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Original Article

Morphological Types of Anemia and Their Etiology Among Children Attending Elnihoud Teaching Hospital, Elnihoud Locality, West Kordufan State, Sudan

Hafiz Ahmed Hobiel[1*], Abdelnassir Mohammed Ahamed [2]

1. University of West Kordufan, Faculty of Medicine and Health Sciences, Department of Biochemistry, Elnihoud, Sudan.

2. University of West Kordufan, Faculty of Medicine and Health Sciences, Department of Pathology, Elnihoud, Sudan.

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Anemia is a common hematological disorder and global public health problem which affects both developing and developed countries with major consequences for human health and their social and economic development. This study aimed to evaluate the morphological types of anemia ant its causes among children attending Elnihoud Teaching Hospital, Elnihoud locality, West Kordufan State, Sudan**.** This is a cross sectional study conducted from February 2018 to February 2019. A total of 353 anemic children were enrolled in this study. Diagnosis of anemia was based on hemoglobin levels <10 g/dl in both males and females. Hb was significantly lower among anemic children with ages from 5 to 14 years old compared to those with under 5 years old (*p*-value = 0.006). MCV and MCH were significantly lower among under 5 years old anemic children than anemic children with ages between 5 to 14 years old (*p*-value = < 0.0001). Microcytic hypochromic anemia was the most common type of anemia among children with highly significant elevation among under 5 years old anemic children versus those with ages from 5 to 14 years old (p-value = < 0.0001), and the common causes of anemia were iron deficiency, malaria and immune defect or unknown. The study demonstrates that microcytic hypochromic anemia was the most common type of anemia among children particularly among those under 5 years old and the commonest causes of anemia were unknown, iron deficiency, malaria and immune defect.

Keywords*:* Anemia, hemoglobin, microcytic, hypochromic, hypersplenism

Anemia is a common health problem worldwide and it is an important cause of morbidity and mortality among young and growing children in rural areas of developing countries (1, 2). In children, anemia continues to be a major public health challenge in most developing countries, particularly in Africa (3). Anemia in the early stages of life leads to severe deleterious consequences on the cognitive, school performance, physical growth and development (4), work performance in their adult life, poor quality of life and increased costs of health care in children (5).

The etiology of anemia is often multifactorial and there are many conditions predisposing to anemia like nutritional deficiency, infections, blood loss, hemolysis, aplastic anemia, malignancies, chronic diseases such as rheumatoid arthritis, chronic liver disease, chronic renal disease and endocrinal diseases (6, 7).

The impact of anemia is not only because of its

*Correspondence: University of West Kordufan, Faculty of Medicine and Health Sciences, Department of Biochemistry, Elnihoud, Sudan.
Mobile: +249911121879 E-mail: hebiel78@yahoo.com

etiology but also because of its effect on susceptibility to other disease, recovery and productivity (8). The occurrence of anemia is due to the various red cell defects such as production defect, maturation defect, defects in hemoglobin (Hb) synthesis, genetic defects of hemoglobin maturation or due to the synthesis of abnormal Hb and physical loss of red cells (9). Anemia is usually diagnosed based on a reduction in Hb concentration of the blood to levels that are below the normal range (10).

The current study aimed to clarify the morphological types of anemia and their ethiology among children attending Elnihoud Teaching Hospital, Elnihoud locality, West Kordufan State, Sudan.

Materials and methods

This is a cross sectional study conducted from February 2018 to February 2019 in Elnihoud Teaching Hospital, Elnihoud Locality, West Kordufan State, Sudan. Elnihoud Teaching Hospital is tertiary referring hospital located in Elnihoud Locality about 786 KM west east Khartoum, the capital of Sudan. A total of 353 anemic children their ages from 1 to 14 years old were enrolled in this study. Diagnosis of anemia was based on hemoglobin levels <10 g/dl in both males and females. The ethical approval was received from the hospital management and health service committee in the Locality. Anemic children from outside Elnihoud Locality or recently settle in Elnihoud Locality were excluded.

Questionnaires were filled (detailed medical history and examination), blood samples were obtained for complete blood count (CBC) analysis by automated hematological analyzer (sysmex XP-300). Thin blood smears were obtained and stained by giemsa and leislman stains for blood morphology and neomethyline blue for reticulocytes count. The following tests were taken when needed:

- Both thick blood film and ICT for malaria
- Hb electrophoresis
- Screening test for hemoglobinopathy and other red cells abnormality
- Bone marrow examination
- Serum ferritin
- Direct Coomb's test

Data were statistically analyzed using the Statistical Package for Social Sciences (SPSS) version 20.

Results

Figure (1) shows the ages and sex of the anemic children. Children under 5 years old were (64.6%) and those from 5 to 14 years old were (35.4%). From the total study group (67.2%) were males and (32.8%) were females. Table (1) reveals the comparison of hematological parameters between less than 5 years old anemic children and those from 5 to 14 years old. Significant decrease in the mean Hb level has been seen among anemic children with ages from 5 to 14 years old compared to those with ages under 5 years old (*p*-value = 0.006). Regarding mean cell volume (MCV) and mean cell hemoglobin (MCH) there was significant decrease in their mean levels in under 5 years old anemic children than anemic children with ages from 5 to 14 years old (*p*-values = < 0.0001 and < 0.0001 respectively).

Table (2) shows comparison of some hematological parameters, types and causes of anemia. The percentage of low MCV, normal MCV and high MCV were 78.8%, 19.5% and1.7% respectively. Low MCV was significantly elevated

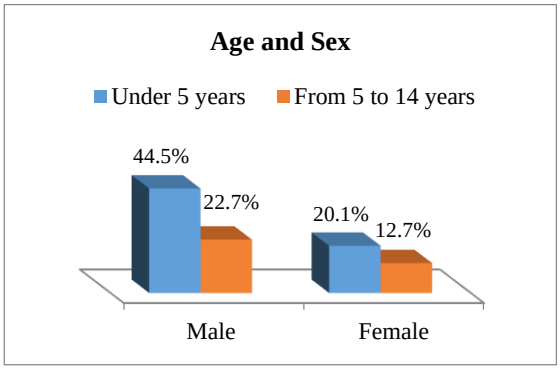

Figure 1. Ages and sex of study group.

Table 1. Comparison of hematological parameters presented as mean ± SEM

Parameter	**Under 5 years** (N = 237)	**From 5 to 14 years** (116)	**p-value**
Hb	7.98 ± 0.11	7.41 ± 0.19	0.006
MCV	68.95 ± 0.60	75.66 ± 1.12	< 0.0001
MCH	19.88 ± 0.26	22.94 ± 0.48	< 0.0001

Table 2. Comparison of some hematological parameters, types and causes of anemia

Character	**Under 5 years**	**From 5 to 14 years**	**Total**	***p*-value**
MCV				
Low	212(89.5%)	66(56.9%)	278(78.8%)	
Normal	25(10.5%)	44(37.9%)	69(19.5%)	<0.0001
High	0	6(5.2%)	6(1.7%)	
Total	237(100%)	116(100%)	353(100%)	
MCH				
Low	227(95.8%)	88(75.9%)	315(89.2%)	
Normal	10(4.2%)	28(24.1%)	38(10.8%)	<0.0001
Total	237(100%)	116(100%)	353(100%)	
Morphological type of anemia				
Microcytic hypochromic	211(89.0%)	66(56.9%)	277(78.5%)	
Microcytic normochromic	6(2.5%)	16(13.8%)	22(6.2%)	
Normocytic hypochromic	15(6.4%)	23(19.8%)	38(10.7%)	
Normocytic normochromic	5(2.1%)	8(6.9%)	13(3.7%)	<0.0001
Macrocytic hypochromic	0	2(1.7%)	2(0.6%)	
Macrocytic normochromic	0	1(0.9%)	1(0.3%)	
Total	237(100%)	116(100%)	253(100%)	
Cause of anemia				
Unknown	75(31.7%)	26(22.4%)	101(28.6%)	
Iron deficiency	59(24.9%)	29(25.0%)	88(24.9%)	
Malaria	55(23.2%)	27(23.2%)	82(23.3%)	
Immune defect	32(13.5%)	9(7.8%)	41(11.6%)	
Genetic defect	11(4.6%)	8(6.9%)	19(5.4%)	0.001
Bone marrow failure	5(2.1 %)	11(9.5%)	16(4.5%)	
Chronic disease	0	5(4.3%)	5(1.4%)	
Hypersplenism	0	1(0.9%)	1(0.3%)	
Total	237(100%)	116(100%)	353(100%)	

vamong under 5 years old anemic children compared to children ages from 5 to 14 years old (*p*-value = < 0.0001). No high MCV was observed among anemic children under 5 years old. Regarding MCH, 89.2% of anemic children had low MCH while (10.8%) had normal MCH and there was no high MCH among all anemic children.

Morphological types of anemia was analyzed microscopically (Table 2). There was significant elevation in microcytic hypochromic anemia among anemic children under 5 years old compared to those with ages from 5 to 14 years old (*p*-value = < 0.0001).

The causes of anemia were (28.6%) unknown,

Table 3. Correlation of the age with Hb, MCV and MCH

Parameter	Correlation coefficient	*p*-value
Hb	- 0.019	0.026
MCV	0.247	< 0.0001
MCH	0.260	< 0.0001

(24.9%) iron deficiency, (23.3%) malaria, (11.6%) immune defect, (5.4%) genetic defect, (4.5%) bone marrow defect, (1.4%) chronic disease and (0.3%) hypersplenism. Unknown, iron deficiency, malaria and immune defect were the most common causes of anemia among children respectively, with significantly higher rate among children with ages under 5 years old (*p*-values = 0.001). Table (3) reveals the correlation of age with Hb, MCV and MCH. The ages of anemic children were negatively and significantly correlate with Hb (*p*-value = 0.026) and positively and significantly correlate with MCV and MCH (*p*-values = < 0.0001 and < 0.0001 respectively).

Discussion

Anemia refers to a condition in which the hemoglobin content of the blood is lower than normal as a result of a deficiency of one or more essential nutrients, heavy blood loss, parasitic infections, acute and chronic infections, and congenital hemolytic diseases. In the present study, 353 anemic children between the age group of one to 14 years old have been studied. Bhaskar *et al*. studied the prevalence and types of anemia among children at a tertiary care hospital, and stated that anemia was most common among under 5 years old female than male (4) Our study however demonstrate that, most of anemic children were under 5 years old males. Previous study carried out by Amulya *et al*. show high occurrence of anemia among female children than male children (11). The findings of this study might be attributed to community negligence especially in rural community towards the nutrition and poor sanitation and health care.

In our study hemoglobin has significantly decreased in anemic children with ages from 5 to 14 years old compared to those with less than 5 years old. However El- Ashry *et al*. stated no difference in Hb level (12). The current result agrees with finding of previous similar study done by Rupali *et al*. who noted that mean Hb level was decreased among children with ages from 5 to 15 years old (13). The present study revealed significant decrease in MCV and MCH among anemic children under 5 years old compared to anemic children with ages from 5 to 14 years old. Same result was also reported by El-Ashry *et al*. (12).

Our study indicates that, microcytic hypochromic anemia was the most common type of anemia among children particularly in those under 5 years old. This corroborates with previous reports by Bhaskar *et al*. (4).

The present study shows that the most common causes of anemia in children were unknown followed by iron deficiency and malaria and then immune defect. These findings are different from results demonstrated by Srinivas *et al*. when they studied hematological profile and outcome of anemia in children at tertiary care hospital, Karimnagar, Telangana, India. They reported that iron deficiency was the most common cause of anemia followed by genetic defect (1). Other previous study done by Camaschella stated iron deficiency was the commonest cause of anemia among children (6). The result of the current study might be due to poor awareness of the locality community about health and nutrition of their children. The present study shows that as the ages of the anemic children increases their Hb level decrease and their MCV and MCH increase.

Conclusion

The study demonstrates that microcytic hypochromic anemia was the most common type of anemia among children particularly among those under 5 years old in Elnihoud locality, West Kordufan State, Sudan and the commonest causes of

anemia were unknown, iron deficiency, malaria and immune defect.

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Conflict of interest

The authors declared no conflict of interest.

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