

Recognizing missed opportunities to diagnose and treat iron deficiency anemia: A study based on prevalence of anemia among children in a teaching hospital

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ABSTRACT

Background: In developing world, anemia is a significant cause of mortality and morbidity in children under 5 years of age. Iron deficiency anemia (IDA) is a very important causative factor for childhood anemia. The aim of this study was to find the prevalence of anemia in different age group, sex, and its pattern of severity in hospitalized children. **Materials and Methods:** A cross-sectional study was carried out in a teaching hospital in Kolkata between April 2016 and September 2016. Children 1-168 months of age were included in the study. **Results:** Of 697 children, 296 (42.5%) had anemia as per the World Health Organization criteria. Males outnumbered the females with a ratio of 1.6:1. The median age of presentation was 29.6 months. The majority were from 1-5 years of age. About 73.3% of children had moderate anemia, whereas 21.3% had severe anemia and only 5% had mild anemia. The mean hemoglobin, mean mean corpuscular volume, mean mean corpuscular hemoglobin concentration, and mean red cell distribution width were 9.3 ± 1.4 g/dL, 73.6 ± 8.8 (fL), 32.2 ± 2.6 , and 16.3 ± 3.4 (%), respectively. Microcytic hypochromic anemia (71.3%) was the most common morphological type in all age groups, whereas macrocytic anemia was the least common among them. Prevalence of IDA was 69%. IDA was documented in close to 80% of children with microcytic hypochromic anemia. Interestingly, IDA was also documented in almost half of the children with normocytic normochromic anemia. **Conclusion:** The high prevalence of IDA among these hospitalized children indicates the role of early screening for IDA in all children with anemia. This early diagnosis and prompt management can prevent the mortality and morbidity related to IDA.

Keywords: Anemia, hemoglobin, iron deficiency anemia, macrocytic anemia, microcytic hypochromic anemia

Introduction

Anemia is a global public health problem especially in developing countries associated with an increased risk of chronic morbidity and mortality. The population that is worst affected by long-term effects of anemia is children under age 5 years. As per the World Health Organization (WHO), prevalence of anemia in preschool-age children worldwide is around 50%.^[1] Prevalence in India is even higher. According to National Family Health Survey 4 (NFHS 4) data, prevalence of anemia in children in the age group of 6–59 months had declined to around 60% from 79%

in the NFHS 3 data.^[2] But a systematic analysis of global anemia burden from 1990 to 2010 revealed that children under the age of 5 years had the highest prevalence in all regions of the world with the highest mean severity in all low- and middle-income countries. The study further suggests that the burden of anemia as measured by the years lived with disability (YLD) has increased in all ages between 1990 and 2010.^[3] In young age groups, increased anemia-related YLD were driven by increased prevalence or a population growth.

Hospital-based studies to determine the prevalence of anemia in children in India are few. Prevalence of anemia has been reported to variously between 55% and 72%.^[4-9] In addition, most of

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the studies are limited to the infancy age group.^[5-7] Prompted by this seemingly high prevalence of anemia among children under 5 years of age admitted to hospital for various reasons, combined with the fact that currently there is limited information on the prevalence and patterns of anemia among children, especially beyond infancy in Eastern India, we conducted this current hospital-based study to have a better understanding of the actual burden.

Materials and Methods

Study design and study setting

This was a hospital-based, prospective, cross-sectional study conducted in the pediatric medicine department of a teaching hospital in Kolkata.

Study period

The study was carried out between April 2016 and September 2016.

Study population

The study population included children 1–168 months of age who were admitted to this pediatric tertiary care institute.

Inclusion criteria

Children (1–168 months) admitted between April 2016 and September 2016 to this pediatric tertiary care institute who had a complete blood count done were included in this study. The children were further assessed for anemia as per the age-appropriate WHO criteria.^[10]

Exclusion criteria

- Children who could not be tested for complete blood count after admission
- Children who were readmitted within the study period
- Outdoor cases.

Ethical approval

The hospital institutional ethics committee approved the study. The objectives and process of the study were explained to the guardian, informed consent was obtained, and confidentiality was assured.

Sample size

The sample size was calculated to be 670 based on the prevalence of anemia among pediatric inpatients from a previous study which was 55%^[5] with 7% absolute precision using the formula $4pq/d^2$ where P is the prevalence, q is $100 - p$, and d is the absolute precision. Structured proforma was created and was pretested before initiating the actual study. Complete blood count, erythrocyte sedimentation rate, C-reactive protein, and iron studies were done. WHO criteria were used to diagnose and grade severity of anemia among study subjects.

Data analysis

Data were analyzed by EpiInfo. Descriptive statistics was used. Independent *t*-test and analysis of variance were used to compare means. *P* value < 0.05 was taken as statistically significant.

Results

Demographic characteristics of study subjects

A total of 697 children were recruited based on eligibility criteria. Among them, 296 (42.5%) had anemia as per WHO criteria. Of 296, 62.3% patients (*n* = 184) were boys and the rest 37.7% (*n* = 112) were girls with an M: F ratio of 1.6:1. The median age was 29.6 months, (range: 1–168 months). Children in the age group of 13–60 months constituted the largest proportion with 47.3% of the study population belonging to this group. Of 296 children, 92 (31.1%) were infants, whereas 64 (21.6%) were older than 5 years of age. The clinicoepidemiological profile of anemia in these hospitalized children is given in Table 1.

Prevalence of anemia

Complete blood counts showed that 42.5% (*n* = 296) of the total study population had anemia. The majority (47.3%) of the patients were in the age group of 13–60 months followed by 31.1% infants and 21.6% of children more than 5 years of age. Most of the patients, 217 (73.3%), had anemia of moderate severity, whereas 63 (21.3%) had severe anemia and 16 (5.4%) had mild degree of anemia, which was a significant (*P* = 0.04) finding in our study [Table 1].

Laboratory parameters of children with anemia

The mean hemoglobin (Hb) level was 9.3 ± 1.4 g/dL (range: 4.5–11 g/dL), the mean mean corpuscular volume (MCV)

Table 1: Clinicoepidemiological profile of anemia in hospitalized children (n=296)

	No.	Percentage	Significance <i>P</i>
Age in months			
1-12	92	31.1	0.11
13-60	140	47.3	
>60	64	21.6	
Gender			
Female	112	37.7	0.63
Male	184	62.3	
Severity of anemia			
Mild	16	5.4	0.04*
Moderate	217	73.3	
Severe	63	21.3	
Type of anemia based on peripheral smear [#]			
Microcytic hypochromic	211	71.3	0.00*
Normocytic normochromic	74	25	
Macrocytic	1	0.3	
Etiological classification of anemia [#]			
Iron deficiency anemia	204	68.9	
Folate deficiency	1	0.34	
Non-nutritional anemia	81	27.3	

[#]Peripheral smear and iron studies were not available in 10 patients; *Statistically significant

was 73.6 ± 8.8 fL, the mean mean corpuscular hemoglobin concentration (MCHC) was 32.2 ± 2.6 , whereas mean red cell distribution width (RDW) was $16.3 \pm 3.4\%$ [Table 2]. The mean Hb level was not significantly different in the different age groups. Anemia was further classified based on peripheral smear report into microcytic hypochromic, normocytic normochromic, and macrocytic varieties.

Morphologic type of anemia

Of 296 children diagnosed with anemia, peripheral smear was done in 286 children, whereas it was not done in 10 children due to various reasons. Most of the children (71.3%) had microcytic hypochromic anemia, followed by normocytic normochromic anemia which was seen in 25% children and only one child was found to have macrocytic anemia, a significant ($P = 0.00$) finding observed in this study [Table 1]. Microcytic hypochromic anemia was the most common morphological type in all the age groups with the highest number (81.1%) found among infants, whereas macrocytic anemia was the least common morphological type among them [Table 3]. Normocytic normochromic anemia was more common in the age group of 13–60 months (29.4%), and macrocytic anemia was found only in one child who was more than 5 years of age [Table 3]. The mean Hb level was significantly lower ($P = 0.004$) in the microcytic hypochromic anemia group compared with the normocytic group [Table 4]. The mean MCV and mean MCHC values did not show any significant difference between normocytic normochromic and microcytic hypochromic group, whereas mean RDW was significantly higher ($P = 0.005$) in microcytic hypochromic group when compared with the normocytic group [Table 4]. All children with normocytic normochromic, and microcytic hypochromic anemia were further tested for iron deficiency anemia (IDA). Serum iron, ferritin, total iron-binding capacity (TIBC) was determined in all of them [Table 5]. In all, 204 (68.9%) children were diagnosed to have IDA based on serum iron, TIBC, and ferritin (at least 2 of 3 positive tests), whereas 81 (27.3%) children had non-nutritional anemia and 1 child was diagnosed with macrocytic anemia who

was further tested for serum vitamin B12 and folate levels and was found to be folate-deficient [Table 1]. So in our study, IDA was the most common anemia detected in our children. IDA was detected not only in the microcytic hypochromic group (169/211, 80.1%) but also in the normocytic normochromic anemia (35/74, 47.3%) group.

Discussion

This study analyzed a set of hospitalized children for the prevalence of anemia. Further the children with anemia were characterized as per severity and morphology. We further explored and determined the burden of IDA among anemic children. As per this study, anemia was found in 42.5% of hospitalized children indicating that anemia is still a serious public health problem in India. This prevalence was lower than that reported by earlier studies in India.^[4-9] Various reasons could possibly account for the difference. First, the previous studies had been conducted some time back. As per the NFHS 4 data, India has seen a progressive decline in the prevalence on anemia in children. For example, anemia in the age group of 6–59 has decreased to around 60% when compared with around 80% as per the NFHS 3 data.^[2] This fact is well reflected if we analyze the relevant studies from India. The study by Saba *et al.*^[4] in 2011–2012 shows a prevalence of 72.8%. This decreased to 56.5% in the study by Sahana *et al.*^[6] in 2013–2014. An even more recent study by Reddy *et al.*^[7] showed a further decline to 43.7% which is very similar to our study. Thus, this study probably reflects the above declining trend of anemia prevalence.

Further among urban children when compared with rural children in the same age group, the burden of anemia is further lower (55%).^[2] The current hospital being located in a metropolitan city has a larger share of patients coming from the urban when compared with rural setting which may further explain lower incidence of anemia among the current group when compared with those from rural setup.^[5,9] Furthermore, the age group of children included in the study may also have influenced the lower prevalence. The study by Narayan *et al.*^[9] recruited children up to 5 years of age, while others^[6,7] studied anemia in the infant age group. Our study, on the other hand, looked at children in the age group of 1–168 months. The inclusion of children more than 5 years in the study perhaps reflected on lower burden of anemia for the total population. In this study, the age group of 13–60 months (47.3%) was the most common age group affected with anemia, which was similar to a study done by Kanchana *et al.*^[10] where 61% of children were in the age group of 2–5 years and Abhay Prakash *et al.*^[11] where

Table 2: Laboratory parameters of children with anemia

Test parameter (unit)	Value (mean±SD)
Mean hemoglobin (g/dL)	9.3±1.4
Mean MCV (fL)	73.6±8.8
Mean MCH (pg)	24.0±3.5
Mean MCHC (%)	32.2±2.6
Mean RDW (%)	16.3±3.4
Mean RBC count (million/mm ³)	4±0.7

SD: Standard deviation; MCV: Mean corpuscular volume; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; RDW: Red cell distribution width; RBC: Red blood cell

Table 3: Age-wise distribution of different morphological type of anemia (n=286)

Morphological types	1-12 months (n=90)		13-60 months (n=136)		>60 months (n=60)		Total
	No.	Percentage	No.	Percentage	No.	Percentage	
Microcytic hypochromic	73	81.1%	96	70.6%	42	70%	211
Normocytic normochromic	17	18.9%	40	29.4%	17	28.3%	74
Macrocytic	-	-	-	-	1	1.7%	1

Table 4: Comparison between morphological types of anemia[#]

	Normocytic normochromic (n=74)	Microcytic hypochromic (n=211)	P
Mean hemoglobin (g/dL)	9.7±1.2	9.1±1.4	0.004*
Mean MCV (fL)	80.3±7.2	71.1±7.7	0.050
Mean MCH (pg)	26.3±2.5	23.2±3.5	0.000*
Mean MCHC (%)	32.5±1.8	32±2.8	0.169
Mean RDW (%)	14.9±2.9	16.8±3.5	0.005*
Mean RBC count (million/mm ³)	3.9±0.7	4±0.8	0.011

MCV: Mean corpuscular volume; MCH: Mean corpuscular hemoglobin; MCHC: Mean corpuscular hemoglobin concentration; RDW: Red cell distribution width; RBC: Red blood cell *Peripheral smear was not available in 10 patients; *Statistically significant

Table 5: Iron studies in two morphologic types of anemia

	Normocytic normochromic (n=74)	Microcytic hypochromic (n=211)	P
Serum iron (µg/dL)	57.6±22.4	52.8±18.2	0.67
Serum ferritin (µg/L)	240.1±47.7	130.7±42.6	0.19
TIBC (µg/dL)	326.3±53.5	398.3±82.5	0.04*

TIBC: total iron-binding capacity *Statistically significant

40.7% were under 5 years of age. The proportion of anemia in boys outnumbered the girls, the ratio being 1.6:1 in our study. This confirms with the study by Saba *et al.*^[4] who have reported a ratio of 1.4:1 and Kanchana *et al.*^[10] who found a ratio of 1.2:1. The higher incidence of anemia in male children may be due to the gender bias prevailing in our society where male child are given more care and are being brought to hospital early and more frequently for treatment.

WHO has age-appropriate criteria for grading severity of anemia into mild, moderate, and severe based on Hb concentration and gender.^[12] Moderate degree of anemia was the most common grade of anemia in this study (73.3%) similar to that reported by Saba *et al.*^[4] and Kanchana *et al.*^[10] In this study, the mean Hb concentration was 9.3 ± 1.4 g/dL and the mean MCV value was 73.6 ± 8.8 fL among the patients studied. Our findings are comparable to the study by Saba *et al.*^[4] where the mean Hb and MCV were 8.5 g/dL and 75.08 fL, respectively, and Sanghavi J *et al.*^[13] where the mean Hb and MCV were 6.54 ± 1.63g/dL and 59.2 ± 5.8 fL, respectively.

In our study, microcytic hypochromic anemia was the most prevalent (71.3%) morphologic type of anemia. Other studies reveal incidence varying between 45% and 70%.^[5-7] Our study depicted microcytic hypochromic anemia as the most common morphological type in all the age groups with the highest number (81.1%) found among infants, whereas macrocytic anemia was the least common among them. This was in comparison to the study conducted at the multispecialty hospital of Bangalore^[4] and Sanghavi J *et al.*'s^[13] study. In this study, IDA (68.9%) was the most common anemia affecting the

children. This finding was in accordance with the WHO global database on anemia^[1] and Sanghavi J *et al.*'s^[13] study where 61% had IDA. In spite of organized steps taken by the government to control IDA, it still remains a common cause of anemia in our country. IDA was documented in close to 80% of children with microcytic hypochromic anemia. Interestingly, IDA was also documented in almost half of the children with normocytic normochromic anemia in our study. Various studies have already shown that close to 40% of patients with IDA may have normocytic erythrocytes.^[14,15] Macrocytic anemia was observed only in one patient and that was attributable to folate deficiency.

Our study has certain limitations. Our study was based on single complete blood counts instead of serial measurements. Full etiological workup to elucidate the causes of anemia, especially where nutritional anemia, was not documented could not be universally done due to resource constraints. Being a single center and urban hospital-based study, it would be difficult to generalize our findings to the general pediatric population, and in rural community. However, this study will serve as a strong indication of anemia prevalence in urban health care centers. This study will also help our clinicians and primary healthcare doctors to understand the clinicoepidemiological profile of IDA and help them diagnose, treat, and develop preventive strategies in future.

Conclusion

As discussed earlier, although the prevalence of anemia is declining over the years, the overall burden of disease as expressed in YLD continues to remain high. Hospitalization may be the first opportunity of a child to be screened for anemia, which must not be missed. Anemia if diagnosed must further be worked up for etiology, especially IDA. Based on our study, it may be appropriate to do iron studies not only for the microcytic hypochromic group but also for children with normocytic normochromic anemia. As anemia, especially IDA, remains a major health problem in children, our health programs should be strengthened to improve the health and nutritional status of our children.

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Conflicts of interest

There are no conflicts of interest.

References

1. World Health Organization. Worldwide Prevalence of Anaemia 1993-2005: WHO Global Database on Anaemia. Geneva, Switzerland: World Health Organization; 2008.
2. National Family Health Survey-4, 2015-16: India Fact Sheet. Ministry of Health and Family Welfare. Available from: <http://rchiips.org/NFHS/pdf/NFHS4/India.pdf>. [Last accessed on 2017 Apr 2].
3. Kassebaum NJ, Jasrasaria R, Naghavi M, Wulf SK, Johns N,

- Lozano R, *et al.* A systematic analysis of global anemia burden from 1990 to 2010. *Blood* 2014;123:615-24.
4. Saba F, Poornima S, Balaji PAR, Varne SRR, Jayashree K. Anemia among hospitalized children at a multispecialty hospital, Bangalore (Karnataka), India. *J Family Med Prim Care* 2014;3:48-53.
 5. Muthusamy BG, Venugopal V, Sumithra S. Prevalence of anaemia among the hospitalized children in a rural tertiary care teaching hospital. *Int J Contemp Pediatr* 2017;4:431-7.
 6. Sahana KS, Ghaliyah K, Anitha P, Prakash S. A study of anemia in hospitalised infants at a tertiary care hospital. *Natl J Community Med* 2015;6:22-7.
 7. Manohar Reddy CV, Sai Geeta C. Evaluation of anemia in hospitalised infants at a tertiary care hospital. *Int J Med Res Prof* 2017;3:208-10.
 8. Behera S, Bulliyya G. Magnitude of anemia and hematological predictors among children under 12 years in Odisha, India. *Anemia* 2016;2016:1729147.
 9. Narayan R, Singh S. A study of severity and frequency of anemia in different age group in 6 months to 5 years children at a teaching hospital in rural Haryana, India. *JMSCR* 2017;5:28086-9.
 10. Kanchana, Madhusudan Sr, Ahuja S, Nagaraj N. Prevalence and risk factors of anemia in under five-year-old children in children's hospital. *Int J Contemp Pediatr* 2018;5:499-502.
 11. Prakash A, Kumar A, Awasthi A, Dutta A, Mittal A. Clinicopathological pattern of anemia in children in age group upto 18 years. *Int J Med Res Prof* 2018;4:262-6.
 12. World Health Organization. Haemoglobin Concentrations for the Diagnosis of Anaemia and Assessment of Severity. Vitamin and Mineral Nutrition Information System. Geneva, Switzerland; World Health Organization; 2011 (WHO/NMH/NHD/MNM/11.1).
 13. Sanghavi J, Asati A. Profile of Anemia with special reference to hemoglobinopathies in a tertiary care centre in Madhya Pradesh. *Int J Pediatr Res* 2015;2:18290.
 14. Bermejo F., Garcia-Lopez S. A guide to diagnosis of iron deficiency and iron deficiency anemia in digestive diseases. *World J Gastroenterol* 2009;15:4638-43.
 15. Ho JC, Chan AK, Chan HH. Iron deficiency as a common treatable cause of chronic normocytic anemia. *Blood* 2014;124:4032.