Hematological Profile of Severe Anemia in Children Aged Below 5 Years

Dr. Purushottapatnam Shaik Subhani[1], Dr. K Nagendra Prasad[2]

[1]Department of Paediatrics, [2]Department of Paediatrics;
Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh, India

Corresponding Author: Purshottapatnam Shaik Subhani

ABSTRACT

Background: Anaemia is defined as a reduction in red blood cell (RBC) volume and hemoglobin (Hb) concentration below the range of values seen in normal healthy individuals. Children aged below 60 months typically manifest with symptoms of underlying illness, rather than anemia per se. Common complaint is widespread weakness. There should be more knowledge and extensive study of this common problem, which needs to be addressed more effectively, and all efforts should be taken to lessen children's suffering and the likelihood of mortality. Hence the current study was undertaken. Our aim is to study the hematological profile of children suffering from severe anemia.
Methods: This is a kind of observational study done on 100 children aged 6 months to 5 years who were admitted into paediatric ward of Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh, India with severe anemia i.e., children with Hemoglobin ≤7gm/dl. Type of anemia was assessed as per peripheral smear findings. Investigations assessed include hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and reticulocyte count.
Results: Most of the children had microcytic hypochromic (MH) or iron deficiency anemia. Normocytic normochromic (NN) anemia is next commonly seen. There is no significant difference in mean age, reticulocyte count in children of MH or NN groups. But there is significant difference in MCV, MCH and MCHC and Hb concentrations between MH and NN groups.
Conclusion: Nutritional deficiency anemia is most commonly seen among children aged 6 to 59 months in India.

Keywords: Severe anemia, Hematological profile, Microcytic hypochromic, Iron deficiency, Hemoglobin

INTRODUCTION

Globally, at any given moment, more patients have iron-deficiency anemia than any other health problem.[1] Anaemia is defined as a reduction in red blood cell (RBC) volume and hemoglobin (Hb) concentration below the range of values seen in normal healthy individuals. It is the commonest haematological illness during childhood children and adolescence. 1.62 population are affected globally with anaemia.[2] According to the 5th family health survey 67.1% of Indian children aged below 5 years have anaemia.[3] It is more common in rural areas compared to urban areas. The incidence is peak at around 6-8 months and 12-17 months, then falls gradually as age increases. There was no significant difference in the prevalence of anaemia based on the child's gender. Following infestation with plasmodium falciparum, malaria which is common in tropical areas, severe anaemia can be seen due to RBC lysis. It can also be caused by genetic disorders like thalassemia and malignancies like lymphoma and leukaemia. It is also

commonly seen among pregnant women.[4] Iron deficiency anemia is the most common type of anemia, affecting around 8% to 9% of the world's population. Elderly patients, due to multiple comorbidities like chronic kidney disease (CKD), malignancy, and medications, anemia is seen.[5] Severe anemia is a common reason for hospitalization. Pathophysiological of anemia in children includes three main reasons. 1. Poor iron bioavailability related to low absorption increasers and high consumption of absorption inhibitors during 2nd year of life. 2. Inadequate intake of iron compared to need. 3. Enhanced requirement during rapid growth stage of infancy and early childhood, which is between 6-23 months. Clinical manifestations of anemia differ from one child to other. Children typically manifest with symptoms of the underlying illness, rather than anemia per se. Common complaint is widespread weakness. There should be more knowledge and extensive study of this common problem, which needs to be addressed more effectively, and all efforts should be taken to lessen children's suffering and the likelihood of mortality. Hence, the current study was undertaken to know the hematological profile among children suffering from severe anemia to provide appropriate management.

The objective is to study the haematological profile of children aged below 5 years with severe anaemia.

MATERIALS & METHODS

Type of study: This is a kind of observational study done on 100 children aged 6 months to 5 years who were admitted into paediatric ward of Fathima Institute of Medical Sciences, Kadapa, Andhra Pradesh, India with severe anemia i.e., children with Hb ≤7gm/dl.

Duration of study: The study was done for a period of 6 months from March 2022 to September 2022.

Sampling method: Convenience sampling

Sample size calculation:

As per the study done by Koteja PV et al.[6] 2.9% of children aged below 5 years had severe anemia in India. Considering the prevalence as 2.9%, the sample size is estimated as follows:

$N=Z^2PQ/E^2$

N=Sample size

P=Prevalence

Q=1-P

N=96

Confidence levels -98%(power)

Error-4%

96 is the minimum sample size. So, we included 100 children in our study, considering few losses to follow up.

Inclusion criteria

1. Children aged below 5 years of any gender with Hb below 7gm/dl.
2. Children of parents who provided informed consent to participate in the study.

Exclusion criteria

1. Children with incomplete data
2. Children who got shifted from PICU within 24 hours of admission (indicating not severe anemia).

Procedure:

After taking history, physical examination was conducted. Following investigations were done using venous blood sample.

1. Hb estimation
2. RBC indices like mean corpuscular volume (MCV), Mean corpuscular hemoglobin (MHC), and mean corpuscular hemoglobin concentration (MCHC).
3. Reticulocyte count
4. Peripheral smear

Other parameters assessed include age and gender.

Hypochromia: More of central pallor due to absence of hemoglobin.

Reticulocyte Count: Reticulocytes are youngest RBCs. They are bigger in diameter than mature red cells and have a delicate basophilic cytoplasmic network.

The total number of RBCs counted across all fields - Y cells

X cells are the total number of reticulocytes counted across all fields

$$\% \text{ reticulocyte count} = \frac{X \times 100}{X + Y}$$

The total number of RBCs counted across all fields - Y cells

X cells are the total number of reticulocytes counted across all fields

Normal reticulocyte count is between 0.5 and 2%

Ethical considerations: The current study was conducted after taking approval from the institutional ethics committee. Informed consent was taken from parents of children included in the study

STATISTICAL ANALYSIS

Data analysis was done using Epi Info software version 7.2.5. The results were expressed as mean ± S.D, percentages. Comparison between numerical values was done using student's T test. P value < 0.05 was considered significant.

RESULT

Peripheral sm ear:
82% of children had microcytic hypochromic anaemia (group MH) and 18% had normocytic normochromic anaemia (group NN) as shown in figure 1. This implies that most common type of anemia is iron deficiency or nutritional anemia.

Figure 1: Peripheral smear findings among all children
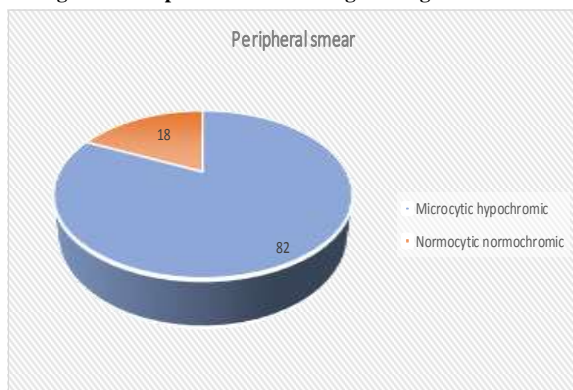
Age:
37% of children were aged 3 to 4 years. 20% of children were aged 2 to 3 years. 13% were aged 1-12 months. 16% of children were aged 1 to 2 years. 14% of children were aged 4 to 5 years as shown in Table 1. There is no significant difference in the mean age of children belonging to MH or NN groups, as per T test(p=0.58).
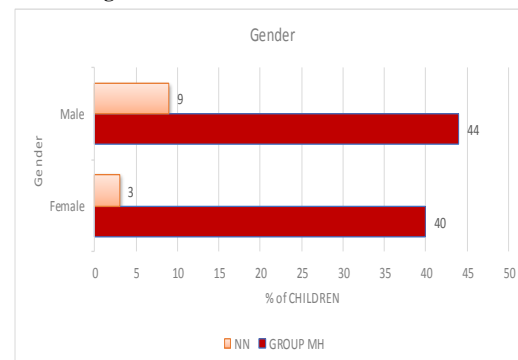
Table 1: Age distribution of children

	Frequency	Percentage
1-12 months	13	13%
1-2 years	16	16%
2-3 years	20	20%
3-4 years	37	37%
4-5 years	14	14%
Total	100	100%

Gender:
53% of the children were males. Among them, 44 belonged to MH group and 9 belonged to NN group as shown in figure 2.

Figure 2: Gender distribution of children

Haemoglobin levels:
65% of children had haemoglobin levels of 5 to 7 gm/dl. 35% of children had below 5gm/dl as shown in table 2. The mean Hb level was 6.2±1.4 gm/dl. There is significant difference in mean Hb levels in MH and NN groups as per T test(p=0.01).

Table 2: Haemoglobin distribution among children

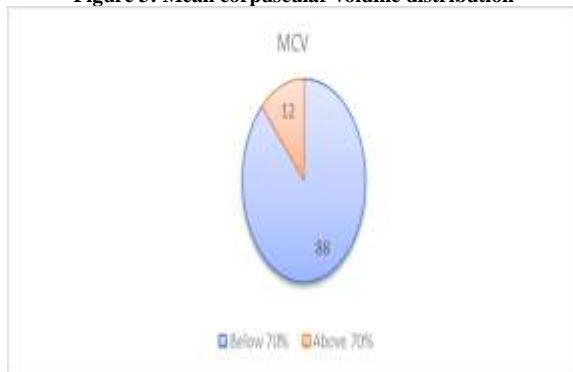| Hemoglobin	Number of cases	Percentage
5-7gm/dl	65	65%
<5gm/dl	35	35%

RBC INDICES:
Mean corpuscular volume:
It was below 70% for 82% of children and above 70% for 18% of children as shown in

figure 3. Mean MCV in group MH was 66.7±4.5% and the mean MCV in NN group was 82.9±5.1%.
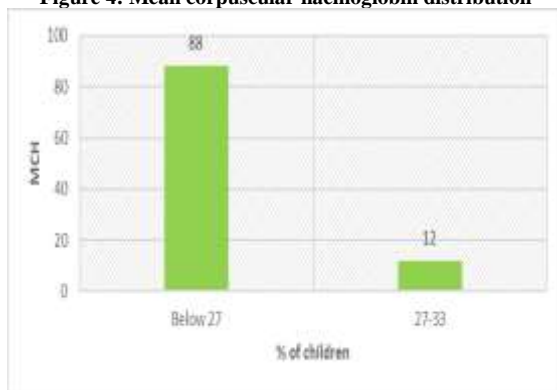
Figure 3: Mean corpuscular volume distribution

Mean corpuscular haemoglobin:

It was below 27pg for 88% of children and ranged from 27 to 33pg for 12% of children as shown in figure 4. Mean MCH in group MH was 24.4±9.2pg and the mean MCV in NN group was 31.2±4.1pg.

Figure 4: Mean corpuscular haemoglobin distribution

Mean corpuscular haemoglobin concentration:

It ranged from 21-30g/dl in 81% of children and above 30 g/dl in 19% of children as shown in figure 5. Mean MCHC in group MH was 27.8±5.3g/dl and the mean MCV in NN group was 34.9±7.8 g/dl. There is a significant difference in MCV, MCH and MCHC among MH and NN groups as shown in Table 3.

Table 3: RBC Indices in two groups

Groups	Mean MCV	Mean MCH	Mean MCHC
MH	66.7±4.5	24.4±9.2	27.8±5.3
NN	82.9±5.1	31.2±4.1	34.9±7.8
P value	0.0001	0.01	0.0001
T value	11.1	2.51	4.09

Reticulocyte count: It was below 0.5% in 20% of children. Ranged from 0.5 to 2% for 59% of children and above 2% for 21% of children as shown in table 4. There is no significant difference in the mean reticulocyte count between MH and NN groups.

Table 4: RBC Indices in two groups

Groups	Mean MCV	Mean MCH	Mean MCHC
MH	66.7±4.5	24.4±9.2	27.8±5.3
NN	82.9±5.1	31.2±4.1	34.9±7.8
P value	0.0001	0.01	0.0001
T value	11.1	2.51	4.09

DISCUSSION

The current study assessed the haematological profile of severe anemia among children aged below 5 years. In our study, the incidence of severe anemia is highest among children aged 3 to 4 years. The study findings were comparable with studies done by Simbauranga et al[7] and Muoneke VU[8] et al. Most of the children in our study were males. Dos Santos et al[9]., Zeleke Mb et al[10] also found similar results with male predominance. Male preponderance could be due to increasing parental care for male babies, which leads to an increase in male admissions. The most common type of anemia was microcytic hypochromic as per peripheral smear findings. It was seen in 88% of children. In the study of Ehouman et al[11] authors concluded that iron deficiency anemia as most common entity in microcytic hypochromic anemia. In the study done by Srinivas Madhuri et al[12] among 316 children aged 2 months to 4 years, it was found that 58% of children were anemic due to iron deficiency anemia and 5 % had megaloblastic anemia- marcocytic or normocytic normochromic anemia. In the study done by Priyanka Chowdary et al[13] in 2021, among 96 children with anemia, 74% had microcytic hypochromic anemia, and 15.6% had normocytic normochromic anemia. 10% of children had dimorphic anemia. Sickle cell anemia, aplastic anemia and thalassemia were also seen, although rarely. In our study, sickle cell anemia and aplastic anemia were not seen. Dimorphic

anemia was also not seen. Study done by Venkatesh[14] identified microcytic hypochromic anemia in 54.4% of cases, macrocytic hypochromic anemia among 11.8% of children and dimorphic anemia among 36.6% of children. Abhishek Janjale et al[15] reported 47.76% cases of microcytic hypochromic anemia. Prashant Marken et al[16] reported 47.2% cases of microcytic hypochromic anemia followed by 36.0% cases of normocytic Normochromic anemia. Arun Kumar Arya[17] did a study on assessing the hematological profile of children with severe acute malnutrition and found that 52% of them had severe anemia.200 children were included. Among them 100 had normal nutritional status or controls, 100 had severe acute malnutrition or cases. Mean hemoglobin was lower in case group compared to control group MCV, MCH and MCHC was lower significantly among cases compared to controls.

In our study, mean MCV, MCH and MCHC levels were less in children with microcytic hypochromic anemia. This was consistent with the results of Ramana Sastry C.P18, Maheshwari B.K et al[19] and Upadhyay et al.[20] Limitation of our study: Single-center study and small sample size. We recommend future studies on RBC variables among children according to age and gender.

CONCLUSION
Nutritional anaemia is the commonest cause of anaemia as evident by our study results. There are significant differences in the haematological indices among children belonging to microcytic hypochromic and normocytic normochromic anaemia. We strongly emphasize a need to counsel parents for better complementary feeding practices and provision of complementary foods at less cost so that lower socio-economic strata can afford.

REFERENCES
1. World Health Organization. Switzerland: WHO; 2008. Global Burdon of Diseases 2004 update, World Health Organization, 20 Avenue Appia, 1211Geneva 27. [Google Scholar]
2. McLean E, Cogswell M, Egli I, Wojdyla D, de Benoist B. Worldwide prevalence of anaemia, WHO Vitamin and Mineral Nutrition Information System, 1993-2005. Public Health Nutr. 2009 Apr;12(4):444-54. doi: 10.1017/S1368980008002401. Epub 2008 May 23. PMID: 18498676.
3. Gov.in. [cited 2023 Jan 7]. Available from: https://main.mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf
4. Baradwan S, Alyousef A, Turkistani A. Associations between iron deficiency anemia and clinical features among pregnant women: a prospective cohort study. J Blood Med. 2018;9:163-169. [PMC free article] [PubMed]
5. Lanier JB, Park JJ, Callahan RC. Anemia in Older Adults. Am Fam Physician. 2018 Oct 01;98(7):437-442. [PubMed]
6. Kotecha PV. Nutritional anemia in young children with focus on Asia and India. Indian J Community Med. 2011 Jan;36(1):8-16. doi: 10.4103/0970-0218.80786. PMID: 21687374; PMCID: PMC3104701.
7. Simbauranga RH, Kamugisha E, Hokororo A, Kidenya BR, Makani J. Prevalence and factors associated with severe anaemia amongst under-five children hospitalized at Bugando Medical Centre, Mwanza, Tanzania. BMC Hematol. 2015 Oct 12;15:13. doi: 10.1186/s12878-015-0033-5. PMID: 26464799; PMCID: PMC4603816.
8. Muoneke VU, ChidiIbekwe R. Prevalence and aetiology of severe anaemia in under-5 children in Abakaliki south eastern Nigeria. Pediatr Ther [Internet]. 2011;01(03). Available from: http://dx.doi.org/10.4172/2161-0665.1000107

9. Dos Santos RF, Gonzalez ES, de Albuquerque EC, de Arruda IK, Diniz Ada S, Figueroa JN, Pereira AP. Prevalence of anemia in under five-year-old children in a children's hospital in Recife, Brazil. Rev Bras Hematol Hemoter. 2011;33(2):100-4. doi: 10.5581/1516-8484.20110028. PMID: 23284255; PMCID: PMC3520632.

10. Zeleke MB, Shaka MF, Anbesse AT, Tesfaye SH. Anemia and Its Determinants among Male and Female Adolescents in Southern Ethiopia: A Comparative Cross-Sectional Study. Anemia. 2020 Oct 9;2020:3906129. doi: 10.1155/2020/3906129. PMID: 33133690; PMCID: PMC7568789.

11. Ehouman MA, N'Goran KE, Coulibaly G. Malaria and anemia in children under 7 years of age in the western region of Côte d'Ivoire. Front Trop Dis [Internet]. 2022;3. Available from: http://dx.doi.org/10.3389/fitd.2022.957166.

12. Madoori S, C. R, Valugula S, G. S, Kotla S. Clinico hematological profile and outcome of anemia in children at tertiary care hospital, Karimnagar, Telangana, India. Int J Res Med Sci [Internet]. 2015;3567–71. Available from: http://dx.doi.org/10.18203/2320-6012.ijrms20151400

13. Choudhary P, Kumar S, Ambhore J. Clinical and hematological profile of anemia in children aged 6 months to 12 years at tertiary care hospital in central India. Int J Contemp Pediatr 2021;8:1704-8

14. Venkatesh G, Talawar S, Shah BH. Clinical Profile of Anemia in Children. IOSR J Dent Med Sci. 2013;10(5):65-9.

15. Abhishek Janjale, Sanket Pande et al. A Study of Severe Anemia in Children in a Tertiary Care Institute.MVP Journal of Medical Sciences. January-June 2018.Vol 5 (1),33-38

16. Prashant Marken, Vinay Bharat et al. Clinicohematological and Biochemical Profile of Anemia in Pediatric Age Group. International Journal of Research and Review. January 2020. 7(1):552-556

17. Arya AK, Kumar P, Midha T, Singh M. Hematological profile of children with severe acute malnutrition: a tertiary care centre experience. Int J Contemp Pediatr [Internet]. 2017;4(5):1577. Available from: http://dx.doi.org/10.18203/2349-3291.ijcp20173072

18. Ramana Sastry C.P.V. Study on clinical and hematological profile of Anemia in children aged 5 to 12 years in rural Telangana. Pediatric Review. International Journal of Pediatric Research. July 2017.4(7).

19. Maheshwari BK, Raut P, Agarwal SK. A Study on the iron status in iron deficiency anemia one month before and after iron therapy in school going children: Journal of Clinical & Diagnostic Research. April,2011; 5(2): 324-327.

20. Upadhyay P, Kanetkar SR. Clinicohematological profile of anemia in pediatric (newborn to eighteen years) age group. Int J Health Sci Res. 2022; 12(2): 260-265. DOI: https://doi.org/10.52403/ijhsr.20220236

******