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Prevalence, Morphological Classification, and Factors Associated With Severe Anemia among Children Under 5 Years of Age at Itojo Hospital

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ABSTRACT: The study sought to establish the prevalence, morphological classifications, and factors associated with severe anemia among children attending Itojo Hospital. A hospital-based cross-sectional study design was used in this study in which children aged less than 5 years who attended the pediatric ward at Itojo Hospital were involved. Patients were consecutively recruited until a sample size of 296 was obtained. Data were collected from patients' caregivers with a structured questionnaire. Data analysis was done using SPSS Version 20.0. Descriptive statistics and bivariate and multivariate logistic regression were used during data analysis. Multiple logistic regression models were used to show the strength of the relationship and the likelihood that each of the factors would lead to severe anemia among children under 5 years. Of the 296 patients enrolled, the prevalence of severe anemia was 13.9%. The Majority of the patients (50.7%) had microcytic anemia, followed by 32.8% with normocytic anemia. Factors that were significantly associated with severe anemia were the age of the child (P=0.029), HIV/AIDS (P=0.000), leukemia (P=0.000), and sickle cell disease (P=0.000). The prevalence of severe anemia among children less than five years of age was found to be relatively high hence increasingly becoming a public health problem. There is a need for age-specific interventions that comprehensively address the issue of improved nutrition, prevention, and management of HIV infection as well as chronic and genetic disorders.

KEYWORDS: Anemia, Anemia classes, Prevalence, Children under 5 years.

1. INTRODUCTION

The global prevalence of anemia is estimated to be 42.6%, and its magnitude in Children varies across the World and where in Africa, South East Asia, America, and European regions is 62.3%, 53.8%, 23.3%, and 22.9%, respectively (Alem et al., 2013). Globally, on average, around 9.6 million children of severe anemia, Africa, has a high prevalence of 62.3% (Rahmati, Delpisheh, Parizad, & Sayehmiri, 2016). Several reports suggested anemia rates ranging between 71% and 79% in Kenya, South Africa, and Tanzania (Foote et al., 2013). The burden of anemia among under-5-year-old children in Uganda was reported to be 67.5% (Kikafunda, Lukwago, & Turyashemererwa, 2009).

According to Elsayid, Al-Qahtani, Alanazi, & Qureshi (2015), the morphological classification of anemia depends on nutritional deficiencies, parasitic infections, blood loss, bone marrow replacement, or suppression and hemoglobinopathies. Then arbitrarily, anemia may be classified as either moderate (7.0-10.0 g/dl) or severe (Elsayid et al., 2015). The most common cause of anemia in young children is low consumption and absorption of iron-rich foods (i.e., meat and meat products) (Black et al., 2013). In developing countries, the most common cause of Anemia is poor nutritional practices (B. Singh, Singh, Kaur, & Singh, 2016).

In terms of morphological presentations, it is believed that a tilt in balance in the production and senescence of erythrocytes, either red cell underproduction, excessive destruction, or both, triggers anemia.(Longo et al., 2012). Almost all anemias are associated with abnormalities in the size, shape, color, distribution, or intracytoplasmic content of the red cells (Jones, 2009). Given that the reference range for mean red cell volume (MCV) is 80-95 femtoliter, (Perkins, 2006) red cell size less than 6 micrometers and MCV less than 0fl is termed microcytic (Ademola & Abiola, 2016) which is associated with macrocytic anemia cases.

The different factors associated with severe anemia are lack of awareness of anemia in parents/guardians coupled with their low educational status, poor nutritional practices, unhealthy food habits, a diet with low iron bioavailability, and malaria and parasitic infestations (Kikafunda et al., 2009).

Among the well-described consequences of anemia are impaired physical growth, immune alterations and increased susceptibility to infection, impaired motor development leading to reduced cognitive ability (Santos et al, 2009), poor school performance, and short or long-term mortality in acute severe cases (Legason, et al., 2017).

In Rwanda, the prevalence of anemia among children under 5 years old was 36.2 in 2016 (WHO, 2017). In 2010, among the 38.1% of the children aged 6-59 anemic months, 24.2 had mild, 13.5% had moderate anemia and 0.5 had severe anemia (Nshimyiryo et al., 2019). These last researchers reported that in the year 2014-2015, among the 36.5% of the anemic children, 20.8% had mild, 15% had moderate, and 0.7% had severe anemia.

Despite multi-sectoral efforts to reduce the burden of anemia in Uganda, the prevalence of anemia was 53% in children aged 6-59 months, up from 49% in 2011(Uganda Bureau of Statistics–UBOS and ICF, 2018). The burden of anemia among under 5 years old children in Uganda was reported to be 67.5%. However, this varies with different districts, that is 58.8% in Namutumba District (Tropical Laboratory Medicine, 2018) and 26.2% in Bushenyi District (Ocan et al., 2018).

Ewusie, et al., (2014), declared that although the prevalence of anemia decreased, it only reduced with an increase in age meaning that children were still in danger of being anemic. The exception was in Karamoja with an 8% prevalence (UNICEF Uganda, 2018) and this increase needs to be subjected to research, but the possible reasons could be difficulty in food reaching this region due to wars and their nomadic lifestyle (Adebisi et al, 2019). Thus the study was aimed at determining the prevalence, morphological classifications, and factors associated with severe anemia among children aged less than 5 years attending Itojo Hospital in Ntungamo District, Uganda.

2. MATERIALS AND METHODS

2.1 Study site

The study was carried out in the pediatric Ward and Hospital laboratory at Itojo Hospital, Ntungamo District, Southwestern Uganda. The geographical coordinates of Itojo Hospital are 0°47'16.0"S, 30°16'38.0" E (Latitude: -0.787778; Longitude:30.277222). The hospital has a bed capacity of 120, although sometimes many more patients are admitted, with many sleeping on the floor.

2.2 Anemia diagnosis techniques

2.2.1 Blood samples collection

The samples were collected from 296 Children under 5 years admitted to the pediatric ward with identifiable signs and symptoms of anemia.

2.2.2 Complete blood count (CBC)

A Complete blood count (CBC) machine called Mindray BC 6200 automated hematology analyzer was used to count the number of blood cells in a sample of the patient's blood.

2.3 Anemia classification determination

Microscopy was used where thick and thin blood smears were prepared to detect the presence of hemoparasites, stained using Giemsta stain, and examined for the observation of red blood cell morphology to enable in classifying type of anemia and staining properties.

2.4. Risk factors assessment

2.4.1 Stool analysis

The freshly collected stool samples from the study participants were analyzed both macroscopically and microscopically using the direct technique with the help of saline, iodine, eosin, and concentration using formal ether to detect the intestinal parasites.

2.4.2 Questionnaires

The structured questions were one way to investigate the risk factors associated with severe anemia. The mothers or caregivers/ guardians of the listed children were convinced and requested to participate in the study.

Data analysis

SPSS version 20.0 was used in descriptive statistics and logistic regression analysis to determine the significance of the factors associated with severe anemia, with a level of significance at 0.05.

3. RESULTS AND DISCUSSION

3.1 The severity of anemia and its prevalence among Children under 5 attending Itojo Hospital

The majority of the patients had mild anemia (48.6%), followed by moderate at 30.4% with the least having severe anemia at 13.9% (Fig 1).

The proportion of patients who have severe anemia was 41 out of the total of 296 patients within the pediatric ward at Itojo Hospital. This consequently makes a prevalence of 13.9% of patients with severe anemia (Fig 2).

As far as the prevalence of severe anemia was concerned, it was evident that the prevalence of severe anemia was higher among children at 13.9 percent. The prevalence in our study findings is lower than that mentioned in a study by Engidaye et al. (2019), which established that of the total anemic hospitalized children 225 from Gondar, Northwest Ethiopia, 20.9% had severe anemia. Contrary, the results are higher compared to the study of Nambiema, (2019) in which the prevalence of severe anemia among children aged from 6 to 59 months in Togo was 2.6%. In a study carried out by Ocan et al. (2018) at Saint Mary's Hospital Lacor, Gulu District, Northern Uganda on Prevalence, morphological characterization, and associated factors of anemia among children below 5 years, the prevalence of severe anemia was 11.9%, which is lower than findings in our study but they quite similar. The prevalence in our study is higher compared to the study by Kuziga et al. (2017), whereby the proportion of children who had severe anemia was as low as 1.3% among children under five years. The observed differences in the prevalence of severe anemia were probably due to differences in the education level of parents, availability of adequate and nutritious food, and knowledge of nutrition among children under five years.

3.2 Morphological classification of anemia

The majority of the patients (50.7%) had microcytic anemia, followed by 32.8% with normocytic anemia and the least 16.6% with macrocytic anemia. The reticulocyte count was found to be normal (Table 1).

Table 1: Morphological classification of anemia

Variable	Category	Freq./%age
Microcytic	Yes	150 (50.7)
	No	146 (49.3)
Normocytic	Yes	97 (32.8)
	No	199 (67.2)
Macrocytic	Yes	49 (16.6)
	No	247 (83.4)

This finding corroborated with results from a study done in Serbia (Djokic et al., 2010). The higher proportion of microcytic anemia was possibly attributed to the presence of parasitic infections such as hookworms and inflammatory diseases such as leukemia as reported in our study.

Nearly half of the anemia cases in childhood are due to iron deficiency as reported by Gebreweld et al. (2019). This deficiency may result from inadequate dietary intake of iron, malabsorption of iron (Gebreweld et al., 2019). In this study, the cause of the microcytic anemia is likely iron deficiency since most of the anemic children were unable to access food some of which would be rich in iron.

Normocytic anemia according to Janus and Moerschel (2010) is normally caused by hemolytic anemia (e.g. malaria), hereditary spherocytosis, and early or partially treated iron or vitamin deficiency.

3.3 Factors associated with severe anemia among children attending Itojo Hospital

In bivariate analysis using the Chi-square test, factors that were significantly associated with severe anemia were the age of the child (P=0.029), income level of parents (P=0.051), parents' education (P=0.024), malaria (P=0.025), HIV/AIDS (P=0.000), leukemia (P=0.000) and sickle cell disease (P=0.000) (Table 2).

Table 2: Results of Multivariate analysis of factors associated with severe anemia

Variable	Adjusted OR (95% CI)	P value
Age of the child		
0-2 years	1.0	**0.031**
3-5 years	0.468(0.235-0.934)	
Income level		
Below 8000sh daily	1.0	
8000-12,000sh daily	2.3 (0.797-6.354)	**0.060**
More than 12,000sh daily	2.7 (0.960-7.712)	
Parents' education		
Primary	1.0	
Secondary	2.7 (0.933-7.586)	**0.067**
Tertiary	3.9(1.396-10.904)	**0.090**
Malaria		
Yes	1.0	**0.068**
No	0.5 (0.230-0.919	
HIV		
Yes	1.0	**0.000**
No	0.11 (0.053-0.239)	
Leukemia		
Yes	1.0	**0.000**
No	0.03 (0.014-0.076)	
Sickle cell disease		
Yes	1.0	**0.000**
No	0.08 (0.038-0.165)	

Variable(s) entered on step 1: Age of the child, income level of parents, parents' education, malaria, leukemia, and sickle cell disease.

Patients who were aged between 3-5 years were less likely to have severe anemia compared to patients who were aged 0-2 years OR = 1.0, (95%CI: 0.47 (0.235-0.934), P= 0.031). Malaria was not a significant predictor of severe anemia P=0.068).

Likewise, HIV-negative patients are less likely to have severe anemia compared to the HIV-positive (OR= 0.11, 95%CI: 0.053-0.239, P = 0.000).

Furthermore, patients who did not have leukemia were less likely to be associated with severe anemia compared to those who had it (OR= 0.03, 95%CI: 0.014-0.076, P = 0.000).

Patients who did not have sickle cell disease were less likely to suffer from severe anemia compared to those who had sickle cell disease (OR =0.08, 95%CI: 0.038-0.165, P= 0.000).

The findings are quite similar to an epidemiological investigation in Iran by Mohammadi et al.(2019) which reported that the older age of children was a protective factor for childhood anemia, and the risk of anemia decreased by 12% with the rise of one month of age. A further study conducted by Li et al. (2020) in Ethiopia found that the risks of anemia in age groups of 6–11 months and 12–23 months were 5.67 and 5.80 times more than those of the age group of 48–59 months, respectively. The higher number of children in the 0-2 years age group being more at risk of severe anemia was partly attributed to low immunity, hereditary diseases, and vulnerability to parasitic infections.

HIV was also significantly associated with severe anemia under multivariate analysis whereby HIV-negative patients were less likely to have severe anemia compared to HIV-positive (P=0.000). The findings are in agreement with a study by Owiredu et al, (2011) that anemia is a common comorbid condition among HIV-infected children and has a profound impact on disease progression and has been noted as a significant predictor of decreased survival time and death. Relatedly, Gotlib, (2011), found that children are more prone to the consequences of anemia due to high iron requirements, low intake of iron from foods, and frequent episodes of infection.

Leukemia remained a statistically significant predictor of severe anemia among anemic children under 5 years after being subjected to multivariate analysis (P=0.000). Sickle cell disease also had a statistically significant association with severe anemia under multivariate analysis (P=0.000). The findings are in agreement with those of Muoneke & ChidiIbekwe, (2011), who found a significant association between sickle cell disease and severe anaemia in Nigeria. Children with sickle cell disease are susceptible to infections which may result in a rapid fall of haemoglobin levels. Magalhaes & Clements, (2011), also established that the risk factors for anemia vary in different settings; and include hematological malignancies and chronic diseases like sickle cell disease (SCD).

CONCLUSION

Our study concluded that the prevalence of severe anemia among children less than five years of age is relatively high. Hence it is increasingly becoming a public health problem in the study area especially among children aged 6–23 months who were more likely to be anemic compared to those older in the 24–59 months' age group**.** The most common morphological type of anemia was microcytic anemia among Hospital-admitted children under 5 years. It was evident that the age of the child, HIV, leukemia, and sickle cell disease were the factors significantly associated with severe anemia. Thus there is a need for age-specific interventions that comprehensively address the issue of improved nutrition, prevention and management of HIV infection as well as chronic and genetic disorders.

DECLARATION OF COMPETING INTEREST

The authors have declared that no conflicts of interest exist.

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AUTHOR CONTRIBUTIONS

A.U: Conceptualization; Investigation; Methodology; Data analysis; Writing and supervision; **S.H & T.H**: Original draft; Writing review; editing & **B.N& E.U**: Review, editing; supervision

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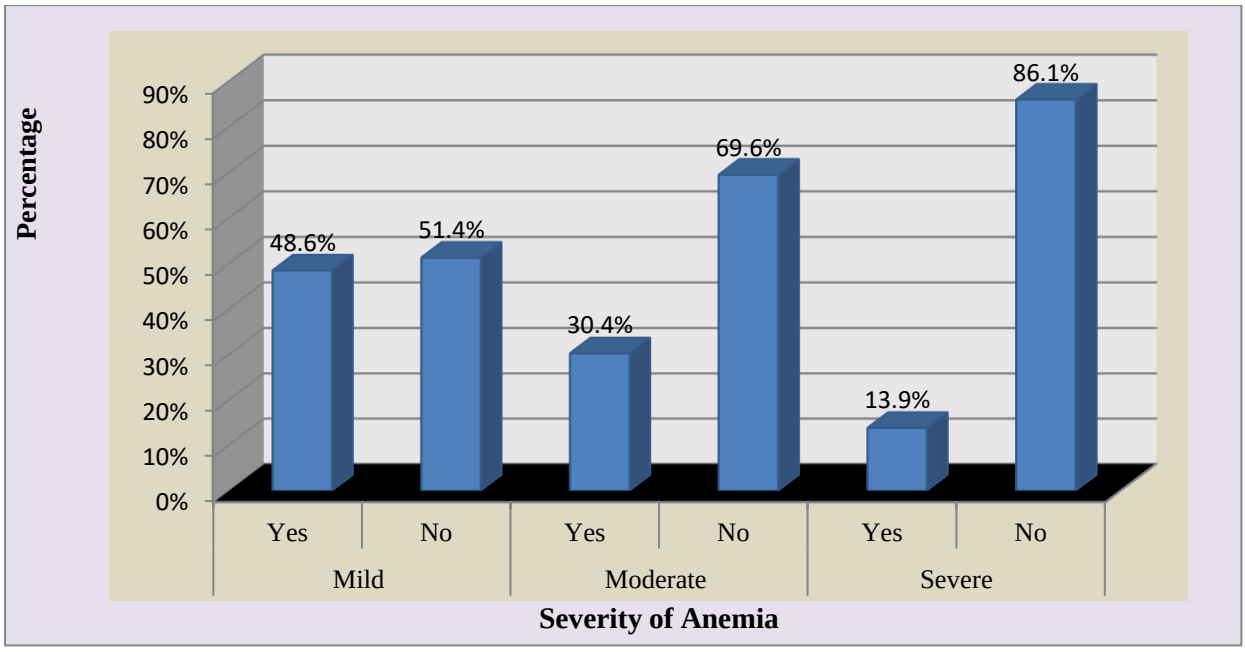

Figure 1: **Severity of anemia in percentage**

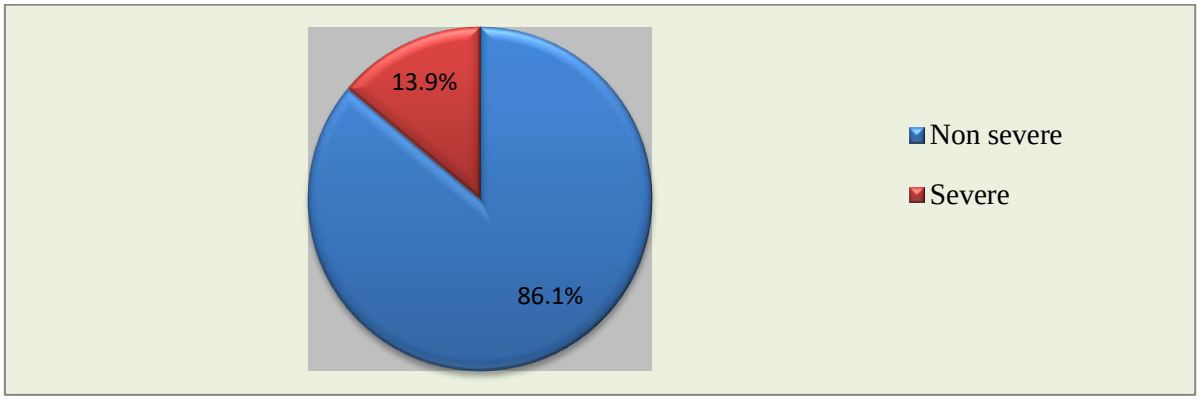

Figure 2: Prevalence of severe anemia among children under 5 years old