Clinical profile of anemia among 6–60-month children living in South Karnataka – A cross sectional study

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ABSTRACT

Introduction: Anemia is a worldwide public health problem and has a variable impact on the physical development of child. This study aims to assess the epidemiological characteristics and clinical profile of anemia among 6–60 month children living in South Karnataka. **Methods:** This was a cross-sectional, community-based study conducted in Bengaluru, from 2012 to 2014. Participants were weighed and measured, and their blood was taken. Demographic, morbidity, and feeding data were obtained from mothers. All the collected data were tabulated and stastically analyzed. **Results:** Prevalence of anemia in children is 77.8%. Seventy-five children (90%) with anemia belonged to lower socioeconomic status. The chief presenting symptoms in the present study were easy fatigability (34%), loss of appetite (36%), pallor (26), and irritability (24%). The chief clinical signs in anemic children were pallor of mucosa (76%), pallor of skin, palms, and soles (64%), tachycardia (23%), cheilitis (13%), and hemic murmur (9%). **Conclusions:** Most of the children suffering from anemia were from lower socioeconomic status. Diarrhea was the chief associated symptom in more than half of the cases studied. Hence, the proper periodic deworming measure is advised. Furthermore, timely giving of weaning food, reducing infection by proper immunization, and good personal hygiene will help to prevent anemia.

Key words: *Anemia, Hemoglobin, Infancy, Iron deficiency, Karnataka, Malnutrition*

Iron deficiency anemia (IDA) is a significant public health problem that has affected both developed and developing countries. In 1980, the World Health Organization (WHO) estimated that 700 million people worldwide were affected by anemia. Approximately 50% of anemia cases are caused by iron deficiency [1]. In 2002, IDA was considered to be among the most important contributing factors for the global burden of disease [1]. Globally, the prevalence of IDA in preschool-age children (0.00–4.99 years) and school-age children is 47.4% and 25.4%, respectively [2].

Majority of anemia cases are caused due to nutritional problems and invariably a common accompanying feature of almost all cases of severe acute malnutrition (SAM). Manchanda *et al*. observed 100% incidence of anemia in SAM [3]. Iron requirements increase during the period of active growth in childhood. Iron deficiency is most often the result of lack of exclusive breastfeeding and use of unsupplemented milk diets which contain inadequate amounts of iron.

Infants, under 5-year-old children, and pregnant women have greater susceptibility to anemia because of their increased iron requirements due to rapid body growth and expansion of red blood cells. [4] In Karnataka, exact data of IDA among under-five children is poor. Hence, this study was conducted to assess the epidemiological characteristics and clinical profile of anemia among children of aged 6–60 months.

MATERIAL AND METHODS

This prospective, cross-sectional study was conducted at the Department of Pediatrics, Dr. B. R. Ambedkar Medical College, Bengaluru, over 1 year 6 months from November 2012 to April 2014. The approval was granted from the Institutional Ethics Committee. Informed consent was taken from parents accompanying children. The inclusion criteria for the study include children in the age group of 6 months to 5 years, children with hemoglobin (Hb) level <11 g/dl, and children with serum ferritin level <12 µg/l [1]. The exclusion criteria were as follows: Children with hemolytic anemia and bleeding diathesis and children with chronic disease and anemia secondary to leukemia and aplastic anemia. For estimating proportion, 500 cases admitted to pediatric ward were taken. A convenient sample of 100 children with a Hb level <11 g/dl and serum ferritin level of <12 µg/l was taken up for detailed study.

Children in the study divided into three groups: Infants (up to 12 months), toddlers (1–3 years), and preschoolers (3–5 years). According to the WHO, Hb <11 g/dL was used as cutoff point

to diagnose anemia. Hence, children with Hb <11 g/dl were screened for IDA (by serum ferritin estimation). A total of 500 children were examined, of which 100 children with Hb level <11 g/dl and serum ferritin <12 µg/l were taken up for the detailed study. Modified Kuppuswamy scale was used for the assessment of socioeconomic status of family.

The detection of anemia was done using proper history and physical examination. History of irritability, anorexia, inactivity, fatigability, onset of pallor or jaundice, exertional dyspnea, decreased mental concentration, psychomotor development, and low-grade fever were recorded. Enquiry was made about the history of prematurity, progression of pallor, purpura, hematemesis, loss of blood from the bowel, ingestion of drugs, pica, frequency of respiratory tract infections, diarrheal disorders, skeletal pain, joint swelling, and other systemic disease. A complete dietary history starting from birth, quantity of milk consumed per day, weaning practices, present diet, and ingestion of vitamins and minerals was obtained.

In general examination, changes in skin, nails, hair, eyes, mouth, and throat, lymphadenopathy, leg ulcers, and presence of bone tenderness were recorded. Systemic examination included an examination of the abdomen for hepatosplenomegaly and cardiovascular system for evidence of congestive heart failure. Hb estimation was the basic investigation done to establish the presence of anemia and to determine its severity. Examination of the peripheral blood smear was done. Red cell changes include target cells and oval cells, and hypochromic microcytes and macrocytes were noted to classify morphological type of anemia.

Urine analysis is done to determine the renal cause for anemia and stool is examined for worm infestation. Stool is also tested for the presence of occult blood. The diagnostic tests such as transferrin saturation, free erythrocyte porphyrin, and serum ferritin were done to establish IDA. To categorize the degree of anemia, the following cutoff points were used: 10.0–10.9 g/dL - mild anemia, 7.0–9.9 g/dL - moderate anemia, and < 7 g/dL - severe anemia [1].

Data were entered into a Microsoft Excel spreadsheet and then analyzed by SPSS 20.0.1 and Graph Pad Prism version 5. Data were summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. Chi-square test was applied. Z-test (standard normal deviate) was used to test the significant difference between two proportions.

RESULTS

The proportion of anemia in children between 6 months and 5 years of age was 77.8%. Among 500 children screened, 111 children (22.2%) had a normal level of Hb, 137 children [27.4%] had mild anemia, 234 children (46.8%) had moderate anemia, and 18 children (3.6%) had severe anemia. The proportion of anemia in males and females was 1.17: 1. The chief clinical signs in anemic children were pallor of mucosa (76%), pallor of skin, palms, and soles (64%), tachycardia (23%), cheilitis (13%), and hemic murmur (9%) (Table 1).

Table 1: Distribution of physical signs in studied children

Physical signs	Number of cases (%)
Pallor of mucosa	76 (76)
Pallor of conjunctiva	76 (76)
Pallor of skin palms and soles	64 (64)
Pallor of nails	60 (60)
Hair changes	49 (49)
Cheilitis	13 (13)
Edema of limbs	9 (9)
Skin pigmentation	3 (3)
Hepatomegaly	8 (8)
Splenomegaly	3 (3)
Tachycardia	23 (23)
Hemic murmur	9 (9)

The chief presenting symptoms in the present study were as follows: Fatigue (34%), loss of appetite (36%), pallor (26%), and irritability (24%) (Table 2). Among the 500 children screened for anemia, none of them with Hb >11 g/dl had clinical evidence of pallor. Among children with mild anemia (Hb - 10–10.9 g/dl), only 44.7% had clinical evidence of pallor. Among children with moderate anemia (Hb 7–9.9 g/dl), 94.4% had clinical evidence of pallor. Among children with severe anemia (Hb <7 g/dl), 100% had evidence of pallor. Thus, pallor is a significant clinical sign of anemia in children with Hb <10 g/dl (moderate and severe anemia). The most important fact that should be kept in mind was that if clinical evidence of pallor alone is used to diagnose anemia, 24% of cases would be missed.

Parasitic infestations were found in 26 cases (26%) which contributed to recurrent diarrhea and malabsorption of essential nutrients including iron. No history of pain in the abdomen was present. Evidence of malnutrition was found in 79% of children. None of the children presented with congestive cardiac failure. Mean caloric intake in 6 months to 2 years children was 923.88 calories/day (normal requirement at this age is about 1100 cals/day). Between 2 and 5 years children, mean calorie intake was 1131 calories/day, whereas normal requirement is about 1100–1400 calories/day. Mean protein intake in children between 6 months and 2 years was 15.57 g/day. Mean protein intake between 2 and 5 years children was 19.14 g/day. The diet deficient in iron and other essential nutrients is the single most important cause of anemia in children of this age.

In 6 months to 2 years of age group, 39% of children, and 2–5 years, 61% of children had anemia. Hypochromic anemia was seen in 82 cases (82%). The next common type was dimorphic anemia seen in 18 cases (18%). Dimorphic anemia was more common in the age group of 1–2 years, being seen in 12 cases. Stool examination showed roundworm in 24 cases (24%) and giardiasis in 2 cases. Occult blood in stools was noticed in 11 cases (11%). However, the cause-and-effect relationship with anemia could not be established.

Peripheral blood smear and stool examination: Peripheral blood smear examination is the simplest and most informative laboratory procedure. Microcytic hypochromic anemia constituted 37% with

a mean Hb level of 8.86 g/dl. There was a marked reduction of mean packed cell volume (PCV) (22.62%), mean corpuscular volume (MCV) (65.35 fl), and serum iron level (50.16 mcg/dI). The mean transferrin iron-binding capacity (TIBC) level was increased (379.72 mcg/dI). Normocytic normochromic anemia constituted 45% with a mean Hb level of 7.9 g/dl. There was also a marked reduction in the mean PCV (33.2%) and mean corpuscular Hb (22.2 pg). The mean MCV was normal (86.8 fl). Moderate reduction of serum iron (mean=56.9 mcg/dl) was found in these cases. The mean TIBC level was increased (307.3 mcg/dI). Dimorphic anemia was found in 18% of cases. The mean Hb level was 6.3 g/dl. There was also reduction of mean PCV (26.16%). The mean serum iron level was decreased (46.6 mcg/dI). The mean TIBC level was increased (378.27 mcg/dl) (Table 3).

DISCUSSION

Anemia during infancy and childhood is one of the most common clinical conditions responsible for varying degrees of morbidity and rarely mortality. Iron deficiency is the most common cause of anemia. It is also the most common nutritional disorder in humans. The demand for erythropoietic factors increases during infancy and childhood because of rapid growth. This coupled with unbalanced nutritional status and excessive loss of blood in some cases contributes to the high prevalence of anemia in this age group [4].

In the present study, 500 children between the ages of 6 months and 5 years were screened for anemia, and 77.8% of children found to have anemia. Firdos and Poornima [5] have reported anemia in 72.79% of children below 5 years of age and Sahu *et al*. [6] have reported anemia in 93.8% of children below 5 years in their community-based study. According to the WHO global database of anemia 1993–2005, 74.3% of children under 5 years of age were anemic. The National Family Health Survey -4 showed the prevalence of anemia in 58.4% of under-five children.

The proportion of anemia in males outnumbered the females, and the ratio being 1.17:1 in the present study. This confirms with the study of Firdos and Poornima who have reported a ratio of 1.4:1. A study conducted by Dos Santos *et al.* [7] also showed a higher incidence of anemia in male children. The higher incidence of anemia in male children may be due to the prevailing custom of caring more for the male child who were being brought to hospital for treatment, more frequently.

More than half of the cases presented symptoms, which were not directly related to anemia. Majority of children presented with gastrointestinal disturbances (54%) in the present study, which correlates with the study by Sharma *et al*. [8] (56.7%). Dos Santos *et al*. showed 43.9% of children presented to the hospital with acute gastroenteritis and 21.3% presented with respiratory symptoms. Pallor was the presenting symptom in 46.5% of the cases in the study by Sharma *et al*. and 46.34% in the study by Dhar *et al*. [9]. However, in the present study, pallor was the presenting symptom in 26% of cases only. This only indicates the lack of knowledge and awareness among mothers in the present study, about the significance of pallor.

Pica (craving and chewing of the substance of no nutritional value) was another presenting symptom seen in 13% of the cases.

Table 2: Distribution of symptoms and signs according to severity of anemia

Symptoms	Total cases (%)		
	Mild anemia (n=38)	Moderate anemia (n=54)	Severe anemia (n=8)
Easy fatigability	8 (21)	19 (35.1)	7 (87.5)
Pallor	3 (7.8)	18 (33.3)	5 (62.5)
Irritability	5 (13.5)	13 (24.0)	6 (75)
Loss of appetite	8 (21)	21 (38.8)	7 (87.5)
PICA	3 (7.8)	6 (11.1)	4 (37.5)
Breathlessness	1 (2.6)	4 (7.4)	7 (87.5)
Physical signs			
Pallor	17 (44.7)	51 (94.4)	8 (100)
Hepatomegaly	1 (2.6)	1 (1.8)	6 (75)
Tachycardia	2 (5.2)	14 (25.9)	7 (87.5)
Hemic murmur	-	4 (7.4)	8 (100)
Associated malnutrition	27 (71)	44 (81.4)	8 (100)

Table 3: Mean hematological and serological values in studied children

Type of anemia	HB (g/dl)	PCV (%)	RBC	RETICS	MCV	Serum ferritin	Serum iron	TIBC	Transferrin saturation%
Microcytic hypochromic	8.86	22.62	3.62	0.88	65.35	6.75	50.16	379.72	13.45
Normocytic hypochromic	9.97	33.2	3.72	O.97	86.2	7.9	56.9	307.3	20.06
Dimorphic	8.2	26.16	3.39	0.94	94.72	6.3	46.6	378.27	12.77
All types	9.26	29.89	3.62	0.93	80.33	7.23	52.60	346.89	16.31

HB: Hemoglobin, PCV: Packed cell volume, RBC: Red blood cell, MCV: Mean corpuscular volume, TIBC: Transferrin iron-binding capacity

Amieleena [10] conducted a study of anemia in hospitalized children in Northern India and showed all cases presented with pica had IDA. Recurrent respiratory tract infections are known to occur in children with anemia. In the present study, 11 cases (12.9%) had associated respiratory tract infections. The presence of pallor of mucosa (76%) is the most important clinical evidence of anemia. This correlates well with the study of Amieleena (100%). Hemic murmur was heard in 9% of cases, similar to report by Sharma *et al*. (21.7%).

Although IDA formed the major group, koilonychia was not found in any case. Sharma *et al*. and Dhar *et al*. have reported koilonychia in 4% and 1.8% of cases, respectively. This low incidence of koilonychia is due to the fact that it takes time for koilonychia to develop. Dietary deficiency, associated infection, and parasitic infestations contribute to the development of anemia.

The mean reticulocyte count in microcytic anemia was 0.88. In the present study, microcytic hypochromic anemias constituted 37% of study population. This is in close correlation with the study of Sharma *et al*. (23.4%) and Dhar *et al*. (64.2%). Dimorphic anemia constituted 18% in the present study. Sharma *et al*. and Dhar *et al*. reported similar incidence in their study (13.7% and 25.6%, respectively). Total iron-binding capacity was increased above the normal range in 35 cases indicating IDA. However, the value was within normal range or reduced in other cases. This can be explained based on the fact that TIBC falls independent of iron stores with malnutrition inflammation and liver disease.

Stool examination showed roundworm in 24 cases (24%) and giardiasis in 2 cases, which caused recurrent diarrhea. This resulted in malabsorption and loss of essential nutrients, contributing to the development of anemia. This correlates with the study of Mehrotra *et al*. [11] (21.4% incidence of worm infestation).

Out study has certain limitations. Since the sample size in our study is small, the data of this study cannot be generalized. Hence, more studies should be done in future with larger sample size to reduce bias and improve generalisability. Long-term follow-up is necessary in iron deficiency patients to record long-term neurodevelopmental outcome, which was not done in our study. Underlying diseases may be the contributing factors for IDA in our patients; detailed etiological diagnosis was not made because of lack of investigation facilities.

CONCLUSION

Most of the children suffering from anemia were from lower socioeconomic status. Diarrhea was the chief associated symptom in more than half of the cases studied. Hence, a proper periodic deworming measure is advised, to reduce parasitic infestation which also contributes to the development of anemia. Furthermore, timely giving of weaning food, reducing infection by proper immunization, and good personal hygiene will help to prevent anemia. Fortification of food items with iron is recommended to prevent IDA in all the age groups.

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