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Original Article

CLINICO-HEMATOLOGICAL PROFILE OF NUTRITIONAL ANEMIA IN HOSPITALISED INFANTS AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: Anemia is a serious global public health problem that particularly affects young children. As many as 67.1% children aged 6-59 mo surveyed suffered from anemia in 2019 and 65.5% in Karnataka, according to NFHS-5. Nutritional anemia is most common but preventable cause for anemia in children in developing countries. This is due to improper feeding habits, especially during the initiation of complementary foods. Hence the present study is to know the pattern of anemia in infants of age group between 6 mo to 12 mo and to assess the nutritional and other associated risk factors contributing to Anemia.

Methods: This study was carried out in 193 children aged 6 mo to 12 mo admitted in our hospital. Detailed clinical evaluation and relevant laboratory investigations were done as per proforma.

Results: In our study majority were of age group 6 to 9 mo (52.8%). 40.4% of mothers of our study infants were anemic during pregnancy and 9.3% were blood transfused. Majority (53.4%) were exclusively breastfed. 45.6% were started on complementary feeding at 4 to 6 mo age.17.6% were moderately wasted and 9.3% of infants were severely wasted. There was a significant association between severity of anemia and mother's anemia, inclusion of cow's milk in diet, adequacy of complementary feeding, and inclusion of formula feeds ($p<0.05$).

Conclusion: Nutritional anemia is most common cause of anemia in childhood, especially in developing countries like India. Parents and caregiver need awareness regarding the effect, causes of anemia and how to prevent it.

Keywords: Anemia, Iron, Vitamin B12, Exclusive breastfeeding, Complementary feeding

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INTRODUCTION

Anemia is defined as a condition in which the concentration of hemoglobin or the number of red cells, either singly or in combination, is reduced below the age-corrected values. The data from WHO shows that 40% of children less than 5 y of age and 37% of pregnant women worldwide are anaemic [1]. As many as 67.1% children aged 6 mo to 59 mo surveyed suffered from anemia in 2019 and 65.5% in Karnataka [2]. The most common causes of anemia include nutritional deficiencies, particularly iron deficiency, though deficiencies in folate vitamin B12 are also important causes; of hemoglobinopathies; and infectious diseases, such as malaria, tuberculosis, HIV and parasitic infections. Special attention needs to be given to the consumption of iron-rich or iron-fortified foods because iron deficiency is the common cause of anemia among under-five-year-old children [3].

Anemia is one of the most important disorders of blood in infancy and early childhood. These result in significant morbidity and mortality in children and constitute a public health problem of considerable importance [4]. Anemia is not a diagnosis in itself but merely an objective sign of presence of disease. Anemia in children differs from those of adults as they tend to be more pronounced and develop rapidly. Anemia significantly affects child's growth, development, well-being and scholastic performance. It decreases the appetite of children, which affect nutrition and a vicious cycle starts which further worsen situation. It is very important co morbidity in hospitalized children which can prolong hospital stay, increased risk of complications and need of blood transfusion.

Most of the infants are asymptomatic and will have non-specific symptoms like anorexia irritability. Further, anemia in infancy will be associated with cognitive and behavioral delays, which includes lower mental and motor development, learning disabilities, decreased immune function. Anemia in infancy is due to improper feeding habits, especially during the initiation of complementary foods, non-exclusive breastfeeding, early initiation of cow's milk, formula feeds. Other important risk factors noticed were lower socioeconomic status, knowledge and attitude regarding feeding practices, preterm gestation, and low birth weight [5].

Nutritional anemia is most common but preventable cause for anemia in children in developing countries. Emphasis on simple measures like adequate nutrition, including breastfeeding, timely starting of complementary feeding in infancy, dietary improvement in toddlers and older children, treating helminthic infections and maintain hygiene to prevent recurrent infections, which hamper nutrition, can decrease the disease burden in society.

Anemia is not a specific entity but rather can result from any of a number of underlying pathologic processes. To narrow the diagnostic possibilities, anemia may be classified on the basis of their morphology and physiology.

Despite our National Nutritional Anemia Prophylaxis program, anemia is still a big problem in India [6]. Hence it is most important to know the prevalence and pattern of anemia among infants of age group between 6 to 12 mo, as this is a critical period where infant's diet is changed and more prone for under nutrition if not received an appropriate diet [7].

MATERIALS AND METHODS

Source of data: Infants between 6 mo to 12 mo who are admitted in an inpatient ward

Methods of collection of data

Study design: A Cross-sectional study

Inclusion criteria

1. Parents of children willing to give informed consent.
2. Infants of age group between 6 mo to 12 mo admitted to hospital.

Exclusion criteria

1. Parents of children not willing to give informed consent.

2. Infants who have H/O Bleeding disorder, H/O Blood transfusions, Hemolytic anemia, acute blood loss.

Method of data collection

- After obtaining approval and clearance from the institutional ethics committee, the individuals fulfilling the inclusion criteria were enrolled for the study

- Informed written consent was obtained from all the parents/legal representatives of study subjects. To collect the required information from the parents the "Direct interview method" of Primary source of information technique was used. The parents were interviewed for collection of necessary information using the pre-tested, semi structured questionnaire method. The questionnaire was prepared by a thorough review of literature.

- In order to obtain co-operation of the patient/parent, they were made comfortable and a positive reinforcement was exerted. No answers were influenced and were helped during difficulty.

- After taking the socio-demographic details like Age, Sex, Address, Maternal history and Feeding history of the infants were taken.

- Feeding pattern of the child from birth to present age like breast feeding, Complementary feeding was taken in detail.

- Socioeconomic status was assessed based on education, occupation, and incomes in the Modified Kuppuswamy's SES.

- All the study subjects were examined in detail and all the data was filled in the pro-forma.

- Venous blood sampling is obtained from each patient enrolled in the study and is sent for estimation of Complete blood count using automated analyzer from 2 ml of EDTA blood sample collected under sterile technique. Peripheral smear study was done with Leishman's stain and Reticulocyte count with New Methylene blue stain. Based on the blood picture, serum Ferritin, Vitamin B12 and folic acid levels were measured in the venous blood using Chemiluminescent technique, Serum iron was determined by calorimetric method and total iron binding capacity (TIBC) by Colorimetric were estimated. Anemia was diagnosed according to World Health Organization (WHO) criteria.

Table 1: Case definitions of classification of anemia

	Non-anemia	Mild	Moderate	Severe
6-12 mo of age	11.0g/dl or higher	10.0-10.9 g/dl	7.0-9.9 g/dl	Lower than 7.0 g/dl

Microcytosis-<75microMand Macrocytosis>90microM [8]

Micronutrients cut off values according to Harriet lane age based values [9]

I. Folate deficiency<4ng/ml

II. Vitamin B12 deficiency<200pg/ml

III. Serum ferritin15-30mcg/dl Normal,<15mcg/dl decreased

IV. TIBC: 250-400mcg/dl-normal,>400mcg/dl increased, <250mcg/dl-decreased

V. Iron deficiency anemia was defined as Transferring saturation index (TSI)<16%.

Sample size

Sample size estimation was done using Open Epi software version 2.3.1. According to the study conducted by Sahana *et al.* [10] with 80% power of the study, the prevalence of infants having microcytic and hypochromic anemia is 69.4%, Using the formula, $n=\frac{Z^2pq}{d^2}$

The sample size estimated is 193.

Statistical analysis

Data was entered in excel sheet and analyzed using the Statistical Package for the Social Sciences 20 (SPSS Inc. Chicago). Sociodemographic data will be presented using descriptive statistics in the form of mean/proportion, median, standard deviation, inter-quartile range and percentage whichever is applicable. Chi-square test will be applied to test the association of various variables to the severity of anemia.

RESULTS

A total of 193 children were enrolled as study population and statistical analysis revealed the following observations. Among the 193 children, 52.8% (n= 102) were aged between 6 to 9 mo and 47.2% (n=91) were between 9 to 12 mo of age. The mean age of children was 9.01 mo±2.05 mo. Among 193 children majority were males (54.4%) and 45.6% were female children. Out of 193 children we studied, majority of the children lived in nuclear families (66.8%) and 33.1% lived in joint families. The socio-economic status of the children was assessed by modified Kuppuswamy's scale and it was found that majority of the families belonged to lower middle (43.5%) followed by upper lower (37.8%).

Majority of the children's family followed non-vegetarian dietary habits (64.8%) and 35.2% followed vegetarian dietary pattern. We found that 51.3% of mothers had hemoglobin>11 gms% during pregnancy, However, there were 8.3% of mothers who did not know their hemoglobin status during pregnancy. We found that 9.3% of mothers had history of blood transfusion during pregnancy. We found that 53.4% of children in our study were exclusively breastfed till 6 mo of age. We found that majority were started on complementary feeding between 7 to 10 mo (38.3%). However, there were 16.1% of infants who were not yet started on complementary feeding. Among them, there were 11 infants aged about 6 mo, 9 infants were aged 7 mo, 4 infants were aged 8 mo and 9 mo each and 2 infants were aged 11 mo. Coming to the pallor distribution in infants of our study. 48.2% of infants had moderate pallor on examination and 21.8% had severe pallor.

Coming to the mean and standard deviation of CBC profile of infants, the mean hemoglobin of infants in our study was 8.51±1.8 gms, mean MCV was 71.6±13.9 and mean MCHC was 26.4±5.6. Coming to the severity of anemia, our study shows the severity of anemia as per WHO classification where Majority had moderate anemia (54.9%) with majority of MCV falling between 60 to 75 fl MCV in our study (46.1%) and majority had MCHC<30 g/dl in our study (69.95%).

Coming to the type of anemia according to peripheral smear in our study, Majority of our study infants had microcytic hypo chromic anemia, followed by normocytic normochromic anemia. We had 18 infants with dimorphic anemia also. We did iron profile to all the study population to know the type of anemia. The mean reticulocyte count was 1.51±0.51, mean TIBC was 355.7±65.9 µmol/l, mean transferrin saturation was 17.4±22.6% and mean serum ferritin was74.4±190.4ng/ml.

We tried to identify the cause of anemia among the study population of our study, where the prevalence of iron deficiency was 82.3% and Vitamin B12 deficiecny was 15.5%.

We tried to find out the association between various risk factors and severeity of anemia among the study subjects in our study which included presence of anemia in pregnant mother, consumption of cow's milk, Socioeconomic status, initiation of complementary feeding, exclusive breast feeding and formula feeds. Among theses risk factors, There was significant association between severity of anemia and mother's anemia, inclusion of cow's milk in diet, late initiation of complementary feeding, and inclusion of formula feeds ($p<0.05$).

Table 2: Association of various risk factors with severity of anemia

Risk factors		Mild anemia	Moderate anemia	Severe anemia	P value
Mother anemia	Present (Hb<11 gms/dl)	20 (40%)	63 (59.4%)	25 (67.6%)	0.021
	Absent Hb>11 gms/dl)	30 (60%)	43 (40.6%)	12 (32.4%)	
Cow's milk	Given	5 (10%)	35 (33%)	14 (37.8%)	0.009
	Not given	45 (90)	71 (67%)	23 (62.2%)	
Nutritional supplementation	Given	10 (20%)	13 (12.3%)	4 (10.8%)	0.374
	Not given	40 (80%)	93 (87.7%)	33 (89.2%)	
SES	Lower	26 (52%)	48 (45.3)	17 (45.9%)	0.757
	Upper	24 (48%)	58 (58%)	20 (54.1%)	
Complementary feeding	Adequate	27 (54%)	23 (21.7%)	5 (13.5%)	<0.001
	Early	12(24%)	26(24.5%)	6(16.2%)	
	Late	11 (22%)	57(53.8%)	26 (70.3%)	
Exclusive breastfeeding	Done	31 (62%)	52 (49.1%)	20 (54.1%)	0.335
	Not done	19 (38%)	54 (50.9%)	17 (45.9%)	
Formula feeds	Given	14 (28%)	18 (17%)	2 (5.4%)	0.021
	Not given	36 (72%)	88 (83%)	35 (94.6%)	
Weight for length	Normal/Mild wasting	43 (86%)	74 (69.8%)	24(64.9%)	0.232
	Moderately wasted	6 (12%)	20 (18.9%)	8 (21.6%)	
	Severely wasted	1 (2%)	12 (11.3%)	5 (13.5%)	

DISCUSSION

This study was primarily designed to determine the clinical and laboratory profile of nutritional anemia among infants attending the Pediatric outpatient Department of a tertiary care hospital. A total of 193 children were recruited, following confirmation of anemia with hemoglobin estimation. After a targeted history and detailed clinical examination, they were subjected to red cell indices and iron studies, reticulocyte count and peripheral smear. Serum vitamin B12 and folic acid levels were estimated in all cases. Based on the above investigations, anemia was grouped into microcytic hypo chromic anemia (115cases), normocytic normochromic anemia (38cases), macrocytic anemia (22cases) and dimorphic anemia (18 cases).

A higher prevalence of anaemia was noted in male children in this study. Male to female ratio was 1:2: 1. This is comparable with studies done by R. G. Goel *et al.* [11] (male: female ratio 1.7: 1) Manchanda *et al.* [12] (male female ratio 2.1: 1) and M. M Kumbhat *et al.* [13] (1.5:1). The male predominance may be due to sheer coincidence or may be because of increased concern of parents towards male children leading to increased incidence of male admissions or this can be explained by hyperactive male children not having feeds.

On the socio-economic front, most of the cases belonged to a lower middle class (43.5%) and upper lower class (37.8%). The presence of anemia, in this socioeconomic group, is explained by the vicious cycle of poverty and malnutrition. Chellan *et al.* [14] also observed a greater prevalence of anemia in higher socioeconomic strata. In a study conducted by Kanchana *et al.* in 2018 in 6m-59months found that 90% children with anemia belonged to lower SES (Kuppuswamy's classification) and 10% belongs to lower middle class [15]. Mehrotra SK *et al.* had reported that 78.4% of anemic children in their study belonged to lower socio-economic status [16].

In our study, on dietary assessment it was found that 35.2% were vegetarians and rest of them were non vegetarians (64.8%). In a study conducted by George KA *et al.* in 2000 in rural preschool children of Kerala found that among 927 vegetarians, 86 (9.27%) were anemic and among 2,706 non-vegetarians, 328 (12.1%) were anemic [17].

Pallor was observed in moderate to severe anemia cases (70%). This is the most prominent and characteristic sign in patients with anemia. Pallor of palms of hands particularly skin creases is more reliable than pallor of skin elsewhere. But though pallor was the most striking feature in the study, it has no direct relationship to the severity of anemia. Studies by Patel *et al.* [18] Manchanda *et al.* [12] Sharma *et al.* [17] reported that the pallor was seen in 100% of patients.

In the present study, 36 children (18.6%) had Hb less than 7g/dl and 106 children (54.9%) had Hb between 7 and 9.9g/dl. The lowest Hb recorded in the study was 2.4g/dl seen in 2 female children aged 8 mo old. Goel *et al.* [11] in their study found Hb<5g/dl in 52% cases and between 5-7g/dl in 48.5% cases. Pramila Ramawat *et al.* [6] reported that as per hemoglobin level according to WHO guideline for anemia 25.4% had mild anemia, 49.2% had moderate anemia and 25.4% had severe anemia.

In our study, microcytic hypo chromic anemia (59.60%) was found to be most common etiology of nutritional anemia followed by normocytic normochromic anemia (19.70%), macrocytic anemia (11.40%) and dimorphic anemia (iron deficiency with vitB12 and folic acid deficiency) (9.30%). We found that 15.5% of our study infants had vitamin B12 deficiency and 5.2% had folic acid deficiency. In a study conducted by Ray S *et al.* among 6m-59 mo found that iron deficiency was present in 75%, iron with B12 deficiency in 47%, iron and folate deficiency in 11%, Vitamin B12 and folate deficiency in 25 % and triple deficiency in 6% [19]. In a study conducted by Kanchana *et al.* showed iron deficiency was found to be 61% in age group 2y-5y and dimorphic anemia in 18% in age group of 6m-5y [16].

Serum ferritin was done in all the cases. It is a sensitive indicator of iron status. In only 16 cases (8.3%) serum ferritin was less than 15 mg/dl. Ferritin is an acute phase protein that rises in response to inflammation. The presence of normal ferritin in cases of IDA can be explained by the fact that in a hospital-based study like ours, subclinical infection or latent inflammation could well be the cause for such an elevation, thus masking the true size of the iron store [20]. This association with inflammation will also be suggested by the elevated CRP in and elevated ESR. When such confounders are encountered; the estimation of RDW may help in identifying true IDA. However, we did not include these investigations in our study. Hence decreased serum ferritin alone was not taken for diagnosis of iron deficiency anemia.

Transferring saturation index is the ratio of the serum iron to total iron-binding capacity, expressed in percentage. The threshold of 16% is used to diagnose iron deficiency. TSAT reflects iron availability for erythropoiesis. Hence in our study TSI was used as reliable indicator of iron status than serum ferritin. In our study 159 children (82.4%) had TSI<16%. In a study, conducted by Chithambaram NS *et al.* among 6m-5years age group in 2015 at Vydehi institute Bangalore found that transferrin saturation was affected in 51% children with iron deficiency anemia whereas serum ferritin in 16% children [21].

In terms of correlation of the hemoglobin with the red cell indices, we found a positive correlation between hemoglobin and MCV and MCHC which was statistically significant and a statistically significant positive correlation with S. folate. This has been borne out amply in many studies.

CONCLUSION

Thus, nutritional anemia is most common cause of anemia in childhood especially in developing countries like India. This can be prevented by

proper nutritional support in growing age more so in the age group of 6m–1 y where they introduce complementary feeding. Though Iron deficiency is the most common cause of nutritional anemia, other causes like vitamin B12 deficiency is also not uncommon.

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AUTHORS CONTRIBUTIONS

Dr. Supriya M A-Intervention and Data collection, Dr. Ravichandra Kothur Rangegowda–Manuscript preparation and Literature review, Dr. Shilpa Krishnapura Lakshminarayana-Data interpretation and review, Dr. Lakshmi M–Conception and Planning

CONFLICT OF INTERESTS

Declared none

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