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Original Research Article

CLINICAL AND HAEMATOLOGICAL PROFILE OF NUTRITIONAL ANAEMIA IN CHILDREN AND ADOLESCENTS AGED 6 MONTHS TO 18 YEARS AT A TERTIARY CARE HOSPITAL IN SOUTH INDIA: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Aim: To study the clinical and haematological profile of nutritional anaemia in children and adolescents aged 6 months to 18 years in a tertiary care hospital in South India.
Materials and Methods: A total of 165 children who attended the paediatric out patient department of MGMGH, Trichy, with anaemia were included in this study. Targeted history was taken and detailed clinical examination done for the study population. Laboratory investigations included Complete Blood Count(CBC), peripheral smear and reticulocyte count. Statistical analysis of all data was done using IBM-SPSS software (version 21.0). p value < 0.05 was considered to be statistically significant and p <0.001 highly significant.
Results: Based on peripheral smear, the study population was divided into Microcytic Hypochromic Anaemia(MHA), Macrocytic Anaemia(MA) and Normocytic Hypochromic anaemia(NHA). In the MHA group, it was found that 48.8% of children belonged to the age group of 6 months to 4 years. Major subjective symptoms were pica, irritability, lethargy and easy fatigability seen in 29.1%, 21.2%, 29.1% and 38.8% respectively. Elevated Red cell Distribution Width(RDW) >15% was seen in 87.5% of the MHA cases. It was also found that 96% of study population with MHA had Mentzer index of >13 suggestive of Iron Deficiency Anaemia (IDA). Haemoglobin level had statistically significant positive correlation with RBC count, Packed Cell Volume, Mean Corpuscular Volume, Mean Corpuscular Haemoglobin, Mean Corpuscular Haemoglobin Concentration and statistically significant negative correlation with RDW. Thus high RDW was found to be a sensitive marker of iron deficiency. **Conclusion:** Nutritional anaemia continues to be a significant health concern among children and adolescents. Early diagnosis is essential for timely management. In resource-limited settings, IDA can be effectively screened using routine investigations such as CBC, peripheral smear, RDW and Mentzer Index, thereby minimizing the need for costly iron profile studies.

INTRODUCTION

Anaemia remains one of the most significant public health problems affecting children worldwide. According to the World Health Organization, the global prevalence of anaemia among children aged 6–59 months was 39.8% in 2019, corresponding to approximately 269 million children affected worldwide.[1] Although the prevalence declined gradually from 48.0% in 2000 to 39.8% in 2019, progress has stagnated since 2010. Recent Global Burden of Disease analyses estimate that anaemia affects nearly 1.92 billion people worldwide, and Iron deficiency anaemia alone accounts for hundreds of thousands of deaths globally each year and tens of millions of disability-adjusted life years (DALYs). South Asia and Southeast Asia carry one of the highest burdens of anaemia globally. Nearly 65% of children in this region are anaemic. In many Asian countries the prevalence of anaemia is particularly high among infants and young children under two years of age.
In India, anaemia continues to be a major public health concern. Data from the National Family

Health Survey (NFHS-4, 2015–2016) reported that 58.6% of children aged 6–59 months were anaemic, representing only an 11.5% reduction from the NFHS-3 (2005–2006) findings.[2,3] Among these children, 28% had mild anaemia, 29% moderate anaemia, and 2% severe anaemia. However, NFHS-5 (2019–2021) reported 67.1% of children aged 6–59 months were anaemic, an increase from 58.6% in NFHS-4, reflecting a rise of nearly 9% compared to NFHS-4.[4] These alarming statistics highlight that anaemia remains a significant national health challenge requiring early diagnosis, prevention, and effective management strategies.

According to the World Health Organization, anaemia is defined as a haemoglobin concentration below the normal reference value for age, sex, and physiological status. Haemoglobin is responsible for transporting oxygen from the lungs to body tissues. A reduction in haemoglobin concentration decreases the oxygen-carrying capacity of blood. Reduced oxygen delivery to tissues may result in symptoms such as fatigue, weakness, dizziness & shortness of breath.“ The most common causes of anaemia include nutritional deficiencies, particularly iron, folate & vitamins B12; haemoglobinopathies, infectious diseases like malaria, tuberculosis, HIV & parasitic infections. Among nutritional anaemia, Iron Deficiency Anaemia(IDA) accounts for 50% of cases”, making it the most common cause of anaemia worldwide.[5]

The causes for IDA varies based on age, gender, and socioeconomic status. Iron deficiency can result from insufficient iron intake, decreased absorption, or blood loss. In neonates, breastfeeding is protective against iron deficiency due to higher bio availability of iron in breast milk compared to cow's milk. Excessive cow’s milk intake in infancy is a common risk factor for iron deficiency anaemia. Another important cause is parasitic infestation particularly in developing countries. IDA is asymptomatic in most of the cases. Pallor is the most common manifestation and is seen in palmar creases, palms, nail beds and conjunctivae. Progressive fall in haemoglobin leads to symptoms such as irritability, headache, easy fatigability, dizziness, shortness of breath, palpitation, chest pain, lethargy and anorexia.[6] Hemic murmur might be heard on auscultation. This is usually associated with significant physical, psychological and social consequences. Tachycardia and high output cardiac failure occur, when haemoglobin level falls further. Other features include pica, poor school performance, leg cramps and reduced resistance to infections. Children with iron deficiency suffer from growth impairment and tend to be shorter than non-iron deficient children. In children with early iron deficiency without anaemia, the most important non haematological manifestation is impairment in intellect, cognitive function and motor function.[7,8] Some neurodevelopmental effects of early iron deficiency may persist despite treatment. Hence prevention of iron deficiency is better. Physical examination reveal pallor, spoon shaped nails (koilonychia), leuconychia, platynychia, splenomegaly in severe and persistent untreated anaemia.

Investigations for IDA includes complete blood count(CBC), peripheral smear, iron profile, stool for occult blood and serum B12 & folic acid levels to look for other causes of nutritional anaemia. Now most of the clinical laboratories are equipped with automated machines to perform CBC to estimate Hb, Packed cell volume (Hct) and Red blood cell count (RBC), while Mean corpuscular volume(MCV), Mean haemoglobin concentration(MCH) and Mean corpuscular haemoglobin concentration (MCHC) values are calculated from the above. Red cell indices are used to classify anaemia based on the size of the red blood cell as normocytic (normal MCV), macrocytic (increased MCV), or microcytic (decreased MCV). MCV indicates the size of the red blood cells. MCH indicates the amount of hemoglobin per red blood cell and MCHC indicates hemoglobin amount (%) per unit volume. In contrast to MCH, MCHC correlates the haemoglobin content with the cell volume. It is expressed in g/dl. Red cell distribution width (RDW), otherwise known as red cell morphology index represents “the coefficient of variation in the volume distribution (size) of the red blood cell” and it is expressed as a percentage, thereby quantifies the variation in the size of red cells (anisocytosis). It is reported as part of a standard CBC. The estimation of RDW may help in identifying true IDA. It is useful in differentiating IDA from other causes of microcytic hypochromic anaemia like thalassemia. High RDW may be due to presence of fragments, groups of agglutination, and/or abnormal shape of red blood cells. IDA usually presents with high RDW and low MCV. Folate and vitamin B12 deficiency anaemia usually present with high RDW and high MCV.

Peripheral smear examination is one of the most important investigations in haematology. A peripheral blood smear is used to categorize anaemia based on the size, shape and color of RBC (indicators of haemoglobin content). It also used in identifying conditions that affect one or more type of blood cells. Examples are anaemia, myeloproliferative disorders, leukemia, and parasitic infestation. If the result from an automated cell count or a differential count indicates the presence of abnormal WBC, RBC and/or platelets, it should be verified and confirmed by a peripheral smear examination. Reticulocyte count may be estimated manually or by automated analyzers and is corrected for the patient's haemoglobin level.

The Mentzer index is the MCV divided by the RBC count. It is helpful in differentiating iron deficiency anaemia from thalassemia. The index is calculated from the results of a CBC. If the quotient of the mean corpuscular volume (MCV, in fL) divided by the red blood cell count (RBC, in Millions per microLiter) is less than 13, thalassemia is more likely. If the result is greater than 13, then iron- deficiency anaemia is more likely.

In developing countries such as India, advanced investigations such as iron studies are not readily available in many healthcare institutions, particularly in resource-limited settings. A large proportion of children attending the outpatient department belong to middle and lower socioeconomic groups, and many parents or caregivers have limited awareness regarding the nutritional requirements of children. As a result, nutritional anaemia remains a common health problem in the paediatric population. Therefore, this study was planned to assess the clinical and haematological profile of nutritional anaemia among children attending Mahatma Gandhi Memorial Government Hospital, Tiruchirappalli. The study also aims to identify the major factors contributing to the increased prevalence of anaemia and to evaluate the usefulness of simple and easily available investigations such as complete blood count, peripheral smear examination, red cell distribution width, and Mentzer index in diagnosing iron deficiency anaemia in resource-limited settings. The findings of this study may help in identifying populations at greater risk of anaemia and in prioritizing areas for intervention. This will also aid in planning preventive and control strategies for nutritional deficiencies through strengthening national child health programmes such as Anganwadi Centres, Rashtriya Bal Swasthya Karyakram, District Early Intervention Centre(DEIC), and Rashtriya Kishor Swasthya Karyakram, along with parental counseling regarding appropriate infant feeding practices, safe drinking water, and sanitation.

MATERIALS AND METHODS

This Prospective observational study was conducted at a tertiary care hospital in Tamilnadu, India over a period of one year. Ethical clearance for the study was obtained from the institutional ethical committee [IEC.No: 55/2020]. Written informed consent was obtained from the parents or caregivers of all children included in the study.

Inclusion criteria: Children aged 6 months to 18 years attending the Paediatric Outpatient Department (OPD) and District Early Intervention Centre (DEIC) with clinical pallor were included in the study.

Exclusion Criteria: Children with anaemia due to malaria, thalassemia, sickle cell anaemia, red cell membrane defects, aplastic anaemia, acute or chronic blood loss, chronic systemic diseases, and those presenting with cardiovascular failure or shock were excluded from the study.

Clinical Assessment

A detailed history was obtained with particular emphasis on symptoms suggestive of anaemia such as weakness, easy fatigability, breathlessness on exertion, and pica. A thorough clinical examination was performed, focusing on signs of anaemia including pallor, nail changes, glossitis, and cardiovascular findings such as hemic murmur, congestive cardiac failure, and edema.

Laboratory Investigations

Routine investigations for anaemia included complete haemogram, peripheral blood smear examination, and reticulocyte count. Blood samples were collected under strict aseptic precautions. Approximately 2 mL of venous blood was collected into Ethylene Diamine Tetraacetic Acid (EDTA) tubes for complete blood count and peripheral smear examination. CBC analysis was performed using an automated haematology analyzer to measure the following parameters: haemoglobin (Hb), red blood cell count, packed cell volume (PCV), mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration, white blood cell (WBC) count, and platelet count. Red cell distribution width and the Mentzer index were derived from CBC parameters. The Mentzer index was calculated by dividing MCV by the RBC count. A peripheral blood smear was prepared, stained using Leishman stain, and examined under a light microscope for red cell morphology. Reticulocyte count was estimated manually using supravital staining techniques.

Statistical Analysis: The collected data were analysed using IBM SPSS Statistics software (version 21.0). Data were presented as frequencies and percentages. Continuous variables were analysed using One-way Analysis of Variance (ANOVA) where appropriate. Categorical variables were analysed using the Pearson Chi-square test. The correlation between haemoglobin levels and red cell indices was assessed using Pearson's correlation coefficient. A p-value of <0.05 was considered statistically significant, while a p-value of <0.001 was considered highly significant.

RESULTS

Among the 165 children included in the study, 48.5% (n=80) were aged 6 months–4 years, 41.8% (n=69) were 4–11 years, 4.2% (n=7) were 12–14 years, and 5.5% (n=9) were 15–18 years [Table/Fig-1]. The mean age of children with microcytic hypochromic anaemia (MHA), normocytic hypochromic anaemia (NHA), and macrocytic anaemia (MA) was 6.02 years, 4.5 years, and 11.33 years, respectively [Table/Fig-2]. Among the study population, 51.5% (n=85) were female and 48.5% (n=80) were male. Socioeconomic status was assessed using the Modified Kuppuswamy Scale.[9] The majority of children belonged to the lower class (40.6%, n=67) and upper-lower class (39.4%, n=65), followed by lower middle class (17%, n=28) and upper middle class (3%, n=5). Regarding birth order, 41.2% (n=68) were first-born, 37.6% (n=62) were second-born, 15.2% (n=25) were third-born, 4.8% (n=8) were fourth-born, and 1.2% (n=2) were fifth-born.

Most children (89.7%, n=148) were born at term, while 10.3% (n=17) were preterm. Among the study population, 81.2% (n=134) received exclusive breastfeeding for less than 6 months, while 15.2% (n=25) were exclusively breastfed for 7–9 months,

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and 3.6% (n=6) for 10–12 months. Breastfeeding duration was 10–12 months in 42.4% (n=70) of children, 7–9 months in 30.3% (n=50), more than one year in 23.6% (n=39), and less than 6 months in 3.6% (n=6). Complementary feeding was initiated before 6 months in 80.6% (n=133) of children, between 7–9 months in 15.8% (n=26), and between 10–12 months in 3.6% (n=6). A mixed/non-vegetarian diet was followed by 66.1% (n=109) of children, while 33.9% (n=56) were vegetarians.

Open air defecation was practiced by 64.8% (n=107) of families, whereas 35.2% (n=58) used latrines.

Awareness regarding hand-washing practices was present in 41.2% (n=68) of caregivers, while 58.8% (n=97) lacked such awareness. Only 17.6% (n=29) of caregivers were aware of social assistance schemes such as National Deworming Day and Weekly Iron and Folic Acid Supplementation Programme, while 82.4% (n=136) were unaware of these programmes. A history of regular deworming was present in 17% (n=28) of children and absent in 83% (n=137) [Table/Fig-3].

Symptom analysis showed easy fatigability in 38.8% (n=64), lethargy in 29.1% (n=48), irritability in 21.2% (n=35), palpitations in 9.1% (n=15), and breathlessness in 0.6% (n=1) of children [Table/Fig-4]. Among these symptoms, lethargy showed a statistically significant association with anaemia (p = 0.047) [Table/Fig-5]. Pallor was present in 100% (n=165) of the study population. Other signs included koilonychia/platyonychia (25.5%, n=42), glossitis/cheilitis (20%, n=33), hemic murmur (19.4%, n=32), and edema (0.6%, n=1) [Table/Fig-6].

Using Pearson correlation analysis, haemoglobin showed positive correlation with RBC count, PCV, MCV, MCH, and MCHC, and negative correlation with RDW. Haemoglobin demonstrated a weak and statistically non-significant correlation with reticulocyte count [Table/Fig-7]. The mean values of haematological indices among children with microcytic hypochromic anaemia, macrocytic anaemia, and normocytic hypochromic anaemia were compared using one-way ANOVA. The mean differences in RBC count, MCV, and MCH were statistically significant between groups, whereas hemoglobin, PCV, MCHC, RDW, and reticulocyte count were not statistically significant [Table/Fig-8].

Table 1: Age Distribution of Study Population (n = 165)

S. No	Age Group	Number of Children (n)	Percentage (%)
1	6 months – 4 years	80	48.5
2	4 – 11 years	69	41.8
3	12 – 14 years	7	4.2
4	15 – 18 years	9	5.5

Table 2: Mean Age of Children by Type of Anaemia

S. No	Type of Anaemia	Mean Age (Years)
1	Microcytic Hypochromic Anaemia (MHA)	6.02
2	Normocytic Hypochromic Anaemia (NHA)	4.5
3	Macrocytic Anaemia (MA)	11.33

Table 3: Socio-demographic, Birth, Feeding and Hygiene Characteristics of the Study Population (n = 165)

Category	Variable	Number (n)	Percentage (%)
Socioeconomic Status (Modified Kuppuswamy Scale)	Upper Middle Class	5	3.0
	Lower Middle Class	28	17.0
	Upper Lower Class	65	39.4
	Lower Class	67	40.6
Birth Order	First born	68	41.2
	Second born	62	37.6
	Third born	25	15.2
	Fourth born	8	4.8
	Fifth born	2	1.2
Gestational Age at Birth	Term	148	89.7
	Preterm	17	10.3
Duration of Exclusive Breastfeeding	< 6 months	134	81.2
	7–9 months	25	15.2
	10–12 months	6	3.6
Total Duration of Breastfeeding	< 6 months	6	3.6
	7–9 months	50	30.3
	10–12 months	70	42.4
	> 1 year	39	23.6
Initiation of Complementary Feeding	< 6 months	133	80.6
	7–9 months	26	15.8
	10–12 months	6	3.6
Diet Pattern	Mixed / Non-vegetarian	109	66.1
	Vegetarian	56	33.9
Sanitation Practice	Open air defecation	107	64.8
	Use of latrine	58	35.2
Awareness of Hand Washing	Aware	68	41.2
	Not aware	97	58.8

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Awareness of Government Schemes (NDD, WIFS)	Aware	29	17.6
	Not aware	136	82.4
Regular Deworming History	Present	28	17.0
	Absent	137	83.0

Table 4: Distribution of Symptoms among Study Population (n = 165)

S. No	Symptom	Number of Cases (n)	Percentage (%)
1	Irritability	35	21.2
2	Lethargy	48	29.1
3	Easy fatigability	64	38.8
4	Breathlessness	1	0.6
5	Palpitation	15	9.1

Table 5: Symptom analysis among various groups of anaemia

		Peripheral Smear						P value
		MA		MHA		NHA		
Irritability	No	2	1.5%	126	96.9%	2	1.5%	0.67
	Yes	1	2.9%	34	97.1%	0	0.0%	
Lethargy	No	3	2.6%	114	97.4%	0	0.0%	0.047
	Yes	0	0.0%	46	95.8%	2	4.2%	
Easy fatigability	No	1	1.0%	98	97.0%	2	2.0%	0.325
	Yes	2	3.1%	62	96.9%	0	0.0%	
Breathlessness	No	3	1.8%	159	97.0%	2	1.2%	0.984
	Yes	0	0.0%	1	100.0%	0	0.0%	
Palpitation	No	2	1.3%	146	97.3%	2	1.3%	0.308
	Yes	1	6.7%	14	93.3%	0	0.0%	

Table 6: Clinical Signs of Anaemia in the Study Population (n = 165)

Clinical Sign	Number of Cases (n)	Percentage (%)
Pallor	165	100
Koilonychia / Platynychia	42	25.5
Hemic Murmur	32	19.4
Glossitis / Cheilitis	33	20.0
Edema	1	0.6

Table 7: Pearson's correlation statistics between haemoglobin, red cell indices

HAEMOGLOBIN	r value	p value
RBC	0.374	<0.0001
PCV	0.757	<0.0001
MCV	0.554	<0.0001
MCH	0.44	<0.0001
MCHC	0.351	<0.0001
RDW	-0.288	<0.0001
RETICULOCYTE COUNT	-0.047	0.550

Table 8: Comparison of mean differences between 3 groups of anaemia

	Peripheral Smear						P value
	MA		MHA		NHA		
	Mean	SD	Mean	SD	Mean	SD	
HB	10.63	0.25	9.15	1.31	9.60	0.57	0.133
RBC	3.27	0.29	4.32	0.47	3.60	0.57	<0.0001
PCV	33.57	1.69	30.69	4.70	30.00	2.83	0.557
MCV	103.70	8.48	71.5	8.05	71.15	1.77	<0.0001
MCH	35.00	0.92	22.5	4.52	21.40	6.22	<0.0001
MCHC	33.77	3.29	30.9	2.70	32.40	3.68	0.148
RDW	22.1	0.40	17.03	3.00	15.80	0.57	0.559
Reticulocyte count	0.60	0.10	0.85	0.45	1.10	0.14	0.459

DISCUSSION

The present study aimed to evaluate the clinical and haematological profile of anaemia among children attending a tertiary care hospital. The findings highlight the significant burden of nutritional anaemia in the paediatric population and the usefulness of basic haematological investigations in its diagnosis.

A study conducted by Sudhagandhi S et al. in Kattankulathur, Tamil Nadu assessed the prevalence of anaemia among school children. Among the 900 children included in the study, 52.88% were found to be anaemic. The prevalence was significantly higher among girls (67.77%) compared to boys (35.55%), and anaemic children were more likely to be underweight.[10] These findings are comparable with the observations of the present study, which also demonstrated a high burden of anaemia among children from similar socioeconomic backgrounds.

Similarly, a study conducted by Sabita Basu among apparently healthy adolescent girls in Chandigarh reported that anaemia was more common among rural adolescents (25.4%) compared to urban adolescents (14.2%), suggesting the influence of environmental and socioeconomic factors on nutritional status.[11]

A nationwide survey by Chellan R et al. evaluating the influence of socioeconomic and demographic factors on anaemia reported that the prevalence of anaemia was higher among children belonging to lower socioeconomic groups, and that the severity of anaemia was inversely related to maternal education and standard of living. These findings are consistent with the results of the present study, in which the majority of children belonged to lower socioeconomic classes.[12]

An Indian study conducted by Gomber S et al. among school children aged 5–11 years from an urban slum demonstrated that the most common type of anaemia was pure or mixed iron deficiency anaemia (68.42%), followed by vitamin B12 deficiency anaemia (28.42%). Among the pure forms, iron deficiency anaemia constituted 41.05% of cases, which is similar to the findings of the present study where iron deficiency anaemia was the predominant type of anaemia in the paediatric population.[13]

In the present study, 48.8% of children with microcytic hypochromic anaemia belonged to the 6 months–4 years age group, whereas a study by Ryan P et al. reported that 75% of children with iron deficiency anaemia were between 1–2 years of age, highlighting that younger children remain particularly vulnerable to iron deficiency.

Regarding clinical manifestations, a study by Indhumathi K et al. reported worm infestation and pica in 44% and 47.3% of cases, respectively. Another study by Maheshwari R et al. reported fatigue in 54% and weakness in 38% of children with anaemia, findings which are consistent with the symptom profile observed in the present study.[14,15]

Red cell distribution width was found to have a strong association with iron deficiency anaemia in the present study. Studies by Sazawal S et al. and Aulakh R et al. also demonstrated that RDW has a sensitivity of approximately 81% in diagnosing iron deficiency anaemia[16,17]. In another study by Indhumathi K et al., elevated RDW (>15%) was observed in 67% of cases, further supporting its diagnostic utility.[14]

In the present study, a small proportion of children (n=2) with normocytic hypochromic anaemia may represent early or evolving iron deficiency, as the average MCH value in this group was relatively low (21.4 pg). Over time, these children may progress to overt microcytic hypochromic anaemia if iron deficiency persists. In resource-limited settings, early identification of iron deficiency is essential to prevent long-term consequences such as growth impairment and cognitive dysfunction. Children identified at an early stage may benefit from oral iron supplementation, thereby preventing progression to severe anaemia.[8]

The findings of the present study highlight the importance of simple and widely available investigations such as complete blood count and peripheral smear examination in the diagnosis of iron deficiency anaemia. Advanced investigations such as serum iron, ferritin, total iron-binding capacity (TIBC), transferrin, and transferrin saturation may not always be available in resource-limited settings. Therefore, RDW derived from CBC can serve as a useful and sensitive marker for early detection of iron deficiency anaemia.

National health programs:

The Ministry of Health and Family Welfare recommends iron and folic acid supplementation for children and adolescents to prevent nutritional anaemia. In 2013, the government introduced the National Iron Plus Initiative to strengthen existing programmes and ensure iron and folic acid supplementation across various age groups.

Under this initiative, programmes such as the Weekly Iron and Folic Acid Supplementation Programme were implemented to provide iron and folic acid supplementation to school-going and non-school-going children and adolescents.

Another important public health intervention is the National Deworming Day, which aims to reduce the burden of intestinal worm infestations among children and adolescents across the country.

CONCLUSION

The present study demonstrated that microcytic hypochromic anaemia was the predominant type of anaemia, observed in 160 out of 165 children, indicating that iron deficiency anaemia remains a major health problem in the paediatric population.

Early identification and management of iron deficiency are essential to prevent long-term complications such as growth impairment and cognitive dysfunction. Preventive measures including exclusive breastfeeding, timely introduction of complementary feeding, avoidance of excessive cow's milk intake, improved sanitation practices, regular deworming, and iron supplementation should be emphasized through public health initiatives and parental education.

In resource-limited settings, iron deficiency anaemia can be effectively identified using simple and widely available investigations such as complete blood count, peripheral smear examination, red cell distribution width, and the Mentzer index, thereby reducing the need for expensive iron studies.

Strengthening national programmes such as the Midday Meal Scheme, National Deworming Day, and Weekly Iron and Folic Acid Supplementation Programme will further help in preventing and controlling nutritional anaemia among children and adolescents.

Limitations: This study was conducted in a single tertiary care hospital with a relatively small sample size, which may limit the generalizability of the findings. Being a hospital-based study, it may not reflect the true community burden of anaemia. In addition, detailed iron and micronutrient studies were not performed in all cases due to resource limitations.

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