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Original Research Article

Clinicohaematological Patterns of Anemia and Correlation with Clinical Conditions in Children Aged 5 to 12 Years in Tertiary Care Centre

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Abstract

Objective : To classify the haematological pattern, severity of anemia in children 5-12 years age admitted and to find its correlation with the clinical conditions.

Methods Crossectional study of 160 patients in two years was done. Patients satisfying the inclusion criteria were selected for study. Relevant clinical data were recorded in a structured proforma including detailed history was recorded with particular symptoms suggestive of anemia such as weakness and easily fatigability, breathlessness on exertion and pica. A thorough clinical examination of every child was done followed by routine investigations for anemia

Results Patients between 7-8 year were found to be the most affected. Anemia was found to be more common in female children as compared to male children (F:M=1.13). Anemia is more common in undernourished child. Most common presenting symptoms were gastrointestinal including vomiting, diarrhea and pain abdomen. Most common sign was Pallor followed by other common signs included signs of dehydration associated with diarrhea, hepatosplenomegaly. microcytic hypochromic anemia was the most common morphological type of anemia and macrocytic anemia was the least common.Thalassemia cases were most common among hemolytic anemias. Iron Deficiency Anemia (Nutritional Anemia) was the most common etiology of anemia.

Conclusion Dietary deficits affect children aged 5 to 12, creating financial, emotional, and psychological burden for patients and their families, as well as depleting critical national resources. As a result, screening for these illnesses, as well as early detection of anemia and related problems, is essential.

Keywords: Haematological Pattern, Severity of Anemia, Microcytic Hypochromic Anemia, Iron Deficiency Anemia

Introduction

In underdeveloped countries, up to 51% of children aged 0 to 4 years and 46% of children aged 5 to 12 years are anaemic. The WHO has estimated that, globally 1.62 billion people are anemic with the highest prevalence of anemia (47.4%) among preschool aged children, of these 293 million children, 89 million live in India while prevalence of anemia among school children is 25.4%. Prevalence of anemia in 5 to 12 years aged children is 62.5% (among vegetarian) and 51% (among non-vegetarian).[1-3]

Most common anemia in developing countries is nutritional anemia which can be due to Iron deficiency (most common cause), Folic acid deficiency, Vitamin B12 deficiency or may be combination of these factors. Other types include hemolytic anemia (congenital or acquired), aplastic anemia, anemia due to blood loss and anemia of chronic disease.[3,4]

Young people are more vulnerable to anemia due to their rapid growth need of high iron.Significant proportion of the apparently healthy children have latent iron deficiency. The probable reason for this might be the rising tendency of consuming snacks and junk foods.[4]

Anemia has adverse effect on growth, physical activity and academic performance. Children with anemia especially iron deficiency are at high risk of long-term impairment in mental and motor development. Anemia also adversely affect immune system thus increasing the susceptibility to infection and poor physical fitness. These may result in mortality and significant morbidity among children and comprise a public health crisis of considerable importance.[5,8,9]

In India, the national program for prevention and control of anemia focuses on pregnant women and young children less than 5 years. Very less and limited studies are there on 5 to 12 years age group and also much study on morphological classification of anemia had not been done previously in this particular age group.The present study was carried out to assess the hematological patterns of anemia in children aged 5 to12 years and its correlation with clinical conditions in a tertiary care centre.

Materials and Methods

Study Design: Cross sectional Study.

Study Area: L.N. Medical College & Research Centre and associated J.K Hospital Bhopal.

Total No. of cases: As per statistician calculation total of 210 patients had to be enrolled in study, but due to covid-19 pandemic 160 patients admitted in Pediatric ward and those satisfying the inclusion criteria are enrolled in the study.

Study Duration: 2 years (December 2019 to December 2021)

Inclusion Criteria:

- All patients in age group 5-12year age admitted in Pediatric ward
- Those who are willing to sign informed consent form, whose consent given by their parents & Assent from child above 10yrs age.

Exclusion Criteria:

- Children less than 5 year and more than 12 years.
- Out patients who were not admitted in the hospital
- Children on iron medications
- Those given blood transfusion in last 3 months.
- Children of unwilling parents

Consent: Informed consent was taken from parents of all patients in age group5–12- year age admitted in Pediatric ward. Concent given by their parents ,consent form attached in both Hindi and English format.

Method of Study (Procedure Planned & Investigation Details)

After obtaining clearance from the Institutional Ethical Committee, an informed consent was taken from parent of all children, who are included in study. Patients satisfying the inclusion criteria were selected for study. Relevant clinical data were recorded in a structured proforma including detailed history was recorded with particular symptoms suggestive of anemia such as weakness and easily fatigability, breathlessness on exertion and pica. A thorough clinical examination of every child was done followed by Routine investigations for anemia were done in the hospital laboratory and under the guidance of the faculty in charge of the laboratory.

Routine Investigations Including

Complete haemogram which consist of estimation of Hb%, RBCs Counts, Packed Cell Volume (PCV), Total Leucocytes count (TLC), Differential Leucocytes counts (DLC), RBC Indices-MCV, MCH, MCHC, Red Cell Distribution Width (RDW), Platelet counts.Peripheral Smear (P.S Comment),Reticulocyte Count,Serum FerritinOther additional tests such as stool and urine examinations, liver and renal function tests, Mantoux test, and radiographic investigations such as Xray, ultrasonography, and CT scan were performed if needed.

The Venous Blood samples of adequate amount were collected in EDTA vials and the collected blood sample was further analyzed for estimation of parameters including HB%, RBC counts, PCV, Total WBC Counts including Differentials Leucocytes count, RBC indices including MCV, MCH, MCHC. Red cell distribution width and Platelet Counts. Hb was estimated by Sahli's method and express in gm%, PCV, MCV, MCH, MCHC & RDW were determined by automated cell counter, & supravital staining technique with methylene blue staining was used for reticulocyte count. glass slides are prepared using leishman stain for Peripheral Smear, and anemia was classified morphologically based on peripheral smear as: -

- Microcytic Hypochromic Anemia
- Normocytic Hypochromic Anemia
- Normochromic Normocytic Anemia
- Macrocytic Anemia
- Dimorphic Anemia

After Routine Complete Hemogram and Peripheral Smear, Reticulocyte counts Using Supravital Technique with Methylene blue stain were done in view of Hemolytic Anemia and S. FERRITIN were among the microcytic hypochromic anemia cases to diagnose iron deficiency anemia.The complete blood count (CBC), which includes estimations of hemoglobin, hematocrit, RBC count, MCV, MCHC, MCH, TLC, and platelet count, is still a valuable starting point in the laboratory examination and classification of anemias.

Anemia was classified in this study according to WHO criteria: Hb concentration of less than 11gm/dl (among children between 6 months to 6 years) and a hemoglobin concentration of less than 12 gm/dl – (among children between 6years to 12 years).

Anemia Grades and Severity (according to WHO criteria) [41] as Mild – Hbpercent between 10 and the age-related cut-off value percent between 7 and 9.9 gm% is considered moderate and Severe - Hb percent less than 7

gm%Normal values of RBC indices taken as PCV-35-45%, MCV-77-95fl, MCH- 25-33pg, MCHC-31-37gm/dl and RDW 14.5-18.5

Based on the MCV values, anemia was classified as Microcytic, Normocytic, or Macrocytic based on the size of the RBCs: Microcytic when MCV is less than 77 fl, Normocytic when MCV is between 77 and 100 FL, and Macrocytic when MCV is greater than 100 fl.Peripheral smear with indications of RBC breakdown in the form of schistocytes, crenated RBCs, increased reticulocyte count, and morphological variants such target cells, which were largely detected in thalassemia, were the diagnostic criteria for hemolytic anemia.

Observation Chart

The present study is a Cross sectional Study carried out in Department of Pediatrics,L.N. Medical College & Research Centre and associated J.K Hospital Bhopal during the period of December 2019 to December 2021. The study included 160 IPD patients aged 5 to 12 years old who were admitted to the Pediatric ward of J.K hospital in Bhopal with anemia, as well as those who arrived with other complaints and were found to be anemic incidentally.

Table 1: Distribution of Cases According to Age and Gender

Age in years	No. of cases	Male	Female	Total %
5-6 years	44	26	18	27.6
7-8 years	90	38	52	56.2
9-10 years	13	6	7	8.1
11-12 years	13	5	8	8.1
Total	**160**	**75**	**85**	**100**

Table 2: Distribution of Cases According to Gender and Severity

Grade of Anemia	Males		Females		
	No.	%	No.	%	**Total**
Mild Anemia	35	46.4	39	46	**74**
Moderate Anemia	30	40	40	47	**70**
Severe Anemia	10	13.3	6	7	**16**
Total	**75**		**85**		**160**

Table 3: Anemia Frequency In Relation To Nutritional Status

Anemia	Nutritional Status	Number	Percentage
Present	Undernourished	118	73.7
Present	Well Nourished	42	26.3
Total		**160**	**100**

Table 4: Distribution of Cases According to Grade and Nutritional Status

Grade of Anemia	Undernourished		Well-nourished		
	No.	**%**	**No.**	**%**	**Total**
Mild	42	35.5	32	76.1	**74**
Moderate	62	52.5	8	19.1	**70**
Severe	14	12.1	2	4.8	**16**
Total	**118**		**42**		**160**

Table 5: Distribution of Common Presenting Symptoms

Symptoms	No.	%
Gastro-intestinal symptoms	75	46.8
i. Pain Abdomen	52(69.3%)	
ii. Vomiting	13(17.3%)	
iii. Loose Motions	7(9.3%)	
iv. Blood in stool	3(4%)	
Respiratory symptoms	42	26.3
Fever	22	13.8
Generalized Weakness/ Fatigue	15	9.4
Inability to gain weight	7	4.4
Urinary symptoms	6	3.7
Decrease Appetite	4	2.5
CNS Symptoms	4	2.5
Skin rash	3	1.8
Facial puffiness	2	1.25
Ear discharge	1	0.6

Table 6: Distribution of Common Clinical Findings

CLINICAL FINDINGS	NUMBER
Pallor	**86**
Signs of dehydration	**27**
Fever	**25**
Crepitations / Wheeze	**21**
Hepatosplenomegaly	**18**
Tachycardia / Tachypnoea	**14**
Cervical Lymphadenopathy	**7**
Abdominal Tenderness	**7**
Edema	**6**
Petechiae	**5**
Icterus	**4**
Koilonychia	**4**
Hyperpigmentation	**3**
Short stature	**3**
Seizure	**3**
Dry skin	**2**
Muscle wasting	**2**
Microcephaly	**1**

Table 7: Distribution Based on General & Systemic Diseases

General and Systemic Diseases	No.	%
GIT Diseases	64	40.0
Respiratory System diseases	54	33.7
Nutrition related disorders	14	8.75
Infections	19	11.8
CNS Disease	5	3.1
Renal Disease	4	2.5

Table 8: Distribution of Cases Based On Clinical Diagnosis

Clinical Diagnosis	No.	%
Acute Gastroenteritis and Acute Diarrheal Diseases	65	40.6
Respiratory tract infections	45	28.1
Tuberculosis	13	8.1
Dengue fever	12	7.5
Enteric fever	9	5.6
Bronchial asthma	5	3.1
Acute appendicitis	5	3.1
Acute Glomerulonephritis	4	2.5
Rickets	2	1.3

Table 9: Distribution Based on Morphological Pattern

Morphological Types	Number	Percentage
Microcytic Hypochromic Anemia	88	55
Normocytic Hypochromic Anemia	34	21.25
Normocytic Normochromic Anemia	21	13.12
Dimorphic Anemia	12	7.5
Macrocytic Anemia	5	3.12
Total	160	100

Table 10: Distribution of Cases Based on Etiology

Etiology	Number	Percentage
Iron deficiency anemia (IDA)	113	70.6
Megaloblastic anemia	8	5
Thalassemia	7	4.37
Sickle cell anemia	4	2.5
Others. 1Anemia due to infectious disease-75% 2.Anemia due to renal cause -14.3% 3.Anemia due to blood loss -10.8%	28	17.5
Total	160	100

Table 11: Corelation Between Etiological and Morphological type of Anemia

Etiological type	Morphological type					
	Microcytic hypochromic anemia	Normocytic hypochromic anemia	Normocytic normochromic anemia	Dimorphic anemia*	Macrocytic anemia	Total
Iron deficiency anemia	75	22	10	6	0	113
Megaloblastic anemia	0	0	0	3	5	8
Thalassemia	5	2	0	0	0	7
Sickle Cell Anemia	0	1	0	3	0	4
Others	8	8	12	0	0	28
Total	**88**	**34**	**21**	**12**	**5**	**160**

Results

- As per the WHO Criteria, 160 pediatric patients of age group 5-12 year were diagnosed with anemia.Among 5-12year age group, patients between 7-8 year were found to be the most affected.
- Anemia was found to be more common in Female children as compared to Male children (F:M=1.13). Among 5-12 years Children, Mild degree of anemia was most prevalent followed by Moderate and Severe type.
- There was significant relation between Anemia and Nutritional status, Anemia is more common in Undernourished child.
- Most common presenting symptoms were Gastrointestinal including Vomiting, Diarrhea and Pain abdomen followed by Respiratory symptoms and Fever.
- Most common sign was Pallor followed by other common signs included signs of Dehydration associated with Diarrhea, Hepatosplenomegaly.
- Gastrointestinal ailments were shown to be the most frequently related with anemia in this study, followed by Respiratory diseases.The most common clinical diagnosis related with anemia in this study was Acute Gastroenteritis & Acute Diarrheal Disease followed by Respiratory tract infections.
- Microcytic Hypochromic Anemia was the most common morphological type of anemia and Macrocytic Anemia was the least common.
- Thalassemia cases were most common among Hemolytic Anemias.Iron Deficiency Anemia (Nutritional Anemia) was the most common etiology of anemia.

Statistical Analysis:

The collected data was summarized by using frequency, percentage, mean & S.D. To compare the qualitative outcome measures Chi-square test or Fisher's exact test was used. To compare the quantitative outcome measures Independent t test was used. If data was not following normal distribution, Mann Whitney U test was used. SPSS version 22 software was used to analyse the collected data. p value of

<0.05 was considered to be statistically significant.

Discussion

Gupta V, Tripathi S reported on the clinico-haematological profile of pancytopenia in children from the Departments of Pediatrics and Pathology, Institute of Medical Sciences, Banaras Hindu University, India, over a period of 30 months. A detailed history, clinical examination and haematological parameters were recorded. Bone marrow aspiration and trephine biopsy were carried out in all cases. Aplastic anaemia was the most common cause of pancytopenia (43%) followed by acute leukaemia (25%). Infections were the third most common cause of pancytopenia of which kala azar was the most common. Megaloblastic anaemia was seen in 6.7%.[6]

Venkataswamy C et al did clinico-haematological profile of hereditary haemolytic anaemias in a tertiary health care hospital in south indiaThe study was carried for duration five and half years (four years of retrospective and one and a half years prospective). All the patients diagnosed as hereditary haemolytic anaemia based on peripheral smear and special haematological investigation were included in the study. The clinical parameters and haematological parameters of all these patients were studied.Among thalassaemia syndromes beta thalassaemia was commonest clinically presenting disorder with a high morbidity. Sickle cell anaemia showed a higher level of HbF and a relatively milder clinical course. Haemoglobinopathies constitute the major group of hereditary haemolytic anaemia (74%). Genetic counselling is an important step in reducing the incidence of thalassaemia major.[7]

Reshma ST et al studied clinico-haematological study of pancytopenia.The study was a prospective study ,50 patients were evaluated clinically along with haematological parameters, bone marrow aspiration and wherever required .In all patients, a detailed relevant history along with a physical examination was done .Fever and generalized weakness were the most common symptoms. The commonest physical findings were pallor followed by splenomegaly and hepatomegaly.The commonest cause of pancytopenia was Aplastic anaemia (36%), followed by Myelodysplastic syndrome .As a large number of pancytopenic patients have a reversible aetiology, early & proper diagnosis may be life saving. Maximum diagnostic yield can be achieved by correlation with clinical findings & laboratory parameters.[8]

In a similar studies like us ,Subramaniam N et al studied clinicohematological study of thrombocytosis in children. Chauhan V et al studied clinico-haematological profile of children with vitamin B12 deficiency anaemia. Onimawo IA et al did assessment of anaemia and iron status of school age children .The objective of all these studies was to investigate anaemia in school children aged 7-12 years as well as identify factors associated with anemia in the children. Haemomoglobin (Hb), haematocrit (PCV) and serum ferritin were used to determine anaemia and iron status in 208 children. [9-11]

Sayyari AA et al studied prevalence of anaemia in 2-12-year-old Iranian children. The study was part of the National Health and Disease Survey in 1999 that used a cluster sample of 1 in 1000 of the Iranian population. Of 4170 children aged 2- 6 years, 7.3% were diagnosed with mild anaemia, 2.5% moderate anaemia and 1.0% severe anaemia [WHO definitions]. Of 8461 children aged 7- 12 years, 10.9% were diagnosed with mild anaemia, 3.0% moderate anaemia and 1.1% severe anaemia. The prevalence of anaemia was significantly higher in rural than urban areas.[12]

Hall A et al reported on the haemoglobin concentrations and prevalence of anaemia in schoolchildren in eight countries in Africa and Asia as a part of programmes to develop school-based health services.Anaemia was

found to be a severe public health problem (defined as >40% anaemic) in five African countries for children aged 7–11 years and in four of the same countries for children aged 12–14 years. Anaemia was not a public health problem in the children studied in the two Asian countries. More boys than girls were anaemic, and children who enrolled late in school were more likely to be anaemic than children who enrolled closer to the correct age. Anaemia is a significant problem in schoolchildren in sub-Saharan Africa. School-based health services which provide treatments for simple conditions that cause blood loss, such as worms, followed by multiple micronutrient supplements including iron, have the potential to provide relief from a large burden of anaemia.[13]

Choi JW investigated if Helicobacter pylori infection relate to iron deficiency anaemia in prepubescent children under 12 years of age.Haemoglobin levels, iron parameters and serum IgG antibodies to H. pylori were measured in 693 children aged 9 to 12 y. No significant differences in the seroprevalence of H. pylori infection and antibody titres to H. pylori were found between the IDA group and the non-anaemic controls.It was concluded that H. pylori infection does not seem to contribute to iron deficiency in prepubescent children.[14]

Egbi G et al studied anaemia among school children older than five years in the Volta Region of Ghana. The Ghana School Feeding Programme (GSFP) was instituted on pilot basis in an effort to provide nutritious lunch to school childrenThis cross-sectional study involved a random sample of 143 pupils aged 6 to 12 years. Blood samples were collected and analysed Seventy-one percent of pupils had low SF levels. MP prevalence was 67.8%. Hookworm infestation was only observed in males (18.0%). Dietary iron and vitamin C intakes were 18.98±8.8mg and 23.7±6.7mg, respectively. Child's sex, SF and MP were associated with anaemia. Males had a lower likelihood of being anaemic (OR = 0.2, CI 0.1-0.5, p = 0.002)The study findings underscore the need for multi-pronged approaches that address both malaria control and nutrition in order to reduce anaemia among pupils.[15]

Behera S et al studied magnitude of anemia and hematological predictors among children under 12 years in Odisha, India. Gomber S et al in a similar study saw prevalence & etiology of nutritional anaemia among school children of urban slums. Hematological indicators were measured by standard procedures, which include red blood cell (RBC) indicators, white blood cell (WBC) indicators, and plasma ferritin. By both above studies ,it was concluded that the prevalence of anemia was higher with concomitant acute infection among study population, which is a matter of concern. Since the hematological parameters are interrelated with each other as well as with the age and gender, relevant intervention strategy and constant monitoring are needed while providing public health nutrition programs to eradicate anemia.[16,17]

Lopez A et al in their study found that anaemia affects roughly a third of the world's population; half the cases are due to iron deficiency. It is a major and global public health problem that affects maternal and child mortality, physical performance, and referral to health-care professionals. Children aged 0–5 years, women of childbearing age, and pregnant women are particularly at risk. [18]

Several chronic diseases are frequently associated with iron deficiency anaemia—notably chronic kidney disease, chronic heart failure, cancer, and inflammatory bowel disease. Measurement of serum ferritin, transferrin saturation, serum soluble transferrin receptors, and the serum soluble transferrin receptors–ferritin index are more accurate than classic red cell indices in the diagnosis of iron deficiency anaemia. In addition to the search for and treatment of the cause of iron deficiency, treatment strategies encompass prevention, including food fortification and iron supplementation. Oral

iron is usually recommended as first-line therapy, but the most recent intravenous iron formulations, which have been available for nearly a decade, seem to replenish iron stores safely and effectively.

Conclusion:

Dietary deficits affect children aged 5 to 12, creating financial, emotional, and psychological burden for patients and their families, as well as depleting critical national resources. As a result, screening for these illnesses, as well as early detection of anemia and related problems, is essential.The need of the hour is for a standardized definition of screening criteria and an effectual method to respond to irregularities.

Declarations:

Funding: None **Conflicts of interest/Competing interests**: None **Availability of data and material**: Department of Pediatrics L.N. Medical College & Research Centre and associated J.K Hospital Bhopal **Code availability**: Not applicable **Consent to participate**: Consent taken **Ethical Consideration**: There are no ethical conflicts related to this study. **Consent for publication**: Consent taken

What this study add to existing knowledge
Children aged 5 to 12 years are the most vulnerable to dietary deficiencies, causing financial, emotional, and psychological hardship to patients and their families, as well as depleting vital national resources. As a result, screening for these disorders is required, as is early screening for anemia and related conditions. Dietary deficits affect children aged 5 to 12, creating financial, emotional, and psychological burden for patients and their families, as well as depleting critical national resources. As a result, screening for these illnesses, as well as early detection of anemia and related problems, is essential.

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