 months	70	93.3
	Less than 6 months	5	6.7
Diet Pattern	Mix/Nonvegetarian	52	69.3
	Vegetarian	23	30.7

[Table 3]- Socio- Demographic characteristic of study population.

Most common presenting symptom was lethargy followed by easily fatigability, irritability and poor school performance [Table 4].

Symptoms	Number of cases	Percentage (%)
Lethargy	55	73.3
Easy Fatigability	45	60
irritability	30	40
Poor-school performance/ Lack of concentration	18	24

[Table 4]- Distribution of symptoms among the study population.

Moderate anemia was the most prevalent 42 (56%), followed by mild anemia 30 (40 %) and only 03 children (04%) had severe anemia. Peripheral smear examination showed that microcytic hypochromic anemia (MHA) smears were most common 41 (54.6%), followed by normocytic normochromic anemia (NNA) 32 (42.6%). Only 02 (2.8%) cases of dimorphic anemia were seen indicating nutritional deficiencies as one of the major causes of anemia [Table 5].

Anemia Severity	Mild	30	40
	Moderate	42	56
	Severe	03	04
Peripheral Smear	Microcytic hypochromic	41	54.6
	Normocytic Normochromic	32	42.6
	Dimorphic anemia	02	2.8

[Table 5]- Showing degree and type of anemia seen on peripheral blood smear.

MHA had the lowest mean Hb 7.34 g/dl, followed by 10.2g/dl in NNA and 11.0 g/dl in dimorphic anemia.

Type of Anemia	HB (mean±SD)	PCV (mean±SD)	MCV (mean±SD)	MCH (mean±SD)	MCHC (mean±SD)	RDW (mean±SD)
MHA	8.564±1.34	29.1±8.33	61.2±10.32	20.1±4.33	33.4±20.2	14±2.56
NNA	10.2±2.23	30.45±4.28	74.34±6.06	22.45±2.12	35.3±12.8	15.2±.48

DIMORPHIC ANEMIA	11.0±0.2	32.6±2.1	84.2±3.44	28.2±1.65	30.6±1.30	24.6±0.24
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[Table 6]- Red cell indices were analyzed for the various anemia.

DISCUSSION:

In our study, 75 children were, 64% (48) were males and 36% (27) were females, with slight male dominance. Age distribution revealed majority of all participants 45 (60%) were aged 6 months to 2 years, 20 (26.6%) aged 3 years to 5 years and 10 (13.4%) aged 6 years to 11 years.

The prevalence of anemia was higher in girls (74.1%) as compare to boys (41.6%), which is similar to the study conducted by Ponnusamy et al. [6]

Chellan R et al. evaluated the influence of various socio-demographic factors on anemia in nationwide survey and reported that prevalence of anemia is directly related to the standard of living, which is consistent with our study as majority children belong to lower socio-economic classes. [10]

Most common presenting symptom in our study was lethargy (73.3%) followed by easily fatigability (60%) while Indhumathi et al. reported worm infestation and pica in 44 % and 47% of cases respectively. [11] Maheshwari R et al reported fatigue in 54% and weakness in 38 % of children which is consistent with symptom profile in our study. [12]

Moderate anemia was most prevalent 42 (56%), followed by mild anemia 30 (40 %) and only 03 children (04%) had severe anemia which is concordant with the study conducted by Mukhija G et al. and Wu J et al. with 41.2% and 46% cases respectively. [1,3] Peripheral smear examination showed that microcytic hypochromic anemia smears were most common 41 (54.6%), followed by normocytic normochromic anemia 32 (42.6%). Only 02 (2.8%) cases of dimorphic anemia were seen which is concordance with study conducted by Mukhija G, with 45% of MHA, 36.6% of NNA and 7.5% of dimorphic anemia which is relatively higher than our studies. [1] Wu J et al. demonstrated 81% of MHA peripheral smear which is relatively higher than our study. [3]

Goswami S et al. recorded 45% of NNA smear, followed by 37% MHA and 18% dimorphic smear. [13] Samal D.T. et al. also recorded 64% of MHA smear, 18 % of NNA, 12% dimorphic and 6% of macrocytic morphology on peripheral smear. [14]

In our study MHA had the lowest mean Hb 8.56 g/dl, followed by 10.2 g/dl in NNA and 11.0 g/dl in dimorphic anemia. Ponnusamy V et al. reported mean Hb of 9.15g/dl in MHA cases which is concordant with our study. [6]

Mentzer index was calculated in all cases of microcytic hypochromic anemia. 36 cases (92.6%) had Mentzer index of more than 13 along with high RDW indicating iron deficiency anemia as the cause, while 03 cases (7.4%) had value less than 13 and relatively normal RDW indicating thalassemia as the causes. Normocytic normochromic anemia may represent early stage of iron deficiency anemia as the MCH in this group is relatively on the lower side (22.45pg) if iron -deficiency persists. Dimorphic anemia indicates combined nutritional deficiency.

Iron deficiency anemia 38 cases (50.3%) constituted the major cause of anemia which is concordant with the study conducted by Mukhija G, Samal D T et al. Gomber S et al with 47.5%, 52% and 41.05% cases respectively. [1,14,15]

CONCLUSION:

Our study indicates the great burden of anemia among children between 6 months to 11 years of age. Microcytic anemia was the prominent type of anemia, iron deficiency anemia as the major health problem in pediatric age group. Our study also highlights the importance of simple investigation, like CBC and peripheral blood smear in early diagnosing and categorizing type of anemia. Since most of the younger children are asymptomatic a detailed history, thorough physical examination along with laboratory investigation plays a crucial rule in early detection of anemia.

REFERENCES:

1. 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 Pharma*. 2025;7(5):495-501.
2. International Institute for population sciences, Ministry of Health and Family Welfare, Government of India. National Family Health Survey (NFHS-5), 2019-21: India. Mumbai: IIPS;2021.
3. Wu J, Saranappa S. A clinical study of anemia in children aged 6 months to 5 years, in a tertiary care centre, Bengaluru, India. *Curr Pediatr Res*. 2024;28(05):2245-2249.
4. Rahman MH, Chauhan S, Patel R, et al. Anemia among Indian children: A study of prevalence and associated factors among 5-9 years old. *Child Youth Serv Rev* 2020; 119:105529.
5. World Health Organization. Nutritional Anemias: Tools for Effective Prevention and Control. Geneva: WHO;2017.

6. Ponnusamy V, Siva P et.al. Clinical and Hematological profile of nutritional anemia in children and adolescents aged 6 months to 18 years at a tertiary care hospital in South India: A Prospective observational study. *Int J Acad Med Pharm* 2026; 8 (2): 1077-1083.
7. Bain BJ, Leach M. Blood cells a practical guide. John Wiley & Sons; 2025 Nov 10.
8. Pandey C, Singh RK. Clinical spectrum of malaria in hospitalized children at a tertiary care centre in North India – A retrospective study. *Journal of Nepal Pediatric Society*. 2025 Aug 12; 45(2): 14-19.
9. Guidelines on hemoglobin cutoffs to define anemia in individuals and populations. Geneva: World health Organization; 2024. Licence: CC BY-NC-SA 3.0 IG0.
10. Chellan R, Paul L. Prevalence of iron -deficiency in India: Results from large nationwide survey. *J Popul Soc Stud*. 2010; 19:593-597.
11. Indhumathi AT, Srikumari D, Kulandaikasthuri k. Profile and outcome of nutritional anemia in children attending pediatric department of a tertiary care hospital Chennai. 2015.
12. Maheshwari BK, Raut P, Agarwal SK, Joshi U, Dhirhe TC, Gahine R. Iron status in iron deficiency anemia before and after iron therapy in school going children *J Clin Diagn Res*. 2011; 5(2): 324-327.
13. Goswami S, Acharjee R, Dey S. Determinants of anemia among children aged under five years in Assam India. *Int J Contemp Pediatr* 2020; 7:1.
14. Samal D.T., Ray, D., P.C., Karan D.S., Dash, D.D.K., Mohapatra, TD.M.D., & Saboth, D.P.K. Clinico-hematological profile of severe anemia in children (6 months- 14 years): a hospital -based prospective observational study. *Student's Journal of Health Research Africa*. 2026; 7(2):6.
15. Gomber S, Bhawna MN, Lal A, Kela K. Prevalence and etiology of nutritional anemia among school children of urban slums. *Indian J Med Res* .2003; 118: 167-171.